PTFE Based Lead Free Metal-Polymer Plain Bearing Materials for Lubricated Applications

Technical Information

GGB

1 Introduction

This brochure describes the range of GGB's PTFE based metal-polymer plain bearing materials for industrial and automotive lubricated applications, including hydraulic cylinders, pumps and motors, shock absorbers and McPherson Struts, power steering pumps, transmissions, compressors, etc.

PTFE based metal-polymer plain bearing materials have been used extensively for many years in a wide range of industrial and automotive lubricated applications, where they provide improved friction and wear performance relative to conventional bimetal bearing alloys. In recent years, however, as the operational requirements of equipment have increased, so have the demands on the performance of the longest established of these materials, DU™. In response to these market requirements, GGB has undertaken an extensive development program resulting in a range of lead free bearing materials with enhanced properties designed to meet the most stringent performance requirements in these lubricated applications.

All of these new materials are lead free and comply with the European Parliament's End of Life Vehicles directive (ref: 2000/53/EC) on the elimination of hazardous materials in the construction of passenger cars and light trucks.

2 Materials

Structure and Composition

GGB's PTFE based metal-polymer materials share a common structure of a steel backing to which is bonded a porous bond interlayer impregnated and overlaid with a filled PTFE bearing layer.

Microsection

PTFE Lining Compositions

Material	DP4™	DP30™	DP31™
Lining Composition	PTFE + CaF_2 + aramid fibre	PTFE + thermoplastic	PTFE + fluoro-polymer + fillers

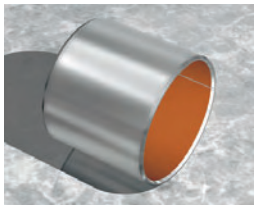
Physical and Mechanical Properties

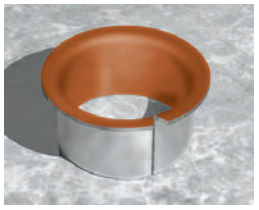
Physical Properties	Units	Values DP4	DP30	DP31
Coefficient of thermal expansion - parallel to surface - normal to surface	$1/10^6$ K	11 30	11 30	11 30
Maximum operating temperature T_{max}	°C	280	200	280
Minimum operating temperature T_{min}	°C	-200	-200	-200
Mechanical Properties				
Compressive yield strength	N/mm^2	350	350	350
Max. load - static - dynamic	N/mm^2	250 140	250 140	250 140

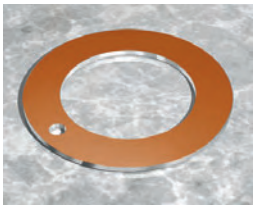
3 Forms

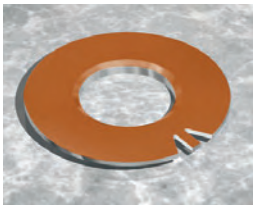
Basic Forms

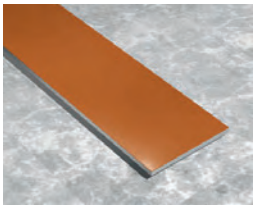
All materials are available as flanged and cylindrical wrapped bushes, thrust washers, strip material, and as special parts manufactured to customer requirements.


DP4 Cylindrical bushes


Flanged bushes


Thrust washers


Flanged washers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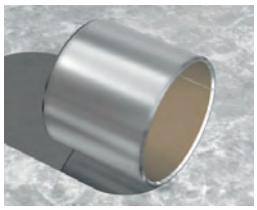
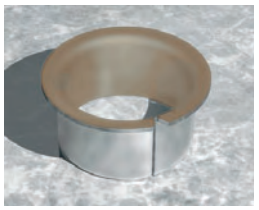
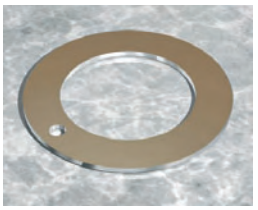
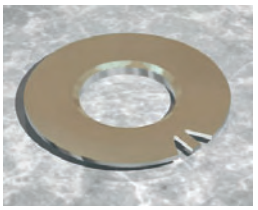
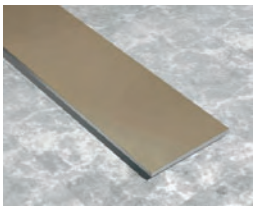
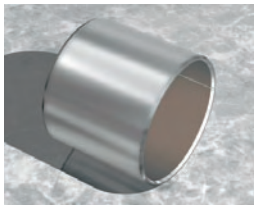
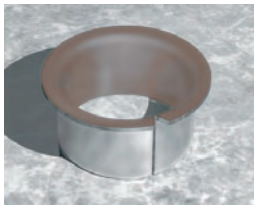
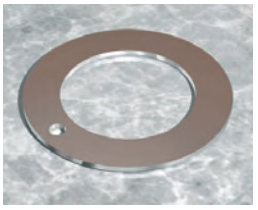
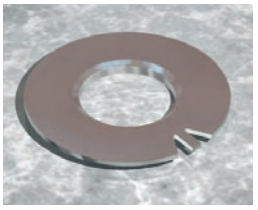
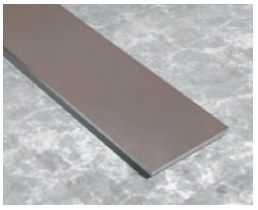





DP30






DP31

Patent Information

DP4: US Patent No. 5,911,514
European Patent No. 708892 and others apply

DP30: Patent pending for US

DP31: US Patent No. 6,461,679
Patent pending for Europe and other areas

Trademark Information

DU™, DP4™, DP30™ and DP31™ are trademarks of GGB

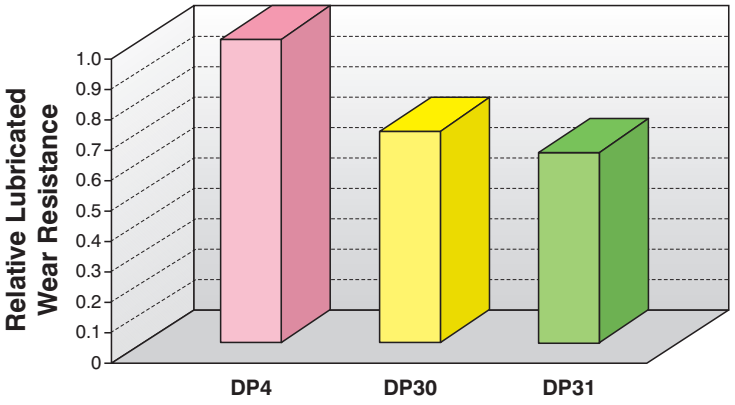
Performance Factors

Each application, depending on the equipment design, usage, lubrication and operating conditions, places individual demands on the bearing material properties required for satisfactory performance.

The following describes the major performance factors required for satisfactory operation in lubricated applications and indicates the relative performance of each of the materials for each of the factors.

Boundary Lubricated Wear Resistance

For a long service life, a low wear rate is necessary particularly under severe mixed film or boundary lubricated conditions where the generated lubricant films are of the same order, or less than, the surface roughness of the mating surface.

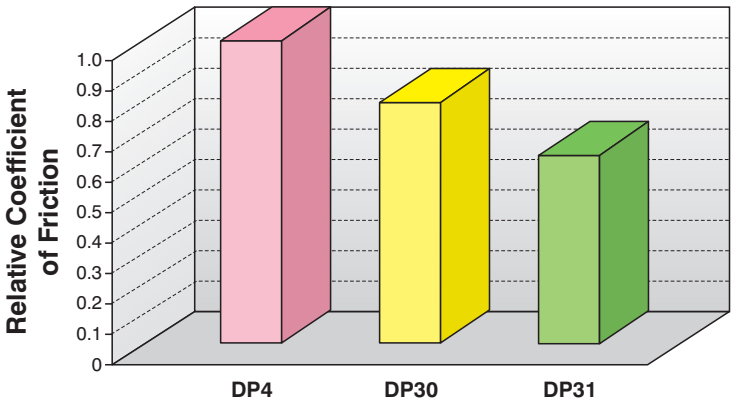


Test Conditions:
Speed: 0.11 m/s Load: 12 - 40 MPa Lubricant: BP Bartran HV

Lubricated Friction

A low and constant static and dynamic friction is generally desirable in most applications. However, actual friction values depend on the many design and operating factors that influence the lubrication conditions.

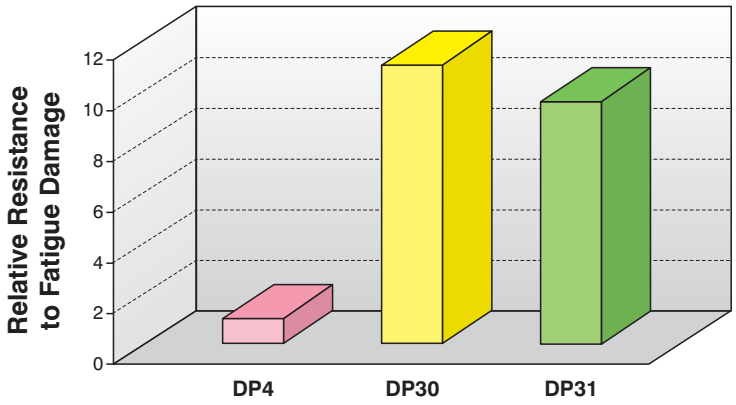
Friction is lowest under full hydrodynamic conditions and increases as the generated lubricant films decrease through mixed film to boundary conditions. None of the materials show stick-slip effects.



Test Conditions:
Speed: 0.81 m/s Load: 12.8 MPa Temperature: 100°C Lubricant: SAE 20W50

Hydraulic Fatigue Strength

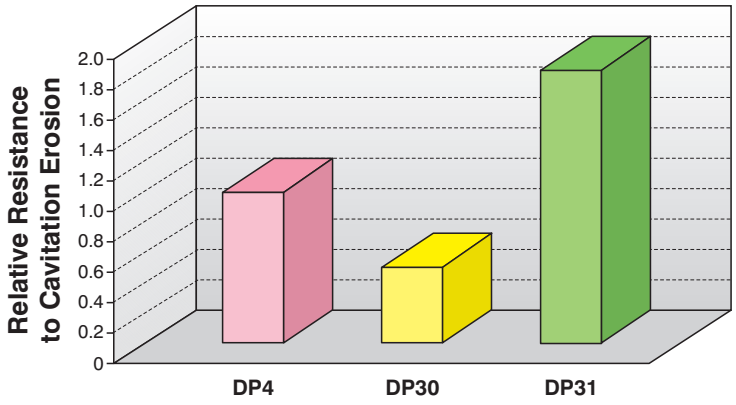
Under dynamically loaded lubricated conditions the resulting pressure fluctuations generated in the lubricant film can result in fatigue damage of the PTFE bearing lining. This damage takes the form of localised removal of the PTFE in the form of "worm tracking" across the bearing leading to a reduced service life.



Test Conditions:
Load: 120 MPa Frequency: 50 Hz Lubricant: BP Bartran HV

Cavitation Erosion Resistance

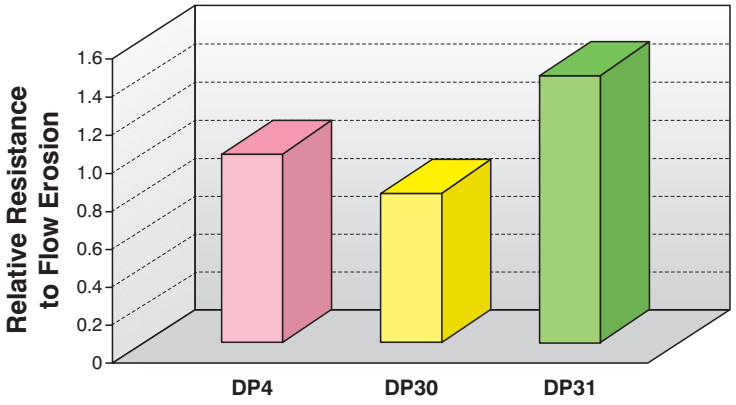
Under dynamically loaded lubricated operating conditions, vapour cavities can be generated within the lubricant film, which subsequently collapse, causing damage to the PTFE bearing lining. This damage takes the form of localised removal of the PTFE and fillers across the bearing surface, leading to a reduced service life.



Test Conditions:
Frequency: 20 KHz Medium: Water

Flow Erosion Resistance

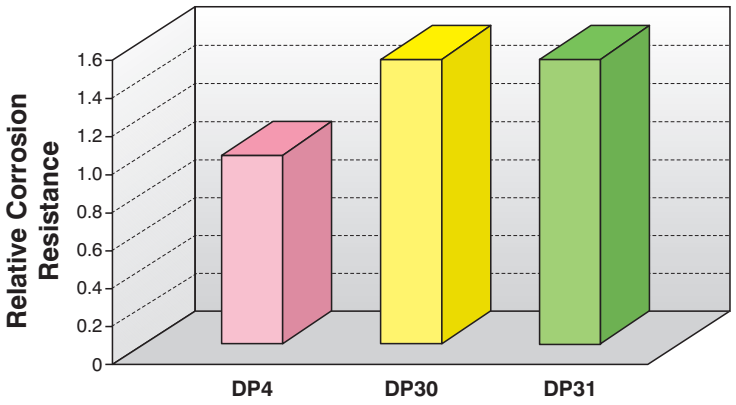
High velocity lubricant flow through the bearing can result in the gradual erosion of the soft PTFE bearing lining from the bearing surface leading to a reduced service life.



Test Conditions:
Pressure: 13.8 MPa Temperature: 60 °C Lubricant: BP Bartran HV

Corrosion Resistance

Lubricants and additives degrade with prolonged operation at high temperature and the resulting decomposition products can chemically attack fillers of the bearing lining or the bronze of the interlayer.



Test Conditions:
1000 hours submersion Temperature: 140 °C Lubricant: various oils

Overview & Selection Guide

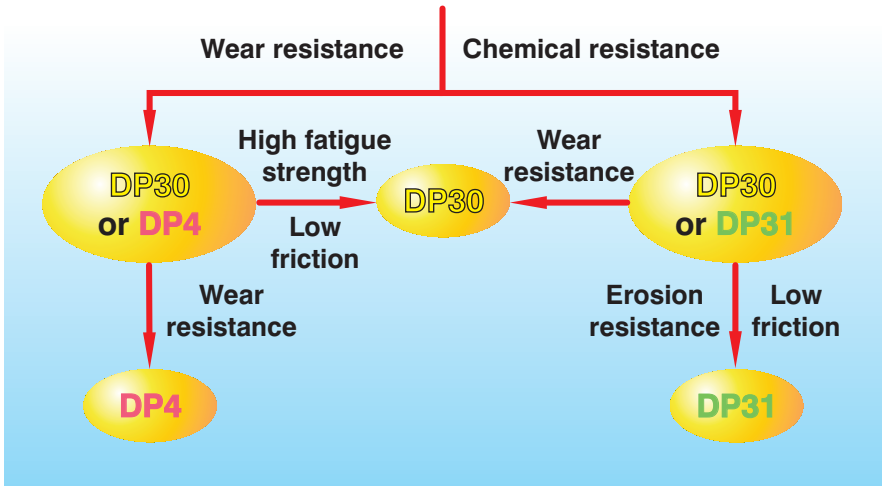
Product selection may be simplified using the following table and flow-chart which summarises and compares the relative strengths of each of the materials.

Performance Comparison

Material	Lubricated wear resistance	Lubricated friction	Hydraulic fatigue strength	Cavitation erosion resistance	Flow erosion resistance	Corrosion resistance
DP4	1	2	4	2	2	2
DP30	2	2	1	3	2	1
DP31	2	1	2	1	1	1

Ranking: 1 excellent | 2 good | 3 satisfactory | 4 not recommended

Hydraulic Bearing Material Selection Guide



Product Information

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