# Technical Brief

# Uneven Wear in Marine Slow-Speed 2-Stroke Engines

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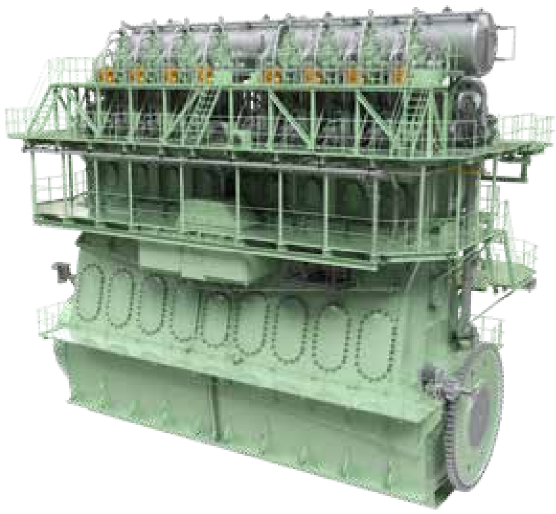
*Uneven liner wear remains a persistent challenge for marine slow-speed 2-stroke engines — the backbone of global shipping. This issue reduces engine efficiency, increases maintenance costs, and can lead to liner damage. This technical brief explores common contributing factors and mitigation strategies, drawing on real-world insights from Gulf Marine's Cylinder Oil Optimization Program, including a case study where excessive liner wear in one cylinder was traced to an undersized lubricator piston (an uncommon cause of excessive liner wear). This case, as well as many others, underscores the importance of precise lubrication management and continuous monitoring in preventing uneven liner wear.*

## Understanding Uneven Liner Wear

Uneven liner wear occurs due to various mechanical and operational influences. When wear rates differ across cylinders, it leads to performance inconsistencies, potential engine failures, and increased operational expenses. The primary mechanisms responsible for liner wear include adhesive wear caused by insufficient lubrication or due to excessive deposit build up on the piston crown, abrasive wear from hard particles in fuel like cat fines (catalytic fines), corrosive wear due to acidic condensation – commonly known as cold corrosion, and erosive wear linked to high-pressure airflow or improper combustion dynamics. Each of these factors can contribute to an accelerated and non-uniform wear pattern across the cylinder liners.



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### Commonly Discussed Contributing Factors to Uneven Wear

Several commonly discussed factors influence uneven wear in marine slow-speed 2-stroke engines.

- Poor fuel atomisation in injectors and inconsistent fuel quality, leading to carbon deposits and liner wear.
- Blocked cooling water passages or reduced flow rates to certain cylinders, causing overheating and wear.
- Prolonged low-load operation, resulting in inadequate sealing and accelerated wear.
- Worn piston rings causing blow-by, which increases liner wear.
- Uneven cylinder lubrication due to clogged nozzles or malfunctioning lubricator pumps.
- Cat fines unevenly distributed among cylinders, accelerating wear.
- Variations in air cooler efficiency, affecting thermal balance and wear patterns.

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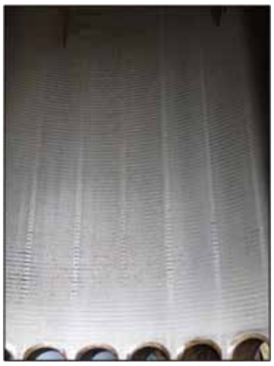
## Case Study:
## Inadequate Cylinder Oil Supply Due to Undersized Lubricator Piston

An instance from Gulf Marine's Cylinder Oil Optimisation Program involved an engine fitted with a scrubber system and operating on High Sulphur Fuel Oil (HSFO). The issue was initially detected when elevated iron content was repeatedly observed in Scrape Down Analysis (SDA) results for Unit #2. Further visual scavenge space inspection revealed abnormal liner wear patterns, with cold corrosion considered a likely cause of the increased iron levels.

During the process of fine-tuning the cylinder oil feed rate, it was also noted that Unit #2's cylinder oil consumption was lower than expected under the Monitoring Operating Program (MOP) compared to other units. A thorough inspection confirmed the absence of external leakages, prompting a detailed investigation. It was subsequently discovered that the lubricator piston for Unit #2 was 0.4 mm smaller in diameter than specified in the SPAF file and compared to other units. With the stroke length unchanged, this reduction in piston diameter resulted in decreased oil delivery per stroke.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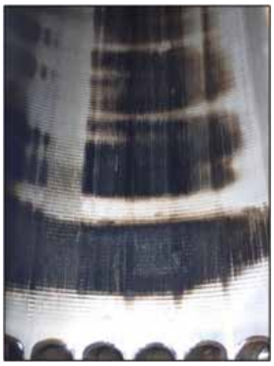
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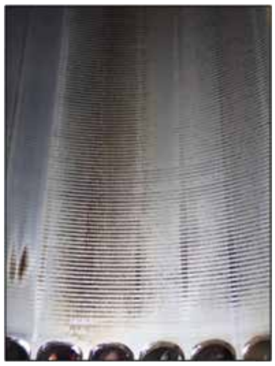
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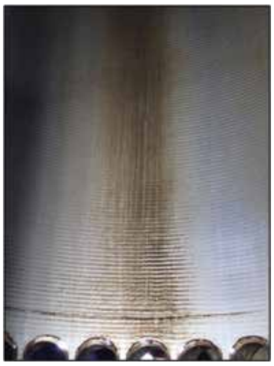
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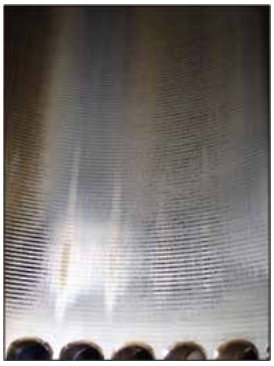
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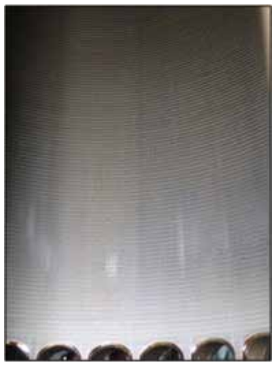
*Unit #6*

The insufficient cylinder oil supply, combined with HSFO operation, limited the neutralisation of acidic condensates and accelerated cold corrosion on the liner surface.

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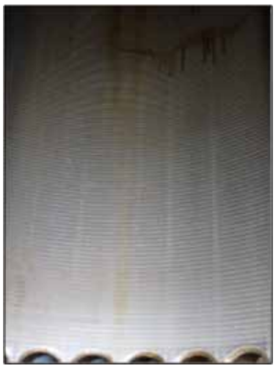
## Corrective Action

To address the issue, the cylinder oil feed rate factor (FRF) for this unit was adjusted to compensate for the reduced oil delivery. The lubricator piston was subsequently replaced with the correct size, conforming to the engine maker's specifications. Follow-up monitoring confirmed a reduction in iron wear levels, with normal visual condition (as shown below), highlighting the importance of vigilant lubrication management.



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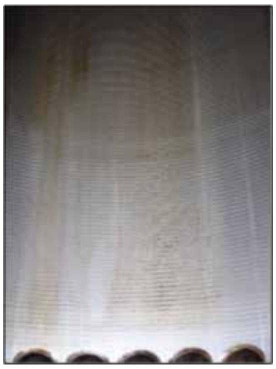

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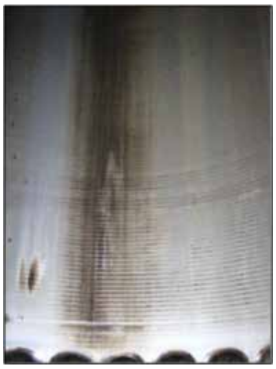

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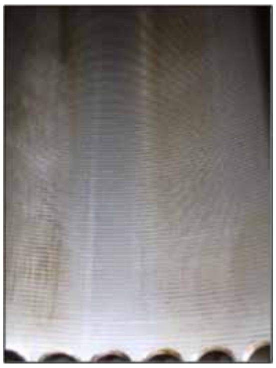

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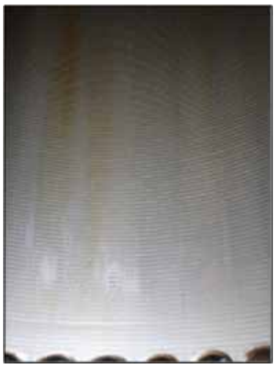

*Unit #6*

### Engineering Best Practices for Preventing Uneven Wear

To detect and prevent excessive and uneven liner wear, our recommendation is to implement regular scavenge inspections along with routine SDA sample analysis to identify abnormal wear trends at an early stage. Since fuel plays a pivotal role, maintaining fuel quality is essential for ensuring smooth operation. Routine inspections and audits of engine spares help ensure compliance with OEM specifications and prevent potential liner damage.

### Conclusion

This case study demonstrates the relevance of lubrication strategies, condition monitoring, and adherence to engineering practices in managing uneven liner wear. Using diagnostic insights and appropriate corrective actions can contribute to improved engine reliability, extended component service life, and optimised operational efficiency. Gulf Marine continues to provide lubrication solutions and monitoring systems designed to support our customers in maintaining engine performance.

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