



SUPPORTING THE TRANSITION TO LEAD-FREE BEARINGS IN LARGE DIESEL ENGINES: THE CHALLENGE FOR FOUNDRIES

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The EU has restricted the use of lead-containing bearings in diesel engines. This poses a challenge for engine makers, who traditionally used lead in bearings to achieve satisfactory engine reliability. Its qualities as a dry lubricant protected the bearings from particulate contaminants, such as those left over from the casting process (moulding sand, and residues from the binder and the coating itself). To support the transition to lead-free bearings, SEMCO IC coatings are designed to significantly improve the removal of such casting debris from even the most complex of castings. In doing so, these coatings continue to set new standards when it comes to the ultra-low number of particles remaining in the as-cast condition.

The latest generation of SEMCO IC coating is also formulated so that any remaining coating particles are softer than the bearings. This eliminates the risk of wear to the bearing from coating residue.



INTRODUCTION

As greater performance and environmental demands are placed on engines by original equipment manufacturers and regulators alike, so too do the demands placed on component castings by engine makers. One trend has been a growing restriction on the use of lead (Pb) in bearing alloys used within commercial internal combustion engines (ICEs) and associated systems.

Lead has long played an integral part in engine bearings as part of traditional tri-metal bearings. Its relative softness and low melting temperature meant it effectively acted as an integral lubricant, offering a level of protection and flexibility to the bearing. Its use was therefore considered necessary to achieve satisfactory reliability in terms of seizure resistance, conformability, and debris resistance, particularly in larger engine sizes and engines operating in demanding environments.

THE LEAD-FREE BEARING CHALLENGE

However, for all its benefits, lead's toxicity has led regulators to progressively restrict its use. Lead-free bi-metal bearings are now the norm in light engines; since January 2022, the EU has also restricted the use of lead in heavy engines.

To understand why this presents a challenge, it is necessary to discuss the coatings applied to the sand cores used for casting an engine's complex inner geometries. These coatings protect the core from the superheated molten metal and facilitate knock-out after casting. They also help to reduce the number

of particles remaining in those parts of the engines that are inaccessible to post-casting cleaning, although the coatings themselves may leave a ceramic residue on the surface of the casting.

These residual particles pose a problem because cast engine component surfaces are never completely smooth: there will always be some indentation or pitting of the surface. Residual particles can thus become caught in these indentations and are impossible to remove with current cleaning methods (e.g., shot blasting).

Now picture the engine running: fuel combustion causes dynamic loading onto the bearing of the crank shaft, resulting in vibration. Over the lifetime of the engine, this vibration will shake loose those casting residues. Moreover, from each particle that is shaken loose, vibration and friction will cause multiple new particles to be generated – all small enough to bypass filters.

Lead's lubricating properties protected the bearings against wear by these particles. In bearings that do not contain lead, however, that protection is removed, raising the risk of bearing damage. To counter this, the latest generation of SEMCO IC coating from Foseco is formulated so that any ceramic residue left on the casting is softer than the bearing.

This effectively eliminates the risk that coating residues will damage the bearings when the engine is running. The benefit is longer engine service intervals and improved engine reliability: key factors for any engine operator, but particularly so when the engine is used in applications that take it considerable distances from service facilities, such as in marine environments.



LOWERING CARBON EMISSIONS

In addition to supporting engine makers transition from lead-containing bearings, the new generation of SEMCO IC coatings also helps reduce carbon emissions generated during the casting process.

During pouring, carbonaceous materials in the coating combust and are released as carbon monoxide or carbon dioxide. The latest SEMCO IC formulation has been engineered to reduce the carbon content of the coating by replacing it with other minerals, and thus reduce the potential for carbon-based gas emissions.

COATINGS FOR INNER CLEANLINESS

SEMCO IC coatings continue to improve overall inner cleanliness of the casting, with one customer going as far to give SEMCO IC the 'new world record in terms of the super-low quantity of particles found after casting'. This not only ensures a cleaner casting is supplied to the engine manufacturer, but also has important benefits for the operating life of the engine, as particles remaining after casting will accumulate in the oil and coolant system.

SEMCO IC coatings therefore reduce the lifetime contamination of oil and coolant, extending engine service intervals, while improving engine performance (a properly cooled and lubricated engine runs more efficiently than an engine with blocked channels), and reducing the overall amount of oil and lubricant consumed by the engine.

Moreover, SEMCO IC coatings lower the occurrence of scabbing and veining defects, reducing the need for post-casting cleaning (lowering foundry production costs and reducing re-work), and creating the option to cast thinner engine geometries without facing casting problems.

CONCLUSIONS

As the demands of engine manufacturers and regulators become increasingly tighter, SEMCO IC coatings offer substantial benefits to the foundry when it comes to inner cleanliness and the need to eliminate the use of lead in bearings and bushings.

They are however just one weapon in the Foseco clean casting arsenal. From linings and slag coagulants to ensure a clean melt; filters, stoppers and nozzles for a clean pour; or coatings to minimize surface defects – Foseco's range of solutions supports foundries in their continuing quest to cast cleaner, improve yield and control costs.



Three properties underpin SEMCO IC performance:¹

- **Coating flake formation:** SEMCO IC has been engineered to form strong, well-defined ceramic flakes that readily detach from the surface of the casting and act as a carrier for other debris during knock-out. This helps to improve cleaning of the casting, even in the most inaccessible of areas.
- **Improved gas permeability:** during casting gas is released in the sand mould as the binder combusts. Without a sufficient degree of permeability to let that gas through, pressure will build up behind the coating and may result in premature flaking, scabbing defects and scrap. SEMCO IC offers better gas permeability than conventional coatings and thus improved resistance to scabbing.
- **Anti-veining:** standard vein block testing, comparing SEMCO IC with conventional coating products, has demonstrated SEMCO IC has higher resistance to vein formation, reducing the need for fettling.

REFERENCES

¹ For more detailed discussion of the properties of SEMCO IC, see Genzler, C., 'Coating for Improved Inner Cleanliness', Foundry Practice No. 269, pp. 3-10.

ABOUT THE AUTHOR

Christoph has worked in the foundry supply industry for 34 years and is currently European Product Manager Coatings. In this role he is responsible for helping customers find the most suitable coating products for their application, raw material selection and approval, best practice transfer and marketing of coatings. Christoph enjoys interacting with customers, talking to different people, meeting different cultures and last but not least... solving problems. In his spare time he likes to ride his motorcycle or bicycle.

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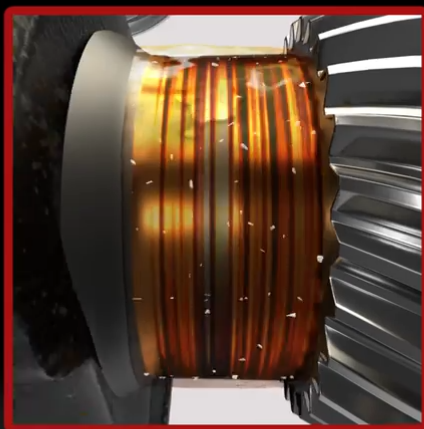


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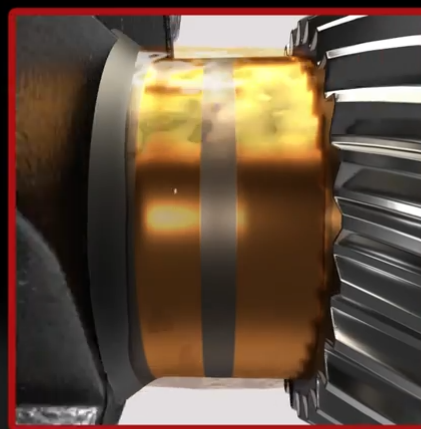
WATCH ANIMATION

Engine manufactured with conventional coatings



Scratches in bearing shell

Through the use of SEMCO IC coatings



Reduced remaining particulates by >50%



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