

# MAHLE

*Motorsport*

## HIGH PERFORMANCE ENGINE BEARINGS - The Lead-Indium Overlay

Technical Information



## DON'T COAT .... LET THE OVERLAY DO ITS JOB

The overlay does not operate in isolation, it relies on the bearing substrate and backing, so all 3 layers need to be designed in conjunction with one another. A careful balance of properties is struck through material composition and manufacturing processes to give optimum bearing performance.

These include hard phase properties such as strength and wear resistance on one side, and soft phase properties of conformability, compatibility, and embeddability on the other.

In high performance motorsport applications, the soft-phase properties are hugely important, and the lead-indium overlay combined with the right substrate and backing does it best of all.

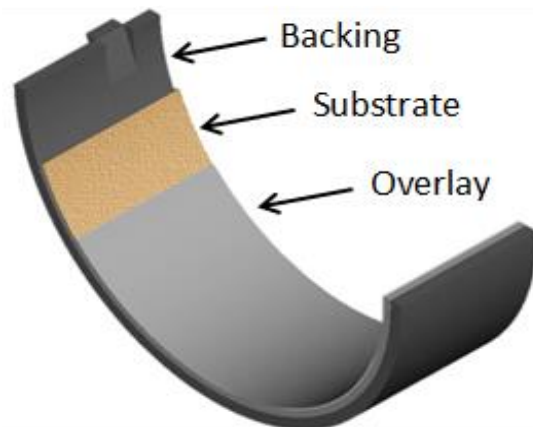
Lead-indium allows the right level of surface modification, ranging from....

**POLISHING** to **LIGHT WEAR** to **MODERATE WEAR** to **HEAVY WEAR** to **WIPING**...

.... whatever is needed to dissipate heat and prevent seizure.

Don't add a second overlay and upset the balance.... Don't waste money polymer coating the lead-indium overlay.

**TRI-METAL BEARING**



## UNDERSTANDING SEIZURE RESISTANCE

Seizure occurs when a sustained breakdown of the oil film occurs causing contact between the journal and bearing leading to irrecoverable overheating of the bearing.

To alleviate seizure, the lead-indium overlay begins its work with elastic deformation, or plastic deformation if necessary, as a means to dissipate heat, but if pressed further through crank deformation for instance, this mechanism can be extended to **wear**, and the lead-indium overlay will provided the required degree of wear until the oil film has recovered.

As a final resort, lead-indium's speciality is **wiping**. This is where the overlay shears and redeposits in other parts of the bearing. Clearly the bearing system has a problem if wiping occurs, and it is often the pre-cursor to seizure.

However, following an event that causes wiping, if the oil film recovers then the bearing can survive albeit in a damaged condition. Seizure does not occur on the lead-indium overlay. If the oil film does not recover, then seizure will only finally occur when the overlay has been removed from the critical area and the bronze substrate exposed.

It is important to note that bearings with greater levels of wear resistance and less conformability will be less able to dissipate heat in this manner and will result in earlier overheating and seizure.

## BEARING CONSTRUCTION

Bearing design begins with load carrying capacity. MAHLE Motorsport's VP2 substrate is where the strength comes from. Once this has been satisfied, further conformability, compatibility and embeddability is built in with the lead-indium overlay. These properties are further tuned by careful definition of the overlay thickness

**MAHLE MOTORSPORT RACE BEARING CONSTRUCTION**

Properties		VP2
<b>Backing</b>	Material	Steel
	Carbon %	C 0.2%
	Min Hardness	80HRb
	Hoop Stress Guideline	375
<b>Substrate</b>	Process	Cast
	Pb%	Pb 23%
	Sn%	Sn 1.5%
	Cu%	Cu Balance
<b>Overlay</b>	Rod + Main Brgs Only	PbIn

The general rule in multi-layer bearing construction is to build layers with increasing soft phase properties (compatibility, conformability, and embeddability) towards the running surface. The addition of a polymer coating counteracts this progression and removes some of the anti-seizure mechanisms.

Polymer coating may alleviate some of the limitations of other types of bearing construction, but this is not required for MAHLE Motorsport VP2 bearings which uses a carefully designed combination of strengthened steel backing, cast lead-bronze substrate and lead-indium overlay.

MAHLE's lead-indium overlay remains uncontested as the best possible material for high performance engines

**When the bearing system is put under pressure, it conforms, it dissipates heat, it prevents seizure.**

## **FURTHER POINTS TO CONSIDER ON POLYMER COATING**

- A polymer coating reduces the thermal efficiency of the bearing by introducing a thermal barrier.
  - Does this require more clearance to increase oil flow?
  - Does this require increased oil pump capacity?
- How is the lead-based overlay prepared to ensure adhesion of the polymer?
  - Grit blasting?
  - Does it change the thickness?
  - Does it change the surface texture?
  - Is there any preparation media remaining embedded in the overlay?  
After all, lead-based overlays are designed to have a high degree of embeddability.
  - When the polymer layer wears off does it leave a damaged and compromised bearing to continue operating? In this condition it is unlikely to be the bearing intended by the manufacturer or engine designer.