TECH

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ENGINE BEARING FUNDAMENTALS PART 10 "MOTOR OIL GRADING"

Have you ever wondered what all of the numbers and letters on an oil container mean? Markings like SAE 30 or SAE 10W40 and SF, SE/CC or CF-4. Hopefully the following discussion will help to explain oil grading and how it relates to lubricant performance.

Oils are graded in two ways by entirely separate standards-making bodies. First is the American Petroleum Institute, abbreviated API. Second is the Society of Automotive Engineers, abbreviated SAE. The API establishes grading based on an oil's ability to pass a series of standardized tests for things like rust and corrosion prevention, wear resistance, and prevention of sludge formation. The SAE has established a series of number ratings which indicate an oil's relative viscosity across a range of temperatures.

Since the SAE numbers are probably most familiar, we will talk about them first. Viscosity of an oil is a measurement of its resistance to flow. This characteristic determines to a certain degree how well an oil will lubricate and protect rubbing surfaces. A thick oil (high SAE number) will provide a thicker film or coating on moving parts. An oil which is too thick, however, may not flow rapidly enough at low temperature or on start up to reach wear surfaces quickly enough to prevent wear. A thick oil will also produce considerably greater resistance to cranking at low temperatures.

Oil viscosity is measured under controlled conditions in a laboratory using special test equipment The SAE has established a series of rating numbers which correspond to the ranges of viscosity from very thin or light oil (SAE 5) to very heavy or thick oil (SAE 50 or higher). One of the controlled conditions under which viscosity is measured is temperature. All oils get thinner as their temperature goes up. Some thin out faster than others, but they all thin out. An oil which has a single SAE number assigned has been measured and found to flow at the specified rate for that number when tested at 100 and 210 degrees F. Multi-grade oils, on the other hand are measured at 0 and 210 degrees F. The SAE number met by the oil at 0 degrees F is followed by the letter W, while that met at 210 degrees F is unlettered. An SAE 10W30 oil, for example, has a viscosity equivalent to SAE 10 when tested at 0 degrees F and is equivalent to SAE 30 at 210 degrees F. At temperatures between 0 and 210 degrees F such an oil will be somewhere between these viscosity ratings. Another way of looking at this is to say that multi grade oils do not thin out as rapidly as straight grade oils.

SAE number has absolutely nothing to do with any other characteristic of an oil other than its flow properties. Oils of the same SAE number rating may or may not have any additives.

Oil performance, relative to its intended purposes, is rated by an entirely different system known as the API service classification. A series of actual engine tests have been developed to test oils for various properties and their resistance to deterioration during use. The system for classifying oils, which is

presently in use, was first published in 1970. This system splits service classes in to two categories - one for spark ignition engines and one for Compression ignition engines (Diesels). The first letter of the classification tells which category the oil is classed in. For example, SA, SB, SC, etc., are service classes for oils used in sparked ignited engines. The second letter indicates the relative performance level of the oil within its category.

As new engines are developed, the demands on motor oils keep changing. Oils formulated for engines built in the 1960's are not adequate to meet the lubricating requirements of engines built in the 80's and 90's. To keep pace with engine demands, the petroleum industry has introduced new oil formulations with additives designed to combat wear, oxidation, rust, corrosion, foaming and a number of other effects detrimental to engine performance. When new oils are developed to meet higher levels of performance, a new service classification is created, generally by adding the next letter in sequence to the specific category. For example, SG followed SF, and CF followed CE. Service classifications SA through SE and CA through CC are now considered to be obsolete.

Classification SF came in to existence to meet the warranty requirements of gasoline engines starting with the 1980 model year. SG oils were introduced for 1989 models.

Diesel engine oils are categorized by engine type and operation rather than model year. Oils classed CD meet the requirements of certain naturally aspirated, turbocharged or supercharged diesel engines where highly effective control of wear and deposits is vital, or where a wide range of fuels including those with a high sulfur content is encountered. Oils classed as CD-II are for severe duty two-stroke diesel engine service. Oils with this classification also meet the CD category.

Service class CE was introduced in 1983 for certain turbocharged or supercharged heavy duty diesel engines operated under both low speed-high load and high speed-high load conditions. These oils must also meet the test requirements of classes CC and CD.

The most recent diesel oil classification is CF-4. This classification is based on the needs of diesel engines which must meet the 1991 emissions standards. These oils must meet test standards requiring lower oil consumption and reduced top ring land deposits.

In addition to the individual service classifications described above, there are now many oils which meet both S and C classifications. These are referred to as "cross graded" oils and will have service classifications such as SF/CC. This means that these oils may be used in both gasoline and diesel engines within the service limits specified.

All engine manufacturers give specific recommendations for both SAE viscosity grade and API service classification requirements for oils used in every engine they build. In most cases, the SAE viscosity recommendations will be based on ambient operating temperatures. Most automotive engines can operate over a wide range of ambient temperatures with either SAE 5W30 or 10W30. Most four stroke cycle diesel engine manufacturers recommend an SAE 15W40 viscosity grade, while Detroit Diesel generally recommends a straight grade SAE 40 for their two stroke cycle engines. Again, these recommendations may vary with ambient temperature.

The API service classification specified will depend on the model year in gasoline engines and on the type of service and EPA certification requirements for diesels.