

Technical Brief

Developing a CAT II 40BN Cylinder Oil

[Published in Jun 2022]

*Gulf Oil Marine is the first marine lubricant manufacturer to obtain the MAN No-Objection Letter (NOL) for the CAT II BN 40 cylinder oil. This brief documents the journey toward the development of our CAT II product - **GulfSea Cylcare XP 5040X**.*

Why CAT II Was Needed

Over the years, improvements that were made to engine designs to drive higher fuel-efficiencies, also required the vessel engines to operate well under much harsher conditions: higher pressures and higher temperatures.

In May 2020, MAN ES shared their service letter to introduce higher performance requirements for marine lubricants: CAT II marine lubricants. CAT II lubricants essentially are lubricants with very strong detergency and dispersancy performances, and cleanliness standards equivalent to those found in the MAN-approved 100BN cylinder oils.

However, in 2020, when CAT II was introduced, there wasn't any BN40 cylinder oil in the market that met the CAT II requirements. In fact, it was not until Aug 2021, that the first BN40 cylinder oil was approved by MAN – that product was Gulf Oil Marine's **GulfSea Cylcare XP 5040X**.



MAN Energy Solutions is constantly working on improving the engine design. Highly fuel-efficient engines with higher pressures and higher temperatures require lubricants with matching performance. We are therefore introducing a new strategy that aims at raising the cylinder oil performance.

The cylinder oils are divided into two categories (Cat. I and Cat. II), of which Cat. II is the overall higher performing category.

MAN Energy Solutions
Service Letter SL2020-694/JUSV

Having a 40BN CAT II cylinder oil was critical as many ship operators had switched to using LSFO bunkers to comply with the IMO 2020 emissions requirements. A CAT II marine lubricant with very high BN (for instance, 100BN) may not be suitable for sustained use on a vessel on VLSFO operations as there could potentially be problems due to excessive alkalinity in the cylinder system and other systems (e.g., the SCR, CRS systems).

Getting the Formulation Right

When Gulf Oil Marine started developing the product in 2019, there wasn't a suitable existing BN40 product formulation from which we could make adjustments to get the lubrication technology right. The formulation had to be worked from ground zero.

And indeed, it proved to be difficult to make a 40 BN cylinder lubricant with equivalent cleanliness performance as a 100 BN oil. The embedded technology was especially challenging because the lubrication solution needed to be effective, with the right balance vis a vis cost effectiveness.

There were many trial and errors along the way and the process was arduous: running many tests in labs and on vessels.

Difficulties

The difficulties started with determining the "right" product formulation: the critical part was to figure out how to arrive at a formulation that will work well in a real-world environment purely from the various lab / bench test results. Long experiences have shown that on-shore tests do not replicate very well the actual operational conditions at sea.

Indeed, it was not easy to determine the right formulation. Admittedly, our earliest formulation could not clear the NOL trial. While it was a very severe let-down, it turned out to be a good lesson (albeit a very expensive one).



The Ship Trials

Challenges Came Early

The actual trials themselves presented different sets of challenges. The planning for the trial started 6 months before; it was a tedious process in choosing the right vessel candidate. And this was exacerbated by the Covid-19 pandemic restrictions. The team needed to be on the vessel to work on the required tankage / piping modifications for running the trials.

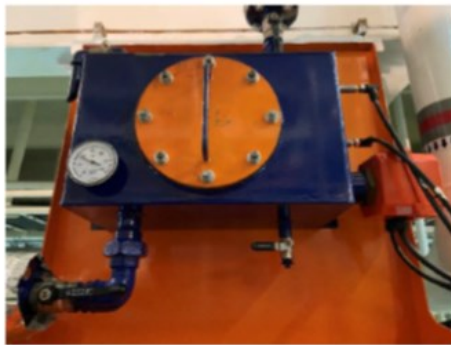
There were also challenges in getting the engine spare parts due to the pandemic. Nonetheless, the spare parts were secured and the necessary works were finally completed to enable the start-of-trial.

Upon finally getting ready for the trial to commence, Irwan Jaafar, Gulf Oil Marine's Global Technology and Product Development Manager who had to clear hurdles after hurdles, could only muse, "If it is man-made, nothing is impossible".

*"If it is man-made,
nothing is impossible"*

*Irwan Jaafar
Technical and Product Development Manager
Gulf Oil Marine*

1



New Heater Tank Installed with platform, ladder and railings

2



Touch Screen Distribution Panel

3



New Transfer Pump Installed

4



3-way valve from Storage Tank #1

5



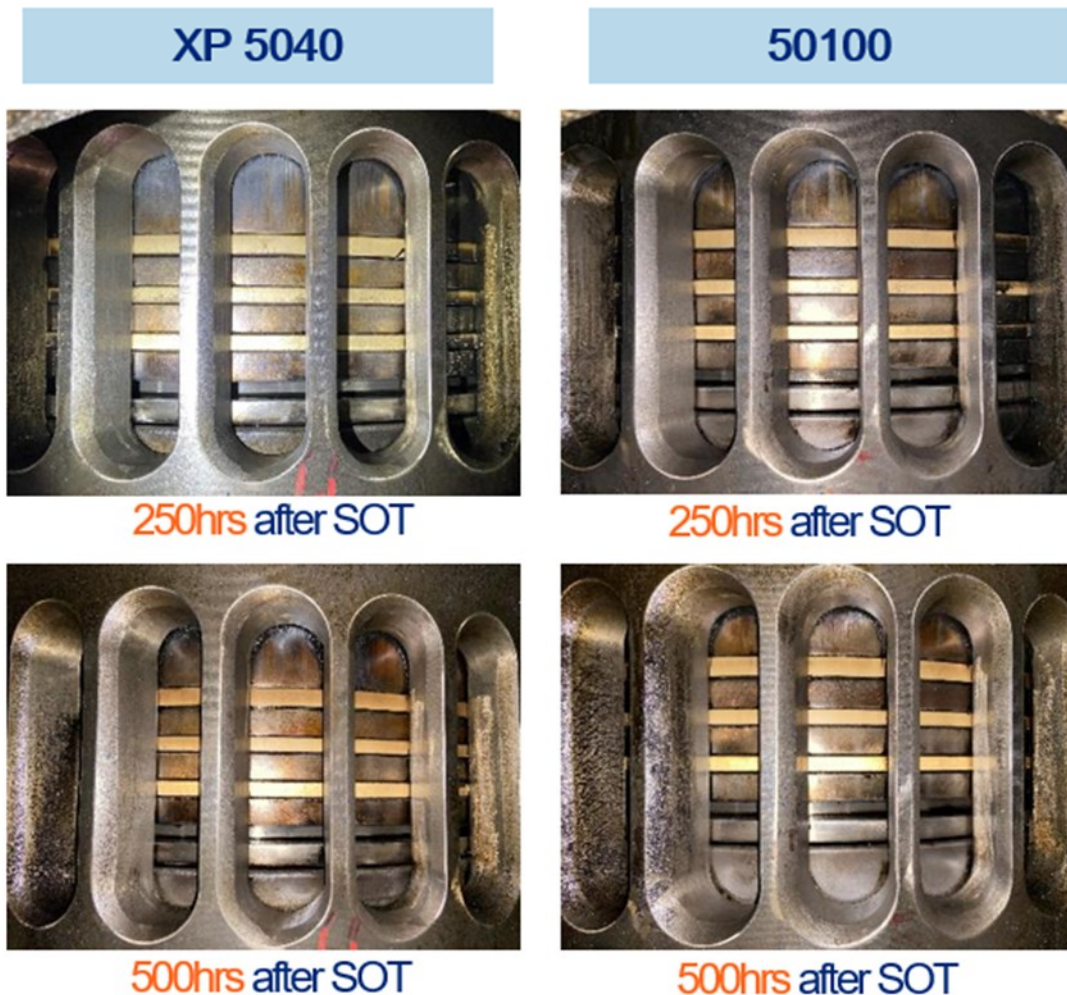
New Strainer / Filter installed

The Ship Trials

Trial Began; Regular Performance Assessments

The ship trial required at least 2000 test-hours. After the start-of-trial (SOT), regular assessment of the performance of the BN40 cylinder oil was performed. In fact, the team evaluated the test product performance over 4 occasions: a) 250 test-hours, b) 500 test-hours; c) 1250 test-hours; and d) 1750 test-hours.

The following photos provide a good overall picture of how the test product performed relative to a 100BN Cat II cylinder oil, over the various test-hours (after the SOT).



Continued on next page

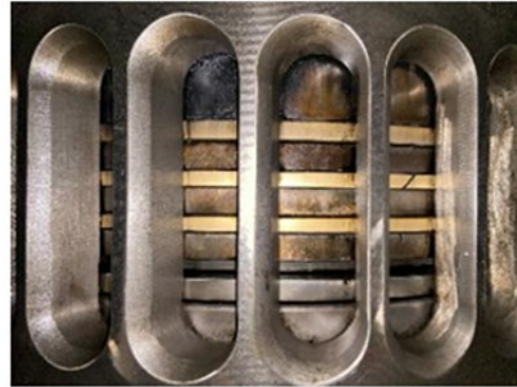
The Ship Trials

XP 5040



1,250hrs after SOT

50100



1,250hrs after SOT



1,750hrs after SOT



1,750hrs after SOT

Trial Successes

Completion of Development Journey

After the success of the ship trial, Gulf Oil Marine obtained the MAN ES NOL. The product subsequently went through a confirmation test which, similar to the ship trial, also required at least 2000 test-hours. Like in the trial, the product demonstrated strong performance. Hence, it successfully completed the confirmation test.

Indeed, after a combined time span of slightly more than 2 years, Gulf Oil Marine was able to effectively develop a product that's OEM-approved and fit-for-use: **GulfSea Cylcare XP 5040X**

Many Thanks to Our Partners

Gulf Oil Marine's trial successes would certainly not be possible without the support and cooperation of its partners.

Particularly, our shipping operator partner, Eastaway Ship Management who provided us with top-notch vessel crew who knew their operations very well and were able to share with us critical operational insights. Our partner also gave us regular access to their vessels for us to take measurements for our assessments.



Irwan Jaafar and his team member, on-board the trial ship for the product performance assessments

“

We are proud to have worked with **Gulf Oil Marine** and MAN ES on these trials and are pleased that we are able to play our roles as vessel operators to help with the overall push to improve the performance of cylinder oils.

”

*Pawanpreet Singh
Deputy General Manager
Eastaway Ship Management Pte Ltd*

Eastaway

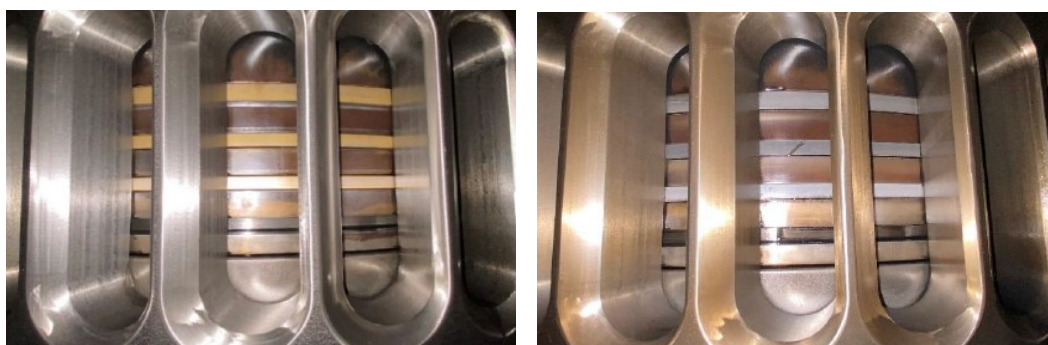
Our CAT II Product Demonstrated Very Strong Performance

Outstanding Cleanliness

With the success of the main trial and the confirmation trial, GulfSea Cylcare XP 5040X has demonstrated outstanding piston cleanliness on two different engine models – MAN Mark 9.2 and Mark 9.5 – both running on very-low sulphur fuels.



Superior Cleanliness: Deposit-free in front as well as at the back of the piston rings



GulfSea Cylcare XP 5040X has an innovative dispersant technology that's combined with non-alkaline detergents, anti-oxidant and wear-protection chemistries; these technologies underpin its superior deposit-control performance, leading to significant wear-rate improvements versus regular BN40 products and hence helping to extend engine component life.

Our CAT II Product Demonstrated Very Strong Performance

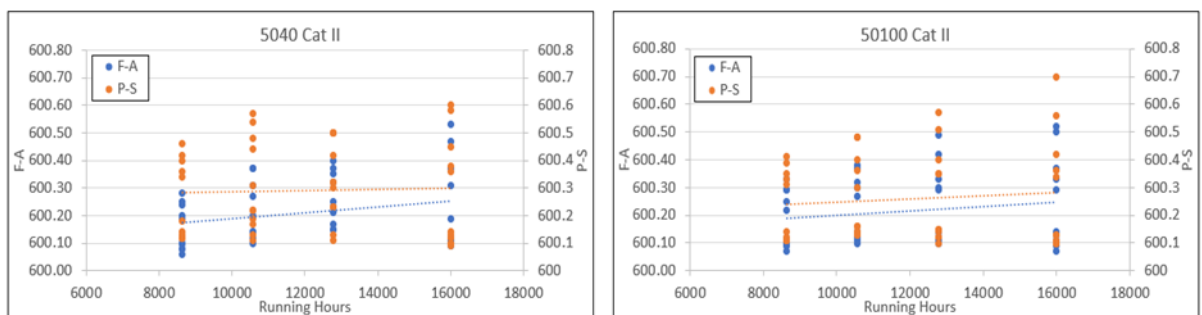
Superior Wear-Performance

The charts show the wear-measurements on the 4 radial points of the cylinders across the various running hours, as well as the estimated trend-lines. The measurements and trend lines are shown for the two different products: the CAT II 40BN and the CAT II BN100 cylinder oils (which was the reference oil in the trial), in the lower left and lower right charts respectively.

The summary table (top chart), shows that the product is assessed to be able to achieve

Liner Wear Rate Comparisons

Product	Wear Rate (mm/1000hrs)
Classic BN40	0.05
Cat II BN40	0.03
Reference BN100	0.04



* Data collected from trial vessels

a 40% improvement in wear-rate performance relative to the classic BN40 product.

Cost Savings for Operators

With industry best practice and sound vessel operations, the use of GulfSea Cylcare XP 5040X is expected to significantly extend cylinder liner life. with both piston ring wear and unplanned breakage greatly reduced.

This performance improvement has huge cost-saving potential for ship operators and owners, as the time between piston overhauls is likely to be increased with a reduction in unplanned piston ring replacement. Certainly, with the reduced frequency of liner changes, there will also be less vessel down-time.

GulfSea Cylcare XP 5040X

Suitable for Different Fuel Operations

As a result of its strong cleanliness performance, the CAT II 40BN cylinder oil is also suitable for various other bunker operations, particularly in cases where there is no need for high BN.

Besides VLSFO, the CAT II 40BN cylinder oil is also recommended for:

1. LNG / LPG
2. Dual-fuel engines
3. A number of future low-carbon fuels endorsed for use by MAN ES (such as, methanol, etc.)

While ostensibly the development of this CATII 40BN cylinder oil was deliver a product that meets the stringent CAT II performance criteria set by MAN ES, Gulf Oil Marine believes that, in a broader sense, this development process has enabled and adequately prepared us for the continuous journey ahead where the environmental requirements (whether in terms of NOX or CO2) will get far more onerous.

— END—