

## Base Number

Testing a lubricant's base number measures its alkaline reserve — or its ability to neutralize degradation acids. Although viscosity is most important, base number determines an oil's suitability for continued use and is critical to safely extending drain intervals. A decrease in base number is typically accompanied by an increase in oxidation, nitration and viscosity.

Sulfur from fuel and nitrogen from the air — when combined with water — form sulfuric and nitric acids that will attack engine metals causing wear that can eventually result in engine failure. To combat combustion byproduct acids, diesel engine oils contain acid neutralizing detergent additives — the most common being magnesium and calcium.

New diesel engine oils typically have a starting base number between 8 and 12. It is generally recommended that diesel engine oil be changed when the starting base number is 50% of the new oil. For example, an engine oil with a starting base number of 10 should be changed if the base number test result is less than 5.0 mg KOH/g.

## Acid Number

Engines fueled by natural gas, on the other hand, operate at higher temperatures than diesel engines requiring lubricating oils with lower ash content. Higher temperatures cause the metal sulfates in barium, magnesium, calcium and phosphorus-based additives to form engine deposits. These ash deposits then cause valves to stick reducing engine efficiency. In addition, excessive concentrations of ash can form in glassy deposits on natural gas engine exhaust catalysts reducing their ability to control harmful emissions.

Typical low ash natural gas engine oil has one third the amount of detergent and one fourth the amount of anti-wear additives as diesel engine oil which leaves them just as vulnerable as diesel engines to the degradation acids produced by combustion. Testing for acid content and monitoring the rate at which these acids form becomes the objective in determining a natural gas engine oil's suitability for continued use or safely extending drain intervals. An increase in acid number is typically accompanied by an increase in oxidation, nitration and viscosity.

The starting acid number of new oil is determined by the amount of acid present from additives. Typical new low ash or ashless natural gas engine oils have a starting acid number between 0.7 to 1.00 mg KOH/g. The general

recommendation is to change the oil when the acid number is four times the acid number of the new oil. For example, a natural gas engine oil with a starting acid number of 1.00 mg KOH/g should be changed when the acid number test result is 4.00 mg KOH/g or greater.

### **More About Total Base Number**

The two most common ASTM test methods for testing base number — ASTM D-2896 and ASTM D-4739. ASTM D-2896 measures both detergents and dispersants and is the preferred base number test method for new (unused) engine oils. ASTM D-4739 measures detergents and is the preferred base number test method for in-service engine oil. It is important to note the difference as it is possible for the detergents in an in-service oil to be depleted but the dispersants be intact. If this is the case, ASTM D-2896 results would not indicate that an oil change was necessary.

The base number test is performed by diluting the sample with a mixed solvent in a reaction beaker. While mixing, hydrochloric acid is titrated to chemically react with alkaline components (detergents) in the sample. When the end point of the chemical reaction is reached, the amount of titrant used is converted to the result and reported in milligrams of potassium hydroxide equivalent per gram of sample (mg of KOH/g).

### **More About Total Acid Number**

ASTM D-644 is the test method for monitoring the degradation acid content of inservice oil. The acid number test method is performed by diluting the sample with a mixed solvent in a reaction beaker. While mixing, potassium hydroxide is titrated to chemically react with acidic components in the sample. When the end point of the chemical reaction is reached, the amount of titrant used is reported in milligrams of potassium hydroxide equivalent per gram of sample (mg of KOH/g).