

Wear-Resistant Coating

INCREASES RELIABILITY OF
HIGH-OUTPUT, HYBRID AND
STOP-START ENGINES

Federal-Mogul Corporation has expanded the performance capabilities of engine bearings by developing a polymer coated bearing shell that can reduce fuel consumption and CO₂ emissions by withstanding mechanical loads produced by heavily boosted engines. IROX addresses the lubrication challenges associated with frequent engine re-starts found in hybrid and other future stop-start engines by protecting both the crankshaft and the bearing shells from damage where metal-to-metal contact would otherwise occur.

It is estimated that the IROX bearing overlay can help increase the life of crankshafts and bearing shells by more than five times in more extreme applications, such as direct-injected engines and engines with stop-start systems, according to the company.

"In order to meet the demands of hybrid and other start/stop engines, we wanted to come up with a wear resistant material," says Bob Sturk, chief application engineer for bearings at Federal-Mogul. "This has been a



The IROX bearing overlay can increase the life of bearing shells and crankshafts in extreme applications (courtesy of Federal-Mogul).

real problem in our industry—finding substitutes for lead materials because each material on the market has its own limitations. IROX gives our customers a better option. It enables them to do more with their engines."

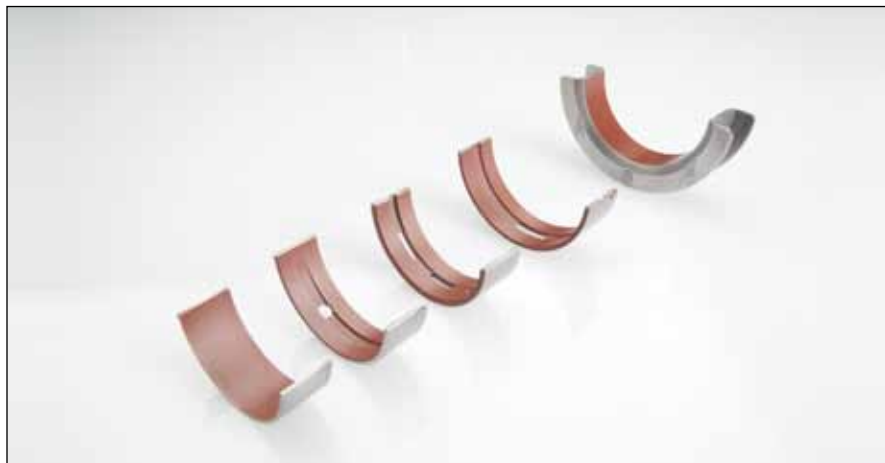
"The drive for increased engine efficiency is placing demands on crankshaft bearings that require new designs and materials applications," adds Michel Prefot, Federal-Mogul's vice president, technology and innovation, bearings. "Satisfactory lubrication requires an adequate oil film between the bearing shell and the crankshaft to keep the surfaces apart. Efforts to reduce fuel consumption and CO₂ output are pushing engine design towards reducing oil film thickness and significantly increasing the number of starts, which is where bearings are most vulnerable. IROX technology overcomes many of the most challenging wear-related issues that will be faced by a majority of

new generation engines."

As engines are downsized but maintain their output through turbocharging, the specific loads on the bearings increase. When hybrids operate in electric mode or when drivetrains using stop-start strategies switch off the engine, the crankshaft speed drops to zero. Without rotation, the crankshaft settles into contact with the bearing shells and the oil pump stops providing lubrication, allowing metal-to-metal contact and causing wear when the engine restarts.

The lubrication conditions at startup are very different from those that exist during high-speed, high-load operation. While solid lubricants or dry bearing materials are effective at preventing metal-to-metal contact at low running speeds, these conventional solutions are not suited to higher speeds that require journal bearings with a generous lubricant supply. Federal-Mogul's new system combines the features of both of these established technologies by introducing a polymer coating for traditional metallic bearing shells, integrated with solid lubricants and wear inhibitors to produce a production-ready solution. Extensive development has led to the identification and optimization of a number of key parameters, such as layer thicknesses, substrate material specification, resin binder properties, curing conditions and functional additive specifications, and a number of patents on the technology.

"Basically, we borrowed technologies from many of our other products for IROX," Sturk says. "The coating



IROX offers good sliding and anti-wear properties along with higher fatigue properties to enhance performance (courtesy of Federal-Mogul).

offers very good sliding and anti-wear properties, but there was also a benefit we didn't originally see coming; we were able to get higher fatigue properties to enhance the performance."

The IROX bearings have an overlay that is a polyamide-imide (PAI) polymer resin binder containing a number of additives dispersed throughout the matrix. These additives provide a variety of properties to the finished coating, such as wear resistance, mechanical strength, thermal conductivity and embeddability (the ability to safely envelop loose abrasive particles).

Test results have shown an improvement in life compared to both conventional shell materials and state-of-the-art competitors. "Typical bearings with aluminum overlays show significant wear after 100,000 stop-start cycles," Prefot says. "However, the new generation of engine systems require 250,000 to 300,000 cycles, so the durability challenge has been raised. Bearings with the IROX overlay can meet the demands of repeated starting; in comparison tests where conventional aluminum overlays showed 100 microns of wear and lead-free bronze showed up to 50 microns, our shells still looked like new with a measurable wear of just a few microns."

Another advantage of the new Federal-Mogul bearings is improved conformability, which has the effect of increasing the bearing surface area and hence increasing the load capacity. This means specific loading can be increased through the use of boosting, and low viscosity oils can be used by vehicle manufacturers (to improve fuel economy) without increasing risk of engine seizure, both important benefits in the development of low emission engines.

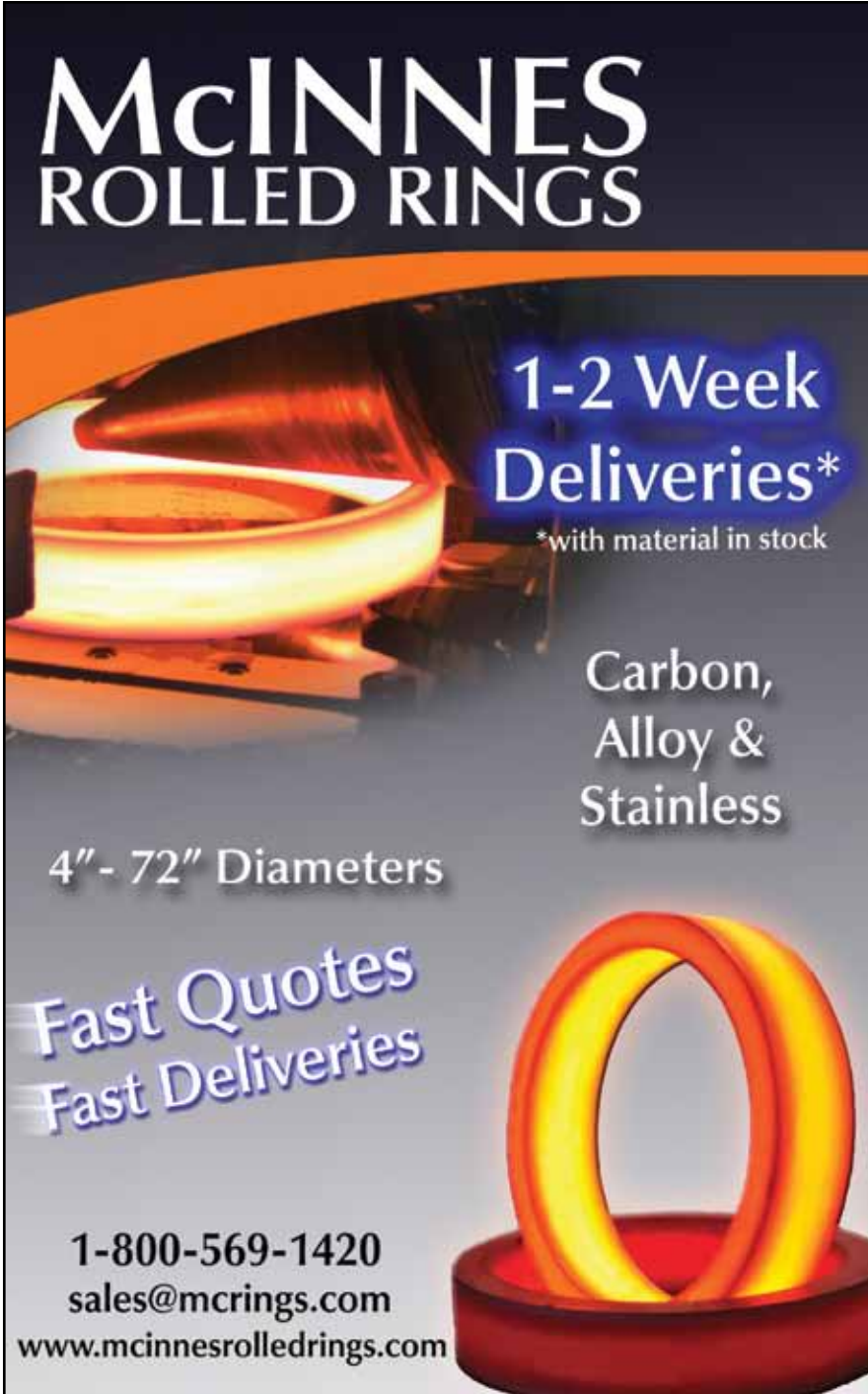
Because of IROX bearing overlay durability, vehicle manufacturers also can now consider utilizing cost-effective nodular iron crankshafts, thus mitigating the need for an expensive, forged steel crank. This compatibility also eliminates the need for hardening of the pins and journals on the crankshafts. As vehicle manufacturers struggle to offset the cost

burden of increasingly sophisticated engine systems such as turbo-charging and direct injection, any reduction in base component specification is welcome.

IROX-overlay bearings are the latest addition to Federal-Mogul's portfolio of lead-free bearings products. "The IROX bearing overlay is an excellent example

of how we're continuing to strengthen our position as the world's leading engine and transmission bearings manufacturer," says Gerard Chochoy, senior vice president, powertrain sealing and bearings. "We see excellent opportunities to displace conventional

continued



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bearings in many automotive and other applications with the IROX overlay.”

“Increasing fuel economy and reducing CO₂ emissions, while meeting the durability challenge of start-stop and hybrid applications, supports the trend of highly-loaded downsized engines while enabling the use of more cost-effective crankshaft materials,” adds Prefot.

Pilot manufacture of the new shells has been underway since 2005, and full-

scale production is scheduled for the first quarter of 2011. “The customer response has been unbelievable,” Sturk says. “IROX enables them to do more with their engines, allowing our customers to get more power out of smaller parts.”

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Excel Gear

LAUNCHES GEAR/GEARBOX OPTIMIZATION SOFTWARE

Excel-Lent gear/gearbox design and analysis software has been developed by Excel Gear, Inc. and written in *Visual Basic .Net*. This software has been written by engineers who also design and manufacture gears for their own use, according to company president N.K. “Chinn” Chinnusamy. “Although commercial software has long been available in the gear industry, it has been too expensive or too complicated to be used by engineers without specialized gear design knowledge. Our software is specifically designed with a user-friendly interactive input screen providing defaults and options in accordance with the AGMA 2001 standard,” Chinnusamy says.

The users of *Excel-Lent* can easily navigate through the input screens to edit, analyze and produce reports on the optimum gear and gearbox design for various industrial and other applications. “This software is not designed for any specific industry,” continues Chinnusamy. “It can be used for machine tools, heavy materials handling equipment or even the wind turbine industry. For the wind turbine industry, for example, the designer needs a full

understanding of all the operating loads on the gear members to arrive at the required power rating.”

The key calculations performed are the AGMA power rating and load calculations, including bending strength geometry factor (J) and pitting resistance geometry factors (I). Output from the software is a single page of data printed in a format that is easy to read and interpret. Other commercial software typically prints five or six pages of information, which may be confusing to most design engineers unless they are gear experts, Chinnusamy further observed.

The users of *Excel-Lent* need not be familiar with AGMA standards to use this software. Those who are not gear engineers can also benefit from the gear engineering knowledge embedded in the software package.

Excel-Lent contains three sections—design, analysis and gear dimensions. Any of the sections can be used

individually to run calculations. On a typical job, according to Excel Gear, hundreds of hours typically spent doing the calculations can be saved. The three sections are detailed below:

Design: This section calculates the size of gears, based on minimal input by the user. The user needs to specify only the input rotational speed, gear ratio, power to be transmitted and the material and heat treatments selected from the material tables of all commonly used materials in the industry. Key values calculated are the diameter and face width of the pinion required to achieve the surface fatigue power rating and optimized DP or module (based on the calculated diameter) required for the bending fatigue power rating. The data are automatically exported to the analysis program for detailed analysis. The results are the power ratings for 5,000–100,000 hours of B1 life (reliability factor of 1). If required, other values such as face width or center dis-



GEAR DESIGN / PRODUCTION SOFTWARE

tance may be entered, but Excel Gear recommends leaving the face width and center distance values blank for optimized gear design. Design and analysis programs are used to design one gear stage in sequence on an external or internal spur and helical gear mesh.

Analysis: This program calculates the power rating of a gear set for 5,000, 10,000, 25,000, 50,000 and 100,000 hours of B1 life (reliability factor of 1). Reliability factor of 1, 1.25, or 1.5 can be selected, as required. The user needs to enter mesh type (spur, helical, internal and external), pressure angle, helix angle (if applicable), pinion speed, number of teeth in pinion and gear, material (from the list provided in the software), face width, DP or module and quality required. Crown and/or profile shift, if used, can also be entered. The program will calculate the power rating of the gear set and show hp or kW capability along with torque, tangential force and static capacity. Static capacity is based on yield strength and, if bending stress exceeds yield strength at any time, permanent deformation or even tooth breakage may occur. If the results are satisfactory, the user can print the single page results only or, optionally, also print all the AGMA factors used in making the calculations. *Excel-Lent* lists commonly used gear material for the user to select. If the results are not as required, the user can select another material or change other design criteria as required to achieve the desired results. If a special material is desired, its yield, bending and contact stress numbers can be easily entered. If any of the required input data are missing, the program will prompt the user to supply what is missing. Metric or inch units can also be selected with just one click.

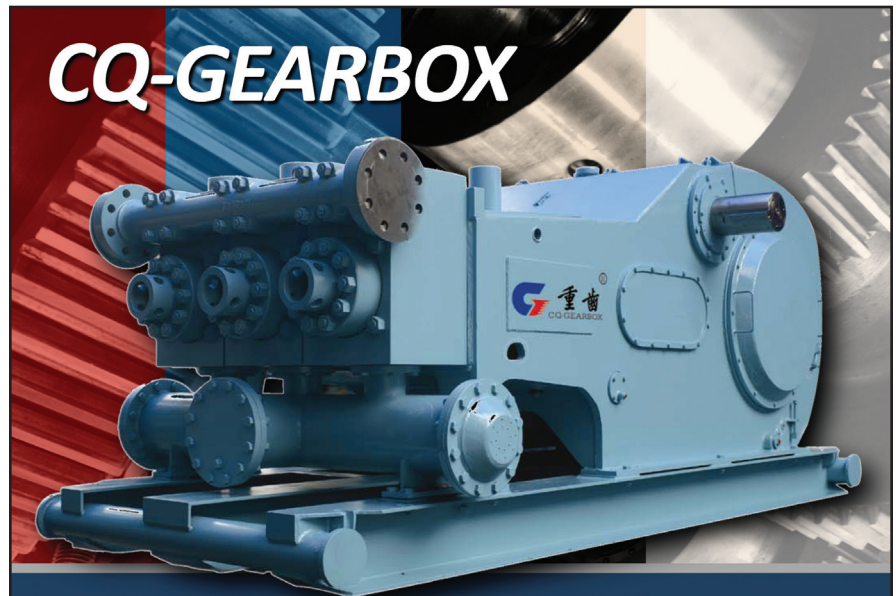
Dimensions: *Excel-Lent* will calculate the manufacturing dimensions for a new pinion and gear or calculate the dimension of a pinion or gear to mate an existing pinion or gear. This can be done for external gears, internal gears or a gear rack. Users need only to enter the

type of mesh (spur or helical, internal or external), pressure angle, helix angle (if helical gears), number of teeth in pinion and mating gear, DP or module and the quality of the gears. It will then calculate the center distance, dimension over pins, span measurement, form diameter, roll angles and all gear tolerances to

match the quality required (AGMA, DIN, or ISO). The program will calculate the helix angle required to match a specified center distance if the user chooses that option.

The program displays plain English error messages when input is question-

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product news

able or in error. For example, if the center distance is incorrect, the program will flash error messages such as, "Center distance specified is too large/small." The program calculates optimized profile shifts for pinion and gear operating at a non-standard center distance, if the operating center distance is specified. If the profile shift required to operate is large and makes the top land narrow, the program will flash warning

messages and display the proper profile shift amount to avoid narrow top land. *Excel-Lent* further provides users the option to balance beam strength or specific sliding of gear and pinion, if desired. This is a key requirement for wind turbine gears. The program will also calculate gear blank tolerances to achieve the desired quality level, if shaft and bore diameters are entered.

For more information:

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Fax: (815) 623-3314
www.excelgear.com

B&R

ADDS PLANETARY GEARS TO SYNCHRONOUS AND STEPPER MOTOR LINE

B&R Industrial Automation recently announced the addition of precision planetary gears to its line of synchronous and stepper motors. The result is a high performance and economical drive program for all industrial fields that can be optimized to meet customers' needs and is provided from a single supplier. B&R developed a motor-gear building block principle together with German manufacturer Neugart. The planetary gears are delivered fully mounted on B&R's 8LSA, 8LVA, 8JSA and 80MP series motors. Gears in both straight and angled designs and with all conventional drive flange geometries were developed together with Neugart as the



technology partner. The standard gears are single-stage for gear ratios of 3, 4, 5, 8 and 10 and have 8–15 arcmin backlash or less. The gears are also offered in two-stage or three-stage designs. At the top of the product line, the premium series provides backlash of less than 1 arcmin as an option paired with high-output torques.

For more information:

B&R Industrial Automation
1250 Northmeadow Parkway S-100
Roswell, GA 30076
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www.br-automation.com

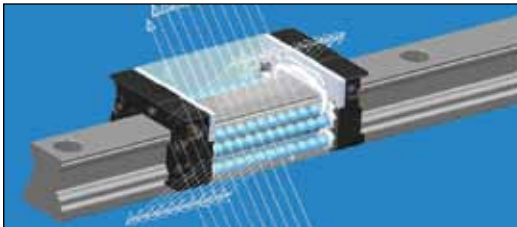
Rexroth

DELIVERS HIGH-PRECISION BALL RAIL SYSTEM

The highly optimized High-Precision Ball Rail linear guide system from Bosch Rexroth Corporation reduces rolling, pitching and yawing deviations

in linear guideways due to ball recirculation. The result is smooth motion with virtually no deviation in the X, Y, or Z direction. The system is suitable for high-end machining, measuring and scanning devices requiring ultra-precise movement. The precision performance is achieved via technological enhancements to the bearing raceway geometry to minimize ball pulsations and reduce

the influence of guideway bolts on the running smoothness of the runner block. Rexroth now includes High-Precision Ball Rail technology as a standard in SP and UP accuracies as well as the completely new XP accuracy class. The blocks can be run on standard Rexroth rails, or for additional accuracy and smoothness, on special high-precision rails. The High-Precision Ball



Rail System is available in preloaded sizes 15–45, with or without ball chain technology. Single-piece rail lengths up to six meters are available.

For more information:

Bosch Rexroth
5150 Prairie Stone Parkway
Hoffman Estates, IL 60192
Phone: (847) 645-3600
www.boschrexroth-us.com

Stafford

RELEASES DUAL-KEYED
COUPLINGS



A new line of large bore couplings was recently introduced by Stafford Manufacturing Corp. Stafford

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Dual-Keyed couplings feature axial and annular keyways to transmit torque while restraining lateral motion in pumps and mixers that are driven by unsupported shafts. Offered in 1" to 5" I.D sizes, the keyways are machined to customer specifications. Available in steel, stainless steel, or aluminum, Stafford Dual-Keyed couplings come with straight- or stepped bores to join dissimilar shafts. Stafford Dual-Keyed couplings are priced according to material, size, and quantity. Price quotations are provided upon request.

For more information:

Stafford Manufacturing Corp.
256 Andover Street
Wilmington, MA 01887
Phone: (978) 657-8000
www.staffordmfg.com

PI Components

AVAILABLE FOR BIO-MEDICAL APPLICATIONS

Physik Instrumente (PI) recently exhibited its latest piezo motors, piezo positioners and six-axis hexapod robots at the Medical Design and Manufacturing (MDM) show in October. Due to their low power requirements, compactness, fast response and nonmagnetic features, these products are typically found in a wide variety of medical device applications. Piezo ceramics can be used in applications from nebulizers to positioning devices in MRI machines. The advantages of piezo motors and actuators over classical motion control components include sterile/high bake out temperatures, no lubrication required, lower power consumption, vacuum compatible, faster response and direct linear motion without conversion



losses. PI features motors for micro liquid dispensing; ceramics for pumps, nebulizers and atomizers; non-magnetic piezo motors for imaging/OCT, MRI; scanning stages for bio-research microscopy and hexapod robots for computer-aided surgery.

For more information:

Physik Instrumente (PI)
16 Albert St.
Auburn, MA 01501
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www.pi-usa.us

igus

RELEASES HYBRID BEARING CONCEPT

The word 'hybrid' is used in engineering to describe a system where two technologies are combined together. Igus has now achieved this with a completely new type of cost-effective hybrid linear bearing that both rolls and slides. The new hybrid bearing, DryLin WJRM, was developed with the goal of reducing driving force, especially in applications involving the manual adjustment of machine-guard doors, partitions and adjustable locks, or for light handling tasks. For this purpose, igus took the advantages unique to slid-

ing and rolling movements and combined them.

A self-lubricating, plastic, sliding sleeve bearing ensures the hybrid linear system is robust, dirt- and moisture-resistant, lightweight and low cost. Meanwhile, a maintenance-free polymer roller brings ease of use to applications where heavy machine doors up to 110 pounds have to be adjusted manually. The required driving force is reduced by a factor of four to five due to this roller bearing, which carries the main load. This makes manual operation much easier. The new hybrid bearing is the latest extension to the DryLin W linear guide range from igus. The extremely compact system was modeled by igus' design engineers in such a way that the rollers fit inside the linear profile without increasing height, which remains at a low profile of 0.71 inches (18 mm). Standard linear guide profiles can be used, which are available in three styles for shaft diameters of 0.39 (10 mm): as individual rails for more flexibility and as double rails for fast installation without time-consuming alignment. The latter comes with a distance between rails of 1.57 inches (40 mm) or 3.15 inches (80 mm). The hybrid bearing housing is made from blue-chromed die-cast zinc. DryLin W is a flexible, modular linear guide system made from hard-anodized aluminum profiles, die-cast zinc housings, stainless steel or aluminum and plastic plain bearing materials. The wide variety of different combinations within this easy-to-install system allows users to optimize available design space.

DryLin W linear guides work without lubrication as dry-running systems and do not require maintenance during operation. They use plastic liners made from iglide J or iglide J200, both of which are low wear and have a very low coefficient of friction. They are also chemical resistant, vibration damping and moisture resistant.



For more information:

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East Providence, RI 02914
Phone: (401) 438-2200
www.igus.com

SplineRail Linear Actuator

SIMPLIFIES DRIVE AND GUIDANCE



Haydon Kerk Motion Solutions, Inc., a manufacturer of engineered linear motion products, recently introduced the SAA06 Motorized SplineRail Linear Actuator. Linear motion has traditionally required separate components to handle both drive and guidance. The compact SplineRail simplifies this by combining both functions in a single, coaxial component. The Motorized SplineRail utilizes a Kerk precision rolled lead screw, supported

by bearings and contained within a concentric aluminum spline, driving an integrated Kerkite composite polymer nut/bushing. The extruded aluminum spline offers excellent torsional stability. KerKote TFE coating and self-lubricating Kerkite nut/bushing material ensure long life and zero maintenance. The motorized version of the SplineRail uses the Haydon Size 17 single stack or double stack stepper motor. When mounted vertically, the SplineRail can also be used to simultaneously lift and rotate (Z-theta motion). With one motor driving the screw and a second rotating the rail, a compact, self-supporting pick and place mechanism can be created. Screw leads are available from 0.05" to 1.2" per revolution, providing a wide range of performance profiles, including self-locking threads that can support a load without external power or breaks. Typical applications include pick-and-place mechanisms and robotic assemblies in life sciences instrumentation, semiconductor equipment, business machines, packaging and assembly, and a wide range of factory automation applications. Combined with Haydon Kerk's offering of motion control components, the Motorized SplineRail can be used to create custom systems for many types of motion.

For more information:

Haydon Kerk Motion Solutions, Inc.
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Crouzet

INTRODUCES SECOND
GENERATION GEARBOXES



Crouzet North America, a company of Custom Sensors & Technologies, has introduced the new GDR1 and GDR2 Gearbox Series featuring quiet operation, versatile mounting and high torque. The new gearbox line is suitable for a variety of medical, commercial and industrial automation applications where smooth performance and continuous duty capability are required. The GDR1 and GDR2 gearboxes feature gear ratios from 25:1 up to 650:1, continuous torques up to 6 Nm, and speeds ranging from 4 to 100 rpm. Heavy-duty metal housings provide optimum durability and robust operation. Frame sizes measure 64.1 mm (2.52") wide x 81.6 mm (3.21") long, with thicknesses of 65 mm (2.56") for the GDR2 and 35 mm (1.38") for the GDR1. The new series is designed with several mounting holes and additional mounting plates for easy adaptability and mounting. The new gearboxes interface with Crouzet's line of DC brush, DC brushless and AC asynchronous motors. DC brush motors are available with 12, 24 and 48-96 volt windings while DC brushless motors feature 9-56 volt windings. AC asynchronous motors are available in up to 40 watts with winding options from 24, 115 and 220 volts at 50 or 60 Hz. Crouzet's Custom Adaptation

continued

Center can customize products to meet specific application requirements, such as adding custom shafts or connectors. Gearboxes can be supplied with flying leads, cables and connectors to suit individual requirements and are RoHS compliant. DC motors can also be supplied with encoders and EMI filters. "Crouzet's new GDR1 and GDR2 provide an excellent value

for a midrange gear motor," says Jim McNamara, Crouzet application engineer. "Customers are finding that the new gearboxes provide a quieter and smoother performance than others on the market," he adds. "With this product addition, Crouzet has increased our spur gearbox torque range by 20 percent."

For more information:

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Brushless DC Servo Motors

EXPAND CAPABILITIES

The BX4 family of brushless DC servo motors from Faulhaber recently welcomed a new member. With a 22 mm module, the 2232/2250 BX4 CSD/CCD is the world's smallest brushless motor with integrated motion controller in uniform-diameter construction, according to the company. It combines all the advantages of BX4 technology in a tiny package: long service life, high non-cogging torque and freedom from adhesives. This makes them suitable for use in demanding application areas such as robotics, automation, medical technology, specialty machinery and the aerospace industry. The drives are based on Faulhaber motion control systems. With their compact, uniform-diameter construction and suitable gearing combinations, they provide the drive solution for a wide variety of applications. The drives have serial RS232 or CAN interfaces and can be configured using *Faulhaber Motion Manager 4.4* software.

Additional features of the new drives further expand their scope of use: a wide temperature range of -25 to +85

degrees C, thermally allowable continuous current up to 0.69 A, and a configurable speed in the range of five to 8000 rpm. The units are also available with customer-specific software on request. All products with integrated electronics have automatic peak and continuous current limitation to protect the motor and the electronics. Operation of the motor and the electronics from separate supply voltages is possible as an option. The new drives are available in two motor lengths (32 and 50 mm) with a rated voltage of 24 V DC.



For more information:

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www.micromo.com