



# Plain Bearings and Polymer Coatings for Agricultural Equipment





# Agricultural Equipment

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The agricultural equipment industry is experiencing significant trends and facing various challenges, driven by technological advancements, sustainability goals, economic pressures, and changing agricultural practices:

## Autonomous Machinery

The development of autonomous tractors, harvesters, and drones is transforming agricultural practices by reducing the need for manual labor and increasing efficiency.

## Robotic Harvesting

Robots capable of picking fruits and vegetables are becoming more prevalent, addressing labor shortages and improving harvest timing and quality.

## Eco-Friendly Equipment

There is a growing demand for agricultural equipment that reduces environmental impact, such as electric or hybrid tractors and machinery with lower emissions.

## Investment and ROI

The high cost of advanced agricultural equipment can be a barrier for small and medium-sized farms, limiting their access to the latest technologies. Farmers need to consider the return on investment when purchasing expensive machinery. Rental of agricultural equipment is becoming more important.

## Sustainability Goals

Meeting and exceeding sustainability goals while maintaining productivity and profitability is a balancing act for agricultural equipment manufacturers.

## Equipment Longevity

Ensuring that equipment is durable and can withstand harsh agricultural conditions is crucial.

## Maintenance Costs

Ongoing maintenance and repair costs can be a significant burden, especially for complex machinery.

The agricultural equipment industry is at a crossroads of innovation and challenge. Trends like automation, sustainability, smart technologies, and connectivity are driving significant advancements, offering the potential for increased efficiency, productivity, and environmental stewardship. However, these trends come with challenges, including high costs, technological integration issues, labor shortages, regulatory compliance, market volatility, and maintenance concerns. Navigating these trends and challenges requires a balanced approach, combining technological adoption with practical solutions to ensure the long-term sustainability and profitability of agricultural operations.



# Agricultural Challenges. GGB Solutions.

## Agriculture Challenges

### Demanding operation conditions:

Exposure to harsh climates, resilience to a wide temperature range, contaminants, dirt and dust and the risk of lubrication contamination and corrosion influence bearing performance.

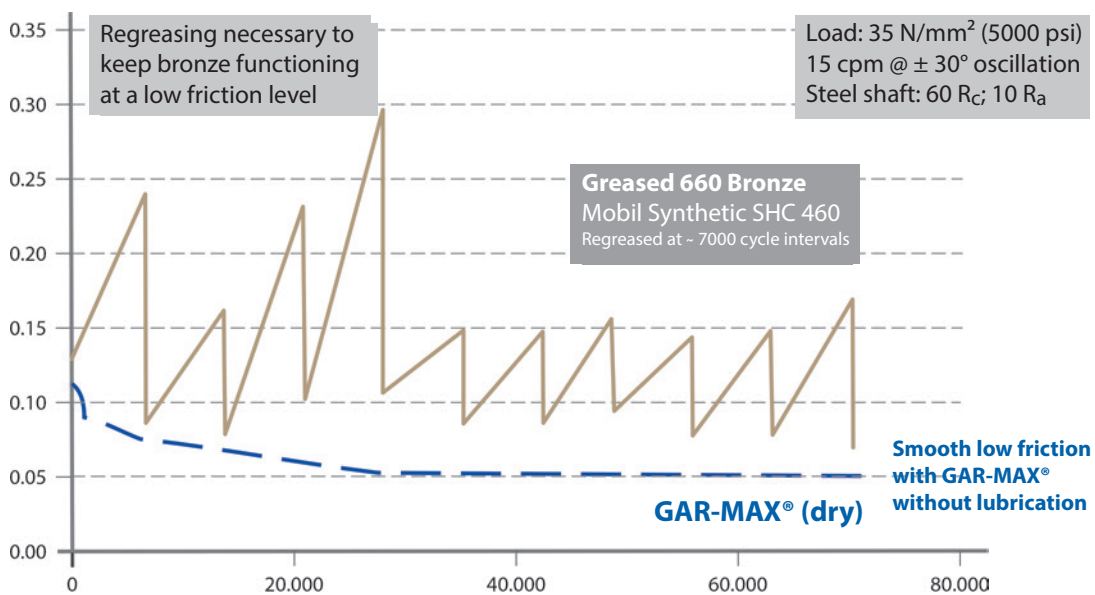
### Equipment failure from wear and tear:

Consistent heavy loads, including shock load lead to excessive wear and tear. Friction caused by grease contamination accelerates the risk of premature failure and financial losses.

## GGB Solutions

Replacing traditional bearings with e.g. **GAR-MAX®**

### Coefficient of friction: **GAR-MAX® (dry)** vs. **bronze (greased)**



## Plain Bearing Identifiers

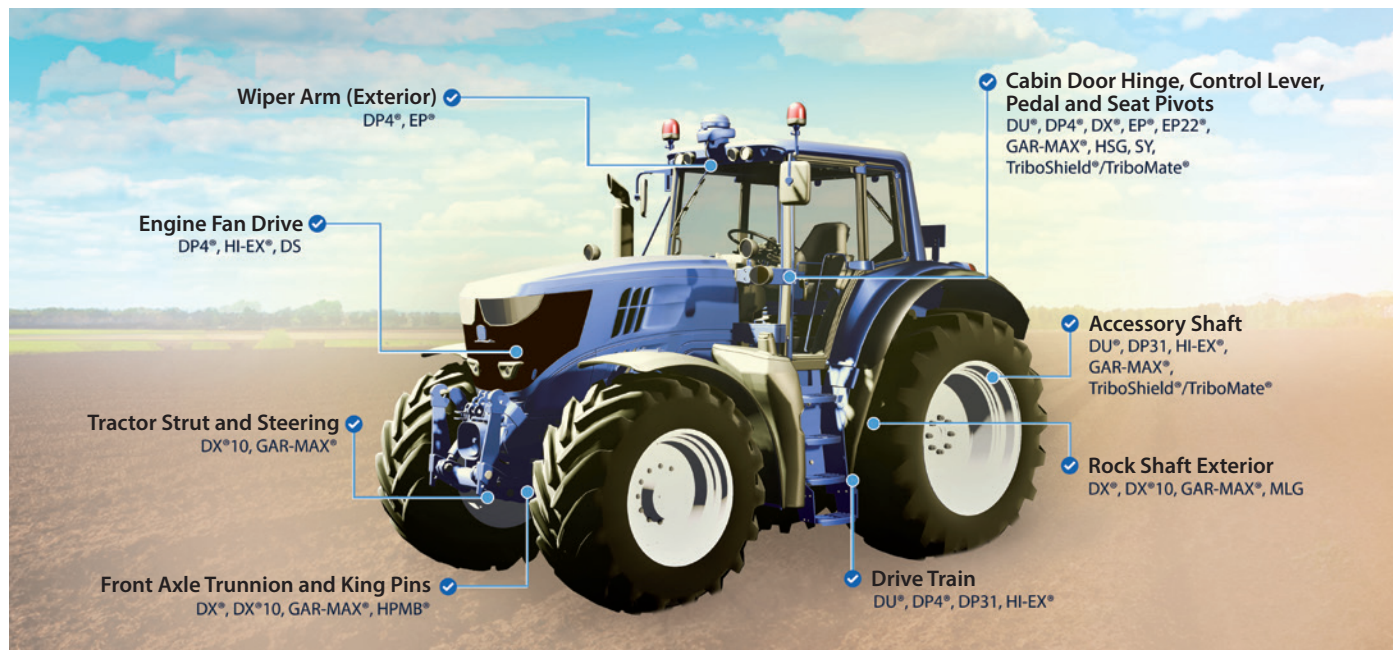
- ✓ Low speeds / low high-loads
- ✓ Pivoting locations
- ✓ Shaft guidance
- ✓ Maintenance avoidance
- ✓ Elimination of constant greasing needs
- ✓ Eliminate fretting debris
- ✓ Oscillating motion
- ✓ Load and shock resistance



“Nobody understands the challenges that agricultural equipment manufacturers like you face better than GGB — from productivity and uptime to all-around dependability, maximum service life and reduced cost of equipment ownership.”



# Agricultural Equipment Applications



- Tractors
- Tractor attachments
- Cultivator, baler
- Wagon or trailers
- Rotary tiller
- Harrow (disc, chain, roller)
- Plow (moldboard, disc)
- Mower
- Dozers
- Seeder, planter
- Fertilizer spreader

## Steering Cylinder



### Application Challenges

- Exposure to outdoors elements
- Wide range of temperature exposure
- Withstands pressure across a broad spectrum of loads
- Elimination of lubricants/grease

### GGB Application Solution

#### GAR-MAX® bearings

- Reduced maintenance with self-lubrication
- Extended service life with a PTFE/High-Strength fiber liner for low wear rate
- Excellent resistance to shock loads
- Liner resistant to abrasion and damage from debris

## Rockshaft



### Application Challenges

- Exposure to outdoors elements
- Wide range of temperature exposure
- Elimination of lubricants/grease

### GGB Application Solutions

#### GAR-MAX®, MLG, DX®, DX®10 bearings

- Lubrication slots decrease the risk of contamination
- Outstanding resistance to impact and shock loads
- Liner resistant to abrasion and damage from debris

## Engine Fan Drive



### Application Challenges

- Requirements for linear motion
- Installation in environments susceptible to debris (e.g. engine compartments)
- Endurance of a diverse range of temperatures

### GGB Application Solution

#### HI-EX® bearings

- Enhanced grease retention with pin-idented liner
- Optimal distribution of lubricant reduces friction and wear
- Simplified installation process
- Rated for high temperature use up to 250°C / 480°F

## King Pins



### Application Challenges

- Endure heavy thrust loads
- Operating in a lubricated environment
- Exposure to outdoor conditions
- Encounters wide range of temperature variations

### GGB Application Solution

#### DX®, DX®10, HPMB® bearings

- The pin-idented liner in DX/DX10 prolongs re-greasing intervals, resulting in decreased maintenance requirements
- Peak performance under heavy loads and slow speeds
- Outstanding resistance to corrosion and chemicals

## Rear Accessory Shaft



### Application Challenges

- Lack of routine greasing can potentially destroy the implement's gearbox
- Improper installation can lead to premature failure
- Exposure to the elements, dirt and debris

### GGB Application Solution

#### HI-EX®, DU®, DP31 bearings, TriboMate® paired coating solution

- The pin-idented liner in HI-EX extends time between re-greasing, minimizing maintenance requirements
- Liner resistant to abrasion and damage from debris
- Demonstrates outstanding resistance to flow erosion and cavitation

## Windshield Wipers



### Application Challenges

- Continual oscillating motion
- Exposure to the elements, dirt and debris
- Operating within a wide temperature range

### GGB Application Solutions

#### DP4®, EP® bearings

- Excellent corrosion resistance
- Unlimited dimensions and design freedom
- Efficient performance in dry, oiled or greased applications

## Cabin Door Hinge



### Application Challenges

- Regular wear and tear can result in loosened hinges or failure
- Exposure to the elements, dirt and debris
- Noisy operation and grease build-up
- Potential for seizure due to elevated friction at contact points and exposure to a corrosive environment

### GGB Application Solutions

#### DP4®, EP®22 bearings

- Endures corrosive environments and exposure to outdoor elements
- Demonstrates excellent wear resistance and low friction characteristics under various loads, speeds, and temperatures
- Eliminates grease

## Foot Control Lever



### Application Challenges

- Handling moderate loads with low frequency fatigue
- Pivoting / oscillating motion
- Operating at low speeds
- Dry running applications without grease
- Exposure to outdoor elements
- Operating within a wide temperature range

### GGB Application Solutions

#### DU®, DP4®, EP® bearings

- Low and consistent friction prevents "slip-stick" resulting in smooth operation
- Increased load capacity and creep resistance
- Thin wall bearing minimizes design envelope providing space and weight savings

## Power Control Lever



### Application Challenges

- Managing moderate loads with low-frequency fatigue
- Pivoting / oscillating motion
- Operating at low sliding speeds
- Operating without grease in dry running applications
- Exposure to outdoor conditions and a wide temperature range

### GGB Application Solutions

#### DU®, DP4®, EP® bearings

- Maintains low and consistent friction, preventing "slip-stick" for smooth operation
- Enhances load capacity and creep resistance
- Operates without the need for grease, ensuring maintenance-free operation

## Seat Adjustments



### Application Challenges

- Operating at slow sliding speeds
- Efficient operation under low loads and minimal friction
- Quieter operation
- Fatigue or erosion sensitivity
- Potential risk of grease contamination from neighboring components

### GGB Application Solutions

#### DP4®, EP®22 bearings, TriboMate® paired polymer coatings

- Minimal friction for smooth movement
- Self-lubricating, as there is no active application grease
- Resilient against corrosion
- Outstanding resistance to temperature variations and wear



# The GGB Difference

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## Application Engineering Expertise

GGB's engineers bring their cross-industrial expertise to a wide range of industries, including automotive, aerospace and industrial manufacturing.

## Research and Development Expertise

With inhouse R&D and testing facilities worldwide, GGB partners with customers worldwide on customized solutions.

## Manufacturing Excellence

It is always our goal to provide superior, high-quality solutions for our customers' needs, no matter where those demands take our products. By combining best practices and the best in quality management, our manufacturing plants are certified in quality and excellence.

## Tribological Expertise

Tribological test results and surface analytical methods help us estimate the tribo-performance including friction and wear of existing materials and new prototypes.



# The GGB Advantage

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### MAINTENANCE-FREE

GGB® bearings are self-lubricating, making them ideal for applications demanding extended bearing life without continuous lubrication.



### LOW FRICTION, HIGH WEAR RESISTANCE

Low coefficients of friction eliminate the need for lubrication, while providing smooth operation, reducing wear and extending service life.



### NVH (Noise, Vibration, Harshness)

Plain bearings provide a smooth sliding motion between surfaces and their material properties and simple design reduce noise, vibration and harshness.



### LOWER SYSTEM COST

A one-piece design offers space and weight reductions and thanks to the material compositions and self-lubricating properties, less maintenance is needed.



### REDUCED CO<sub>2</sub> FOOTPRINT

GGB's flexible and local production platforms facilitate timely deliveries and reduced CO<sub>2</sub> footprint.



### PARTNER SUPPORT

GGB offers tribological, application and design support, and partners with our customers to provide the most efficient solutions.

# Recommended Products



The GGB bearings and polymer coatings are ROHS compliant with the exception of DU.

| Metal-Polymer Bearings              |  |  |  |
|-------------------------------------|--|--|--|
| DX <sup>®</sup>                     |  | DX bearing material for marginally lubricated applications. Optimum performance under relatively high loads and low speeds.  |  |
| DX <sup>®</sup> 10                  |  | DX10 is perfect for heavy duty and harsh environments and offers excellent abrasive and erosion resistance as well as good fatigue strength.   |  |
| HI-EX <sup>®</sup>                  |  | Marginally lubricated bearing material with ultimate robustness and wear performance under highly loaded, thin film conditions. Available with non-indented overlay for hydrodynamic applications. |  |
| DP4 <sup>®</sup>                    |  | Lead-free all-purpose DP4 material offering low friction and good wear resistance in both dry and lubricated applications. Suitable for linear, oscillating and rotating movements.                |  |
| DP31                                |  | DP31 is ideal for oil lubricated applications as it offers superior flow erosion and cavitation resistance and fatigue strength.   |  |
| DU <sup>®</sup>                     |  | Original iconic all purpose metal-polymer product that offers exceptional wear resistance with low friction over a wide range of dry and lubricated running conditions.                            |  |
| Fiber Reinforced Composite Bearings |  |  |  |
| GAR-MAX <sup>®</sup>                |  | GAR-MAX is known for its high load capacity and excellent shock and misalignment resistance.   |  |
| HSG                                 |  | HSG offers twice as much high load capacity and excellent shock and misalignment resistance.   |  |
| HPMB <sup>®</sup>                   |  | HPMB provides machinable inner and outer diameters for application precision, circularity and cylindricity tolerances.   |  |
| MLG                                 |  | MLG provides high load capacity, suitable for lighter duty applications.   |  |



## Engineered Plastics Bearings

EP®



General purpose EP material provides good bearing performance in dry as well as lubricated or marginally lubricated working conditions. Good choice for medium working conditions compared to other Engineered Plastics materials.



EP®22



EP22 bearings provide a good price/performance ratio . Good performance in low load applications, also a good choice for water lubricated applications.



## Metal & Bimetal Bearings

AuGlide®



The machinable bimetal bearings are suitable for high loads and high temperatures, offer excellent fatigue strength under dynamic and shock load conditions, and are suitable for hydrodynamic operation.



GGB-DB®



Cast bronze bearings with solid lubricant inserts offer excellent performance under high loads and intermittent operation. Available with PTFE or graphite inserts for temperature above 250 °C.



## Polymer Coatings

TriboShield®



Our TriboShield formulations cover the full spectrum of mechanical, thermal and chemical capabilities offered by today's coatings materials.



TriboMate®



Your bearing or coating performance can be enhanced with our TriboMate paired solutions.



## OFFERING GLOBAL REACH WITH LOCAL SUPPORT.

We foster a global culture of **Teamwork, Excellence, Quality, Ethics and Integrity**, advancing people and planet, customer excellence, solution engineering and a focus on strategic markets.

We are **committed** to developing **sustainable** solutions for the next generation and advancing environmental sustainability through product innovation, tribology, operational excellence and technology.

We have taken efforts to increase our reliance on **renewable energy, reduce waste** and our overall **carbon footprint**.



# Bearing Application Data Sheet



Please complete the form below and share it with your sales engineer.

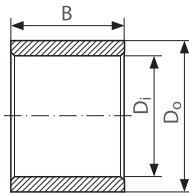
## DATA FOR BEARING DESIGN CALCULATION

Application: \_\_\_\_\_

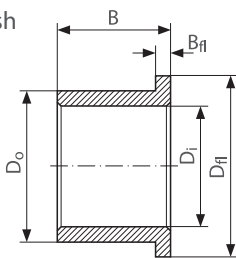
Project/No.: \_\_\_\_\_ Quantity: \_\_\_\_\_  New Design  Existing Design  
 Steady Load  Rotating Load  Rotational Movement  Oscillating Movement  Linear Movement

### BEARING TYPE

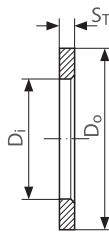
Cylindrical bush



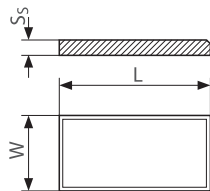
Flanged bush



Thrust washer



Slide plate



Special parts (sketch)

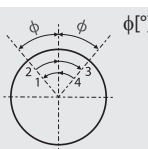
### DIMENSIONS [mm]

|                         |     |  |
|-------------------------|-----|--|
| Inside diameter         | Di  |  |
| Outside diameter        | Do  |  |
| Length                  | B   |  |
| Flange diameter         | Dfl |  |
| Flange thickness        | Bfl |  |
| Wall thickness          | ST  |  |
| Length of slideplate    | L   |  |
| Width of slideplate     | W   |  |
| Thickness of slideplate | Ss  |  |

### LOAD

|                                       |     |
|---------------------------------------|-----|
| <input type="checkbox"/> Static load  |     |
| <input type="checkbox"/> Dynamic load |     |
| Axial load F                          | [N] |
| Radial load F                         | [N] |

### MOVEMENT

|                     |   |  |
|---------------------|---|--|
| Rotational speed    | N [1/min]   |  |
| Speed               | U [m/s]   |  |
| Length of stroke    | Ls [mm]   |  |
| Frequency of stroke | [1/min]   |  |
| Oscillating cycle   |  |  |
| Osc. frequency      | Nosz [1/min]  |  |

### MATING SURFACE

|                |         |
|----------------|---------|
| Material       |         |
| Hardness       | HB/HRC  |
| Surface finish | Ra [μm] |

### CUSTOMER INFORMATION

Company \_\_\_\_\_  
 Street \_\_\_\_\_  
 City / State / Province / Post Code \_\_\_\_\_  
 Telephone \_\_\_\_\_ Fax \_\_\_\_\_  
 Name \_\_\_\_\_  
 Email Address \_\_\_\_\_ Date \_\_\_\_\_

### FITS & TOLERANCES

|                 |    |  |
|-----------------|----|--|
| Shaft           | Dj |  |
| Bearing housing | DH |  |

### OPERATING ENVIRONMENT

|   |          |  |
|---|----------|--|
| Ambient temperature   | Tamb [°] |  |
| Bearing housing material  |          |  |
| <input type="checkbox"/> Housing with good heating transfer properties                          |          |  |
| <input type="checkbox"/> Light pressing or insulated housing with poor heat transfer properties |          |  |
| <input type="checkbox"/> Non metal housing with poor heat transfer properties                   |          |  |
| <input type="checkbox"/> Alternate operation in water and dry                                   |          |  |

### OPERATING ENVIRONMENT

|  |         |  |
|--|---------|--|
| <input type="checkbox"/> Dry                       |         |  |
| <input type="checkbox"/> Continuous lubrication    |         |  |
| <input type="checkbox"/> Process fluid lubrication |         |  |
| <input type="checkbox"/> Initial lubrication only  |         |  |
| <input type="checkbox"/> Hydrodynamic conditions   |         |  |
| Process fluid                                      |         |  |
| Lubricant  |         |  |
| Dynamic viscosity                                  | η[mPas] |  |

### SERVICE HOURS PER DAY

|                        |  |
|------------------------|--|
| Continuous operation   |  |
| Intermittent operation |  |
| Operating time         |  |
| Days per year          |  |

### SERVICE LIFE

|                       |        |  |
|-----------------------|--------|--|
| Required service life | LH [h] |  |
|-----------------------|--------|--|



# Product Information

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This document is provided to give you the analysis tools or information to assist you in product selection. Product performance is affected by many factors beyond the control of GGB. Therefore, you must validate the suitability and feasibility of all product selections for your applications.

GGB products are sold subject to GGB's Terms of Sale and Delivery, which include our limited warranty and remedy. You can find these here: <https://www.ggbearings.com/en/terms-and-conditions>, or ask your GGB representative for a copy.

Products are subject to continual development. GGB retains the right to make specification amendments or improvements to the technical data without prior announcement.

## Document Information

Edition 2024. This edition replaces earlier editions which hereby lose their validity.

Every reasonable effort has been made to ensure the accuracy of the information in this writing, but GGB assumes no liability for errors or omissions or for any other reason.

## Health and Safety

GGB is committed to adhering to all U.S., European and international standards and regulations with regard to lead content. We have established internal processes that monitor any changes to existing standards and regulations, and we work collaboratively with customers and distributors to ensure that all requirements are followed. This includes RoHS and REACH guidelines.

GGB is committed to operating in an environmentally conscious and safe manner. We follow numerous industry best practices and are committed to meeting or exceeding a variety of internationally recognized standards for emissions control and workplace safety.

Each of our global locations has management systems in place that adhere to IATF 16949, ISO 9001, ISO 14001 and ISO 45001 quality regulations. Our certificates can be found here: <https://www.ggbearings.com/en/certificates>.

A detailed explanation of our commitment to REACH and RoHS directives can be found at <https://www.ggbearings.com/en/who-we-are/quality-and-environment>.

## Polymer Fumes

At temperatures up to 250°C the polytetrafluoroethylene (PTFE) present in the lining material is completely inert so that even on the rare occasions in which DP4 bushes are drilled or sized after assembly there is no danger in boring or burnishing. At higher temperatures however, small quantities of toxic fumes can be produced and the direct inhalation of these can cause an influenza type of illness which may not appear for some hours but which subsides without after-effects in 24-48 hours. Such fumes can arise from PTFE particles picked up on the end of a cigarette. Therefore smoking should be prohibited where DP4 is being machined.

## Trademarks

GGB®, DP4®, DU®, DP31, DX®, DX®10, HI-EX®, EP®, EP®22, GAR-MAX®, HSG, MLG, HPMB®, SBC with GAR-MAX®, AuGlide®, GGB-DB®, TriboShield® and TriboMate® are registered trademarks or trademarks, as the case may be, of GGB and its affiliates. TIMKEN® is a registered trademark of The Timken Company.

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