



MATERION



BRUSH PERFORMANCE ALLOYS

**TOUGH BEARING MATERIAL
FOR PROBLEMATIC
BEARING APPLICATIONS**

TOUGHMET[®]

PROBLEMATIC BEARING APPLICATIONS

PLAIN BEARING

Problem: Adhesive wear, abrasive wear, pin deflection, non-ideal or edge loading, cold starts with corrosion resistance and less rigid lubrication intervals.

Solution: ToughMet®



Successful Application:

Bucket Bushings

For Sunrise Aggregates, uptime is crucial. Unplanned service on dredging/open pit excavators and wheel loaders is disastrous.

Sunrise risks significant fines if it cannot deliver gravel and sand on time for road-surfacing contracts.

At peak, Sunrise Aggregates runs equipment 100 hours a week, at high speed, cutting through gravel and digging underwater. The OEM pin and bucket bushings on the excavators were wearing quickly, in approximately 3,500 hours, much faster than other joints which last approximately 8,000 hours. The wheel loader OEM bucket bushings lasted only 4800 hours. Because digging in water makes sustained lubrication

difficult for the excavators, manual lubrication is required every three hours during digging, while the wheel loaders must be greased each day in dry conditions. Sunrise needed a better solution: a bushing that could last until the planned maintenance period of the other joints, with less lubrication intervals and the ability to keep running if regular lubrication periods slipped as quotas neared.

After consulting Materion Brush Performance Alloys for installation fits and clearances, Sunrise put ToughMet® directly into service on two Cat 350L excavators and Komatsu WA500 front loaders, running against chromed, hardened steel pins. Checking the bushings after 8,000 hours on the excavators and after 6,000 hours on the loaders, there was no change in performance, even with a few skipped lubrication cycles.

Successful Application:

Take-up Idler Bushings

Maximizing productivity and the service life of rope shovel components is crucial. Replacing one take-up idler bushing can take a shovel out of service for an entire shift, costing thousands of dollars in lost production and maintenance charges.

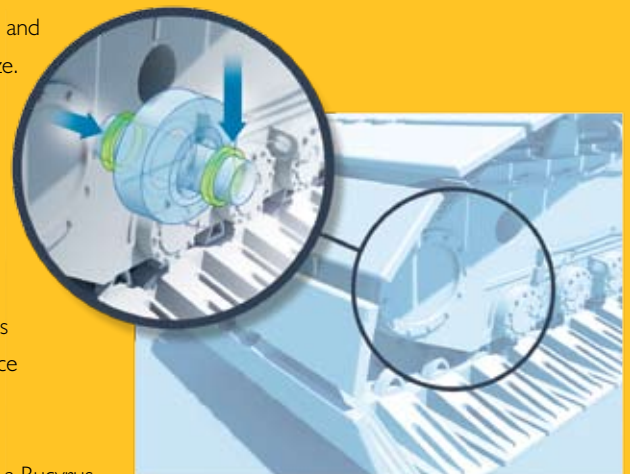
Surface mining equipment manufacturer, Bucyrus International, Inc., recognized the competitive advantages its customers could gain if they extended the bushing life in the take-up idlers. The idler sees ground reaction, as well as steering loads. Generally, idler bushings are subject to abrasive wear, contamination, deformation under severe loads and galling.

The solution presented to Bucyrus was high-performance ToughMet®. Like manganese bronze, ToughMet® has high tensile strength and low friction. ToughMet® also offers a

significantly higher yield strength and hardness than manganese bronze.

A typical manganese bronze take-up idler bushing has an expected service life of about 7,000 hours. ToughMet® bushings, on the other hand, can often last two to three times longer, depending upon its service environment.

ToughMet® was used initially on a Bucyrus 495HF shovel in a demanding tar sands application in northern Alberta. After 10,000 hours of service, the ToughMet® take-up idler bushing was removed for inspection, and showed only about 50 percent wear – far exceeding the performance of manganese bronze. ToughMet® is now standard in the take-up idler bushings for all large shovels manufactured by Bucyrus International.



TOUGHMET® ALLOY IS YOUR ENGINEERED COMPONENT SOLUTION

With proven success in thrust bearings, journal/plain/sleeve bearings and linear/sliding bearings, ToughMet® is a spinodal copper nickel tin alloy with:

- High strength and hardness (like 4140 steel)
- A low coefficient of friction (like leaded bronze)
- Great wear resistance (like steel)
- Freedom from galling (like manganese bronze)
- Great corrosion resistance (unlike steel or bronze)
- Excellent machinability (>3x as fast as tool steel)
- And, no lead (Pb)

How does ToughMet® Compare?

The mechanical properties of ToughMet® are similar to 6-4 titanium, but the frictional characteristics are more like leaded tin bronze.

- Leaded tin bronze (SAE 660)
- Aluminum bronze (C95400)
- Leaded manganese bronze (C86300)
- ToughMet® 3 CX105
- Carburized 8620 steel

Application

ToughMet® wears much better than steel when lubrication is compromised. At most operating temperatures, it won't gall or stick to steel, bronze, titanium or itself.

Corrosion

ToughMet® resists corrosion in environments that are hostile to both iron and copper-based alloys.

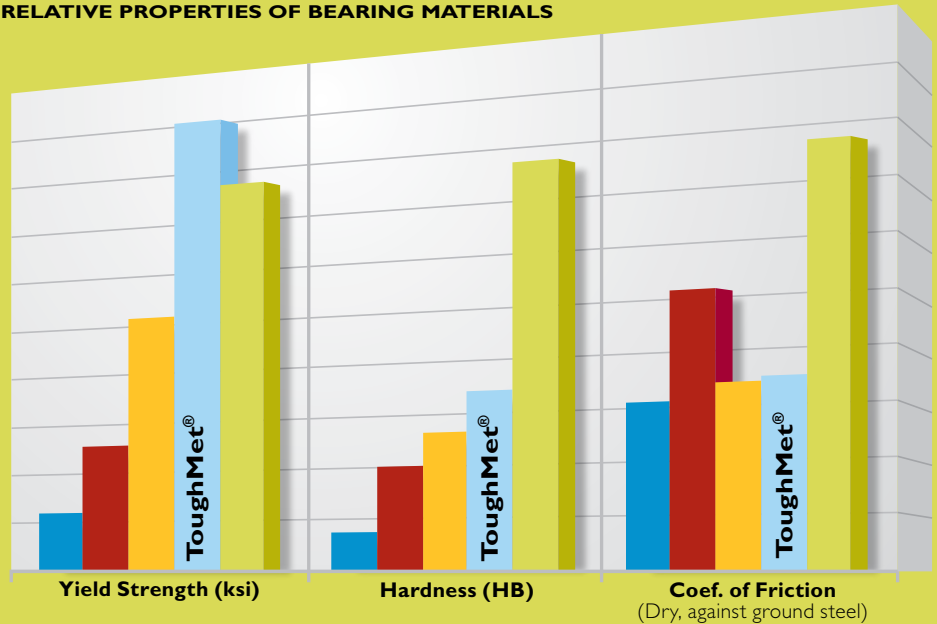
Machining

For a high hardness alloy, ToughMet® machines extremely well.

ToughMet® offers high strength, high hardness, low coefficient of friction for a drop-in replacement, plus a few extras such as corrosion resistance and excellent machinability.



RELATIVE PROPERTIES OF BEARING MATERIALS



TOUGH SOLUTIONS FOR TOUGH APPLICATIONS



THRUST BEARING

Problem: Wear, galling, uneven loads

Solution: ToughMet®

Successful Application:

Transmission Gear Box

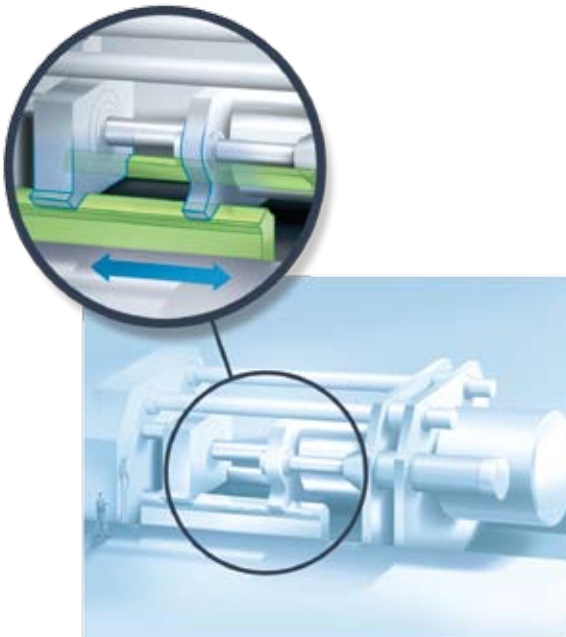
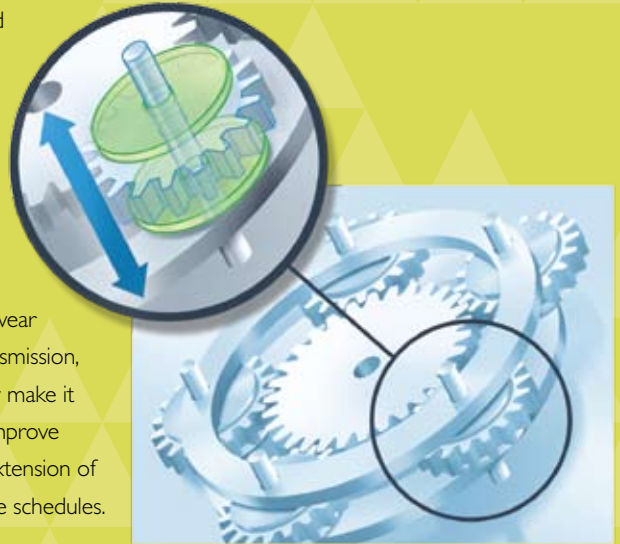
Unexpected maintenance due to premature wear in heavy equipment components can bare a significant cost. If the parts are under warranty, that cost falls to the original equipment maker (OEM). One OEM experienced excessive premature wear complaints in haulage truck transmission gear boxes and sought to reduce the number of claims while satisfying customer expectations of component life.

Potential causes of premature wear included actual thrust in the planetary gear system was higher than predicted, severely shortening the life of the soft leaded bronze washers on the steel pin and/or the gear system suffered limited lubrication from cold starts.

Brush Performance Alloys suggested ToughMet® 3 CX105 due to its resistance to abrasive wear and deformation as well as its ability to survive and perform in lubrication-starved joints.

In field tests, ToughMet® survived nearly four times more pressure than C93200 at the same speed before frictional shear. The wear rate of ToughMet® was 4 to 16 times less than the C93200 and C93700.

ToughMet® virtually eliminated wear of the thrust washers in the transmission, allowing the OEM to confidently make it through warranty periods and improve customer satisfaction with the extension of suggested customer maintenance schedules.



LINEAR/SLIDING BEARING

Problem: Wear, galling

Solution: ToughMet®

Successful Application:

Extrusion Press Ways

A few years ago H.C. Starck began exploring options to increase up time by extending the life of the ways that support the 30,000-pound hardened steel container on the extrusion press. The container holds the billet against the die during the extrusion process.

Approximately 300 times per day, the container slides along the ways allowing operators to lubricate, clean and change the die between extrusions. As the ways wear, operators must re-align the container and die, requiring the press to be down for about 1 to 1 1/2 hours. When

the ways wear out, the press must be shut down in order to remove and replace them. Surfaces of ways made from C95400 aluminum bronze typically showed about 0.060" of wear after one year of service and required replacement after about two years.

To combat the wear problem, H.C. Starck replaced the C95400 container ways with Brush Performance Alloy's ToughMet® 2 CX90. Fifteen months after installation no evidence of wear was found. ToughMet® lasted at least twice as long as the C95400, saving about one day per year in lost production.

IS TOUGHMET® THE RIGHT FIT FOR YOUR BEARING APPLICATION?

■ PLAIN BEARING – JOURNAL/SLEEVE BEARING:

Cylindrical bearings which support a rotating cylindrical shaft.

Choose ToughMet® if your Plain Bearing exhibits signs of adhesive or abrasive wear, pin deflection or edge loading. Or, if it is prone to cold starts with corrosion resistance and less rigid lubrication intervals.



■ THRUST BEARING: Bearings which sustain axial loads and prevent axial movement of a loaded shaft.

Choose ToughMet® if your Thrust Bearing suffers from premature wear, galling or uneven loads.



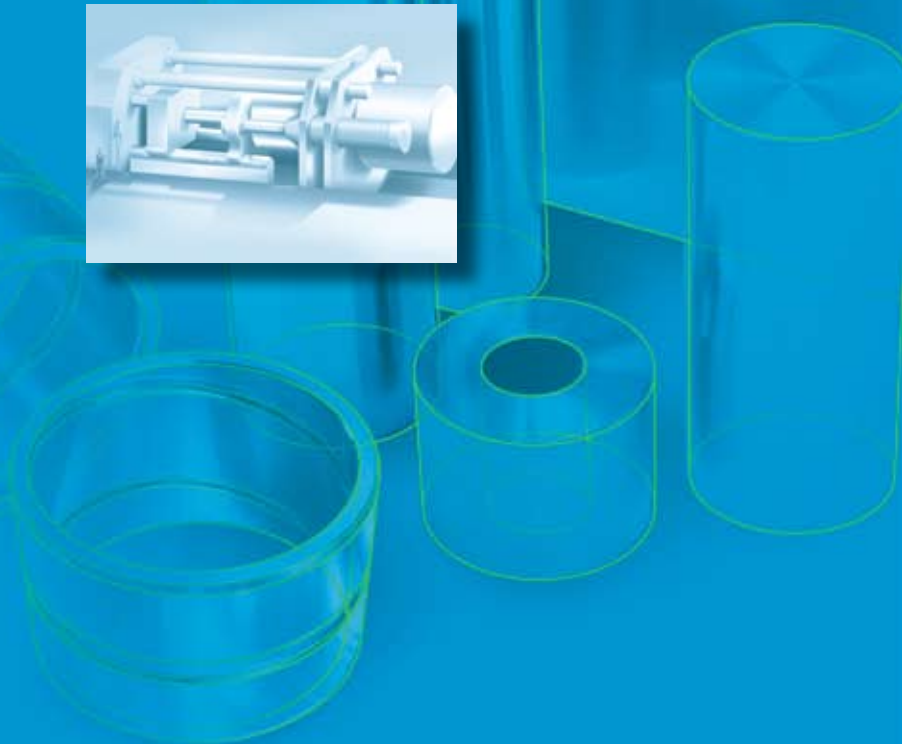
■ LINEAR/SLIDING BEARING: Bearings that provides linear motion; they may take the form of a circular bearing and shaft or two matching surfaces (sliding plates).

Choose ToughMet® if your Linear Bearing fails due to excessive wear and/or galling.



While ToughMet® is most often used in plain bearings, it has also proven successful in replacing rolling element bearings.

If your rolling element bearing suffers from uneven load, uneven lubrication or complex design, ToughMet® can help. Anywhere a potential for metal-to-metal contact exists, either when a high load squeezes lubricant away from the interface or during a cold start, ToughMet® lasts longer and protects mating parts better than conventional bearing alloys.





MATERION

ABOUT MATERION

Materion is the new name for Brush Engineered Materials Inc., its Brush Wellman Inc. subsidiary, and all of the company's businesses worldwide. Materion is among the world's premier providers of advanced materials solutions and services. Now under the one Materion brand, we are better aligned to deliver a broader scope of products, services and expertise needed to drive our customers' growth and profitability and become their first choice in a partner. Materion Corporation common stock trades on the New York Stock Exchange under the symbol MTRN.

MATERION BUSINESSES

Advanced Chemicals	Electrofusion
Barr Precision Optics & Thin Film Coatings	Large Area Coatings
Brush Beryllium & Composites	Microelectronics & Services
Brush Performance Alloys	Natural Resources
Ceramics	Technical Materials

BRUSH PERFORMANCE ALLOYS INTERNATIONAL LOCATIONS

CHINA/HONG KONG
p + 852.2318.1907
brushalloysHK-info@materion.com

CHINA/SHANGHAI
p + 86.21.5237.2328
brushalloysCN-info@materion.com

GERMANY
p + 49.711.830.930
brushalloysDE-info@materion.com

INDIA/PUNE
p + 91.99606.33744
brushalloysIN-info@materion.com

JAPAN
p + 81.33.230.2961
brushalloysJP-info@materion.com

REPUBLIC OF KOREA
p + 82.32.811.2171
brushalloysKR-info@materion.com

SINGAPORE/ASEAN
p + 65.6842.4456
brushalloysSG-info@materion.com

TAIWAN, R.O.C.
p + 886.2.2747.8800 ext. 121
brushalloysTW-info@materion.com

UNITED KINGDOM & IRELAND
p + 44.118.930.3733
brushalloysUK-info@materion.com

BRUSH PERFORMANCE ALLOYS

Main Office
6070 Parkland Boulevard
Mayfield Heights, OH 44124 USA
p 800.375.4205 +1.216.486.4200
www.materion.com/brushalloys