The role of Mini Rotary Viscometer (MRV) testing in assessing engine oil performance

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The Mini Rotary Viscometer (MRV) test is one of the critical cold-temperature tests in SAE J300 that measures the low temperature low-shear-rate viscosity of an engine oil by simulating cold weather starting conditions. This demonstrates the ability of the oil to protect the engine in low temperatures by determining how well the oil flows to critical engine parts during start-up and in use.

The test achieves this by cooling the oil over an extended period to encourage the formation of any wax in the lubricant to crystalise which could form a gel preventing oil reaching the pump and starving the engine of vital protection.

Engine lubricants which perform poorly during the MRV test may result in severe damage to the engine in field conditions such as engine oil pump failure, wear during the startup phases and long-term damage. Selecting the right pour point depressant (ppd), viscosity index improver (VII) and base oils combination is part of the lubricant developer's tools to limit these risks. The wax content of base oil and polymer is mitigated by choosing the correct ppd at the optimal treat rate, matched to the specific properties of the base oil, VII and additive technology.

In addition to the Cold Cracking Simulator (CCS) test, the MRV (ASTM D4684) test has been developed by the American Society for Testing Materials to simulate the extreme cold conditions where the automotive lubricant should flow in the engine.

This test helps the Original Equipment Manufacturers (OEM) to guarantee the lubricant behavior in the engine sump during cold start, in conditions when temperatures drop below freezing.

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The Society of Automobile Engineers (SAE) J300 set the required test limits to qualify both multigrade as well as monograde lubricants.

The Technical Association of the European Lubricants Industry (ATIEL) have delegated their product compliance monitoring program to Services to Associations and Industry in the Lubricants sector (SAIL) to evaluate lubricant performance as part of the European Engine Lubricant Quality Management System (EELQMS). To ensure that lubricants marketed with ACEA engine oil sequence claims meet the required performance standards, SAIL surveys lubricant samples from the marketplace and runs chemical and physical tests in independent laboratories to ensure compliance.

If any sample fails to meet the ACEA sequences, SAIL issues a report to the marketer, inviting them to comment on the findings. The marketer is then required to outline corrective actions to address the non-compliance.

In 2024, SAIL managed over 3,100 individual tests as part of the compliance program. These efforts help to maintain high-quality standards in the lubricants market and provide consumers

with confidence in the products they use. SAIL's compliance monitoring program has identified that the rate of MRV non-compliance has doubled in the period from 2020 to 2024.

The correct pour point depressant (ppd) at the correct level is essential to avoid cold temperature engine failures. Although ppd interchange is permitted within the ATIEL Code of Practice, it is essential that any ppd substitution is supported by passing ASTM 4684 MRV and yield stress data. Unsupported base oil interchange is likely to affect the balance of key component interaction which may lead to sub-optimal protection in cold temperatures.

Base oil and Viscosity Index Improver (VII) interchange guidelines developed by ATIEL are clearly defined in the Code of Practice. Interchange between base oils from different manufacturers and VII are only permitted if supported by a Base Oil Interchange (BOI) or a Viscosity Modifier Interchange (VMI) program.

If in doubt please consult your reputable technology provider.

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