

Base Number and Sulfur Content in Today's Heavy Duty Engine Oils



The role in monitoring base number in today's engine design requirements and modern API oil formulations has changed.

Base number has historically been an indicator of used diesel engine service life. With the current API engine oil formulations, base number has continued to take on less relevancy for monitoring diesel engine oil service life. This is due to the advent of lower sulfur fuels and engine oils, which has reduced the need for high base number oils.

Today's engine oil formulations are engineered to provide extended service life and because of this monitoring oil oxidation and degradation related extended service life has become an increasing focus.

Current API diesel engine classification are represented by API CK-4 and API FA-4.

API CK-4 oils provide better emission control system durability where particulate filters and other advanced after treatment systems are used. These formulations provide enhanced protection against oil oxidation, wear and particulate and deposits control.

API FA-4 is formulated for certain XW-30 oils for use in select high-speed four-stroke cycle diesel engines designed to meet on-highway greenhouse gas (GHG) emission standards.

Base number is still needed in diesel engine oils to neutralize acids that form. The metal organic additives which contribute to alkalinity reserve in the form of base number also provide important detergency properties to the engine oil. These are most commonly represented by the calcium and magnesium containing additives.

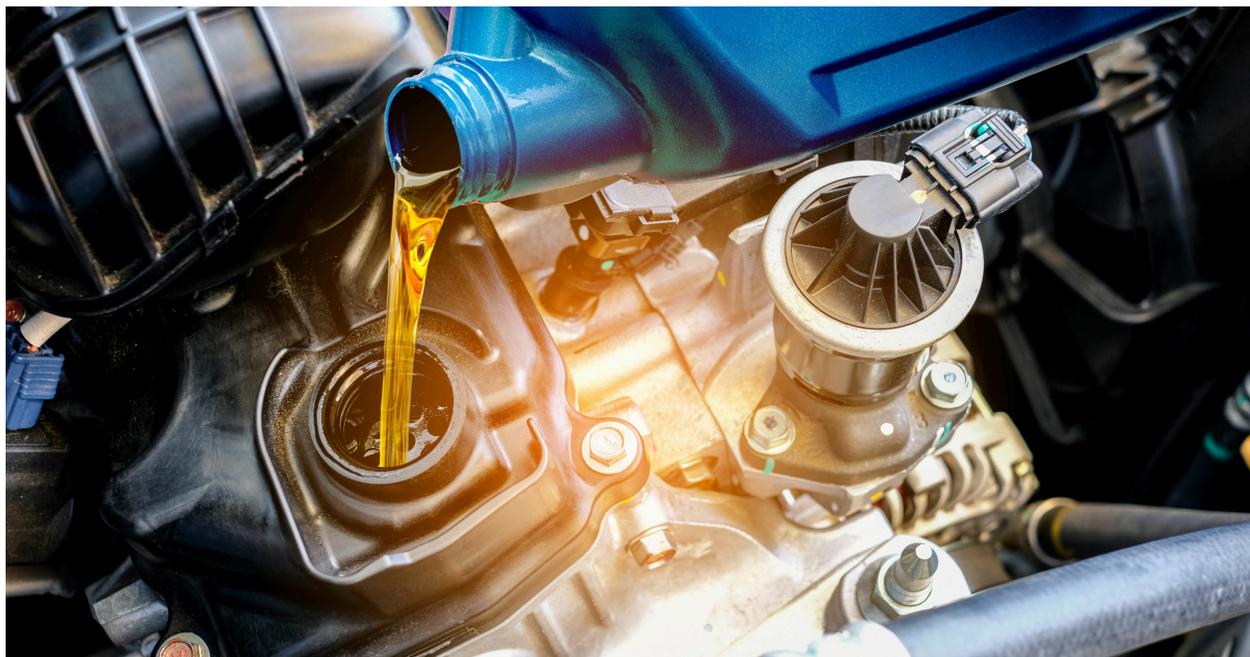
Even though the base number starts out lower in today's engines, oil base number retention is actually better in today's API diesel engine oil classifications. There is still some level of sulfur present, which can create corrosive sulfuric acid. And due to exhaust gas recirculation, NOX compounds react and form a weaker nitric acid back into the oil. But the general rule used in years past of 50% reduction no longer has any real relevancy and the base number can go to very low levels while in service and not be a great concern. The level of base alkalinity is adequate to combat the level of acid creation in today's diesel engine oils, even when the base number gets to low levels during service.

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As base number takes on a less important role for monitoring engine oil service life, the role of testing for acid number, oxidation, and even nitration in monitoring service life has taken on more relevancy. With less concern about neutralization of highly corrosive acids that depletes engine oil protection, better means to look at truer indicators of drain intervals and service life has become a discussion point in recent years.

Many of the additives historically used in diesel engine oil formulations are still in use, only their proportions have changed to meet today's performance requirements.

As noted, calcium and magnesium in today's diesel engine oils are reduced due to lower base number requirements while antioxidants have increased to provide better oxidation resistance for extended drainage.

Phosphorus and general ash content from alkaline additives have lowered to reduce deposit formation and coating of EGR activation sites. This also provides an added benefit of reducing deposits in the engine piston crown.

Sulfur has decreased to lower sulfates, which contributes to accumulation of particulate deposits on engine surfaces and particulate emissions. Though sulfur content is lower, sulfur cannot be completely eliminated in today's diesel engine oil formulations. Sulfur still plays a role as an antioxidant and provides enhanced lubricity properties.

In summary, the relevancy of monitoring base number in used diesel engine oil does not have the significance that it once had. Base number is still in use today as an indicator because it has always been around, and people are used to seeing these test results. There is still a need in some applications to monitor levels of alkalinity reserve.

Lubricant manufacturers are beginning to lean more towards looking at other tests that are more relevant to monitoring the true service life of diesel engine oils.

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