

# HIGH PERFORMANCE BEARINGS FOR **AEROSPACE**





## Partners in Your Success

For over 115 years, GGB has stood for innovation, leadership and a collaborative approach to the world's most challenging bearing needs. We work in concert with our customers to understand their unique application requirements and find bearing solutions for their individual needs. From the bottom of the ocean to the surface of Mars, our bearings and other specialty products represent the pinnacle of technical expertise and materials science.

Our passion for excellence and innovation is driven by more than just the technology that we advance. We're propelled by the knowledge that our solutions help ensure children arrive safely at school each day, that our bearings contribute to a greater understanding of the cosmos and that we're helping millions of flight passengers safely take off and land each year. We're committed to providing innovative bearing solutions because we understand the connections between our bearings and the lives of the people they affect.

### An EnPro Industries Company

GGB is proud to be part of the EnPro Industries, Inc. family of companies. EnPro Industries, Inc. is a global manufacturer of critical safety and high performance products used in some of the most extreme environments on Earth (and Mars). From jet engines to nuclear power plants to pharmaceutical processing, EnPro's components and systems must perform flawlessly under extraordinary mechanical, chemical and environmental stress.

The EnPro Industries family of companies operates R&D and manufacturing facilities throughout the world that work to continually develop new and innovative materials and technologies that drive further advances in the markets we support. EnPro Industries companies currently maintain manufacturing facilities in North and South America, Europe and Asia, employing more than 5,000 people and supporting more than 50,000 customers in more than 100 countries around the world.







## GGB Values

### OUR STRATEGIC VALUE DRIVERS

- Customer solutions provider optimizing applications knowledge and industry expertise
- Industry leader in tribological and materials science
- Global footprint with local presence and delivery

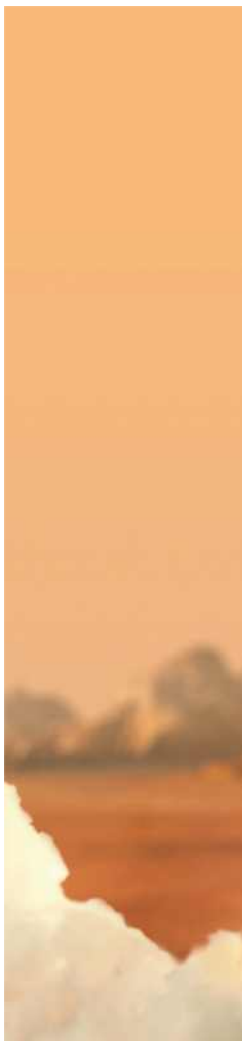


## New Heights in Bearing Performance

GGB provides the aerospace industry with high performance plain bearing solutions to a wide range of application demands. Around the world, major manufacturers of commercial and military aircraft, both fixed and rotary wing, turn to GGB for lightweight, maintenance-free bearings to reduce fuel and labor costs while increasing safety.

Certified to the AS 9100C quality standard, we fulfill the industry's quality management system requirements for the manufacture of metal-polymer, fiber reinforced composite and engineered plastics bearings, while offering full traceability as well as dimensional and material certification.

With a global production platform, our lead times are considerably shorter than our competitors, reducing downtime for maintenance as well as inventory carrying costs. From landing gear struts to wing de-icing systems, not even the sky is the limit with GGB bearing solutions.





## The GGB Aerospace Advantage



### LIGHT WEIGHT FOR FUEL SAVINGS

GGB bearings have a compact one-piece construction which provides space and weight savings compared to traditional roller bearings or greased bronze bearings.



### MRO COST SAVINGS AND LONGER SERVICE LIFE

Being self-lubricating and easy to mount, GGB bearings are ideal for applications requiring long flight hour cycles without frequent stoppages due to maintenance, repair and overhauling.



### ENVIRONMENTALLY FRIENDLY

GGB lead-free bearings comply with increasingly stringent environmental regulations such as the EU RoHS directive restricting the use of certain hazardous substances and the REACH regulation.



### CUSTOMER SUPPORT

GGB's extensive global manufacturing production and supply platform assures a quick turnaround and timely deliveries. With our worldwide sales offices network, we offer local applications engineering and technical support.



### QUALITY CERTIFICATIONS

GGB is certified according to AS9100C including all the requirements of ISO 9001 and respects the environmental system ISO 14001.



## Your Aerospace Bearing Solutions Provider

GGB offers a comprehensive selection of plain bearing solutions to meet the world's most demanding bearing needs. We manufacture Metal-Polymer Bearings, Engineered Plastic Bearings, Fiber Reinforced Composite Bearings, Metal & Bimetal Bearings, in addition to a range of supporting assemblies, bushing blocks and thrust plates.

### Aerospace applications include:

- Actuators
- Interiors
- Pumps
- Airframe
- Landing Gear
- Rockets
- Civil Aircraft
- Military Aircraft
- UAV / Drones



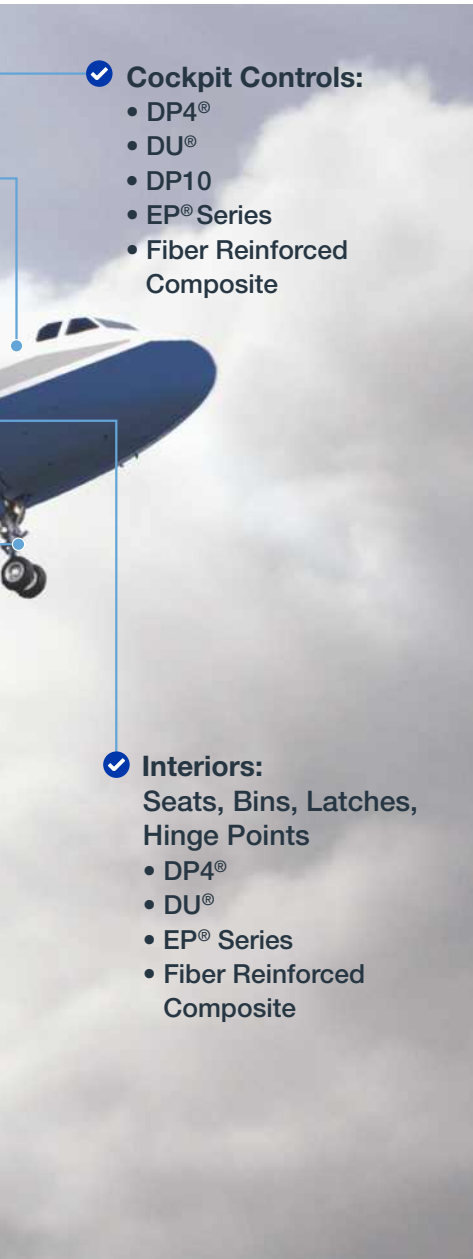


- ✓ **Flight Controls:**  
Aileron, Rudder, Elevator
  - DP4®/DU-B
  - DU®/DU-B
  - DP10
  - Fiber Reinforced Composite
- ✓ **Wing, Trailing Edge:**  
Flaps, Spoilers
  - DP4®/DU-B
  - DU®/DU-B
  - DP10
  - Fiber Reinforced Composite
- ✓ **Wing, Leading Edge:**  
Slats
  - DP4®/DP4-B
  - DU®/DU-B
  - DP10
  - Fiber Reinforced Composite
- ✓ **Auxiliary Power Unit (APU):**
  - DP4®/DU-B
  - DU®/DU-B
  - DTS10®
  - HI-EX™
  - Bushing Blocks and Thrust Plates
- ✓ **Doors:**  
Cargo, Passenger
  - DP4®/DP4-B
  - DU®/DU-B
  - EP® Series
  - Fiber Reinforced Composite
- ✓ **Engine Components:**  
Guide Vanes, Valves, Fuel Systems, Generator, Pumps
  - DP4®/DP4-B
  - DU®/DU-B
  - DTS10®
  - HI-EX™
  - Fiber Reinforced Composite Bearings
  - Bushing Blocks and Thrust Plates
- ✓ **Landing Gear:**  
Struts, Actuators, Pivots
  - DP4®/DP4-B
  - DU®/DU-B
  - Fiber Reinforced Composite

## Products Built to Perform

GGB engineers its bearing solutions for precision performance in unforgiving conditions, on land, in the air and at sea. Because each component we deliver becomes a critical part of a greater operation, quality control is our deliverable difference. Meeting the highest industry standards, our bearings are carefully selected, fully certified and structured to provide safe, reliable running.





✓ **Cockpit Controls:**

- DP4®
- DU®
- DP10
- EP® Series
- Fiber Reinforced Composite

✓ **Interiors:**

Seats, Bins, Latches,  
Hinge Points

- DP4®
- DU®
- EP® Series
- Fiber Reinforced Composite



## DP4® and DP4-B

These self-lubricating metal-polymer bearings are particularly suitable to maintenance-free dry operation. They also offer exceptionally good performance in heavy-duty oil-lubricated applications. DP4-B bearings provide the added benefit of an antimagnetic, corrosion-resistant bronze backing. These lead-free products comply with EVL, WEEE and RoHS specifications.

### TECHNICAL SPECIFICATIONS

#### Maximum load:

**DP4®** Static: 250 N/mm<sup>2</sup> | 36 000 psi  
Dynamic: 140 N/mm<sup>2</sup> | 20 000 psi

**DP4-B** Static: 140 N/mm<sup>2</sup> | 20 000 psi  
Dynamic: 140 N/mm<sup>2</sup> | 20 000 psi

#### Operating temperature:

Minimum: -200°C | -328°F  
Maximum: 280°C | 536°F



## DU® and DU-B

DU® and DU-B bearings provide good wear and friction performance in dry or lubricated applications over a wide range of loads, speeds and temperature conditions. The bronze backing of the DU-B adds corrosion resistance and anti-magnetic properties.

### TECHNICAL SPECIFICATIONS

#### Maximum load:

**DU®** Static: 250 N/mm<sup>2</sup> | 36 000 psi  
Dynamic: 140 N/mm<sup>2</sup> | 20 000 psi

**DU-B** Static: 140 N/mm<sup>2</sup> | 20 000 psi  
Dynamic: 140 N/mm<sup>2</sup> | 20 000 psi

#### Operating temperature:

Minimum: -200°C | -328°F  
Maximum: 280°C | 536°F



## DP10

DP10 metal-polymer bearings offer good wear and low friction performance over a wide range of loads, speeds and temperatures in dry, lubricated and marginally lubricated applications. DP10 is suitable for linear, oscillating and rotating movements, and complies with EVL, WEEE and RoHS specifications for lead-free construction.

### TECHNICAL SPECIFICATIONS

#### Maximum load:

Static: 250 N/mm<sup>2</sup> | 36 000 psi

Dynamic: 140 N/mm<sup>2</sup> | 20 000 psi

#### Operating temperature:

Minimum: -200°C | -328°F

Maximum: 280°C | 536°F



## DTS10®

The DTS10® is the first polymer-lined bearing for lubricated conditions offering low friction and high wear resistance that is designed to be machined on-site for tight tolerances.

With excellent wear resistance and low friction in lubricated hydraulic applications, DTS10® bearings offer excellent chemical resistance, fatigue strength, cavitation and flow erosion resistance, and good behavior in dry start-up conditions. Complies with EVL, WEEE and RoHS specifications for lead-free construction.

### TECHNICAL SPECIFICATIONS

#### Maximum load:

Static: 140 N/mm<sup>2</sup> | 20 000 psi

#### Operating temperature:

Minimum: -200°C | -328°F

Maximum: 280°C | 536°F



### CASE STUDY

NASA's Jet Propulsion Laboratory turned to GGB for a bearing solution for a robotic drilling arm on its Curiosity Mars rover.

The drilling arm operates under extreme temperature, debris and atmospheric conditions to obtain samples of Martian rock for analysis.

GGB selected three DU® metal-polymer bearing segments to serve as the primary suspension components for the drill spindle based on their high performance, self-lubricating properties and wear resistance in a wide range of loads, speeds and temperatures.

Launched in 2011, the Curiosity is still advancing our understanding of the red planet.





## GAR-MAX®

GAR-MAX® fiber reinforced composite bearings provide very good friction and wear properties, as well as high load capacity and excellent resistance to shock, misalignment, chemicals and contamination.

### TECHNICAL SPECIFICATIONS

#### Maximum load:

Static: 210 N/mm<sup>2</sup> | 30 000 psi  
 Dynamic: 140 N/mm<sup>2</sup> | 20 000 psi

#### Operating temperature:

Minimum: -195°C | -320°F  
 Maximum: 160°C | 320°F



## HSG

HSG fiber reinforced composite bearings provide high static load capacity at 415 N/mm<sup>2</sup>, twice that of standard GAR-MAX®, plus excellent shock, misalignment, chemical and contamination resistance.

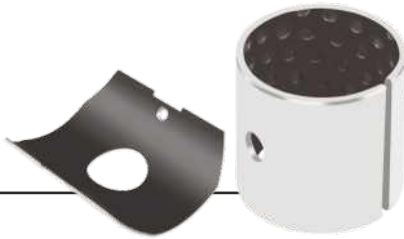
### TECHNICAL SPECIFICATIONS

#### Maximum load:

Static: 415 N/mm<sup>2</sup> | 60 000 psi  
 Dynamic: 140 N/mm<sup>2</sup> | 20 000 psi

#### Operating temperature:

Minimum: -195°C | -320°F  
 Maximum: 160°C | 320°F



## HI-EX™

Available with or without lubrication indents in the sliding layer, HI-EX™ metal-polymer bearings provide excellent wear resistance in marginally lubricated, thin film conditions.

Featuring good chemical and temperature resistance, HI-EX™ is suitable for use with low viscosity fluids. Complies with EVL, WEEE and RoHS specifications for lead-free construction.

### TECHNICAL SPECIFICATIONS

#### Maximum load:

Static: 140 N/mm<sup>2</sup> | 20 000 psi  
 Dynamic: 100 N/mm<sup>2</sup> | 14 000 psi

#### Operating temperature:

Minimum: -150°C | -240°F  
 Maximum: 250°C | 480°F



## EP® Series

The EP® Series of engineered plastics bearings provide low friction and excellent wear resistance in many applications. Made of a variety of engineered resins compounded with reinforcing fibers and oil lubricant, they exhibit excellent dimensional stability, high compressive strength and creep resistance, low thermal expansion and good thermal conductivity.



## Bushing Blocks

Bushing Blocks for hydraulic pump applications are made of proprietary aluminum alloys with good friction and wear resistance. SICAL®3 is characterized by its high load capacity and SICAL®3D by its low friction coefficient.

GGB bushing blocks are suitable for use with oil lubrication and can be supplied with or without pre-installed bearings.



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What you need. Where you need it.  
**When you need it.**

GGB has manufacturing, sales, service and support locations around the globe. This vast network of resources and expertise enables us to respond promptly to your bearing needs wherever you do business.

#### GLOBAL FOOTPRINT

• [ggbearings.com/en/company/global-footprint](http://ggbearings.com/en/company/global-footprint)







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IN901ENG06-19FR