Three primary factors are normally responsible for oil failure.

Oil that becomes too thin, too thick or too acidic has exceeded its useful life.

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Because they work to suspend contaminants and by-products of combustion, it is not uncommon for gasoline and diesel oils to become dark. It may be more noticeable in some applications. It does not mean the oil is failing or must be changed.

Fortunately, a number of different tools are available that measure motor oil's condition and its ability to continuously protect and perform its other key functions.

When motor oil exceeds its useful life or is impacted by a mechanical defect, it most commonly becomes too thin to separate metal parts, too thick to pump or too acidic for continued use.

Too Thin

When oil becomes too thin, it fails to provide the required oil film thickness to separate metal surfaces. Different engine designs require different starting oil thickness or viscosity. Viscosity at 100°C is one of the most highlighted oil properties and is a good indicator of adequate oil film thickness in an engine at operating temperature.

A number of things can cause engine oil to become too thin to protect engine parts. Excessive mechanical shear can thin oil to the point of causing issues with engine protection. As motor oil cycles through the engine, it is exposed to shear stress in the engine's upper end, piston walls and bearings that reduces its shear strength. Continuous exposure to these conditions causes oils built with inferior shear stability to thin excessively, leaving critical engine parts susceptible to metal-to-metal contact.

Fuel contamination of the oil sump is another major cause of excessively thin engine oil. Both gasoline and diesel fuel are thinner than engine oil and when mixed, the oil's viscosity, film thickness and ability to separate parts are significantly reduced. While a small amount of fuel dilution is relatively common and does not have a material impact on oil life, excessive fuel dilution in mechanically compromised equipment is much more harmful.

Too Thick

When it comes to oil, although it may seem like "the thicker, the better," oil that is too thick is just as detrimental as oil that is too thin. Excessively thick oil is the most commonly discussed oil failure and the subject of many big oil company marketing campaigns.

When oil becomes too thick to flow to engine parts, these areas are starved of oil, resulting in metal-to-metal contact that can lead to catastrophic engine damage. The precursor to sludge is oil that has become much thicker than its original design. The cause is a complex chemical reaction involving heat, combustion by-products and oxygen combining to create chemical attack on the oil molecules. The resulting chemical reaction creates a much thicker substance that does not flow or protect as well as the original oil. When the reaction continues, sludge begins to form in areas of higher localized temperature and low flow. While some varnish is normal, sludge is a sign of excessively degraded oil that needs to be replaced. In order to inhibit sludge and varnish, the oil must resist attack by oxidation forces. Synthetic base oils have a much higher level of saturated molecules that inherently resist this constant bombardment. Additionally, antioxidants are added to either reduce the formation of free-radical oxidation precursors or soak up these precursors once they form.

Another cause of oil thickening, primarily affecting diesel oils, is excessive soot-loading in mechanically unsound engines. Diesel oils are designed to handle some soot contamination, but when the soot overloads the available dispersants in the oil, the oil thickens. The agglomerated soot particles reach a critical size and cause excessive wear commonly seen in diesel liners.

Too Acidic

Acids are a normal by-product of burning fossil fuels. Different fuel types, engines and combustion conditions create varying levels of acid formation. These acids, transferred via blow-by gases, are carried away to the engine oil. Oils are designed with a detergent that neutralizes these acids before they accumulate and cause engine damage. The detergent level is measured with a test called Total Base Number (TBN). This measure of alkalinity drops over the life of the oil and reaches a critical level when the oil can no longer consume the acids created by combustion. When TBN reaches a critical level, acids build up quickly and attack the surfaces most susceptible, including yellow metals and lead-lined bearings. Without correction, this condition quickly worsens and results in excessive chemical wear. Although less common, this failure mode can cause significant damage if left uncorrected.

AMSOIL synthetic motor oils are formulated to provide a broad level of overall protection, evidenced by guaranteed extended drain intervals. Synthetic base oils help resist oxidative decomposition, and a properly balanced, high-quality additive package helps keep contaminants in check and engines running for a long time. ■

There are four basic types of wear.

Fortunately, all four can be controlled with quality lubrication.

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In 2011, the average cost of a new vehicle increased to almost $30,000, and the average cost of gasoline rose to $3.52 per gallon, up from $2.78 per gallon in 2010 and $2.35 per gallon in 2009. Considering the sharp increase in the cost of ownership, it's no wonder people are hanging onto their vehicles longer than they have in the past. According to *Consumer Reports*, the average vehicle age in 2008 was five years; today, the average age of vehicles on the road is nine years. As more people look to keep their vehicles longer, more of them learn that, without proper maintenance, vehicles might not last as long as they'd like. It is up to drivers to protect their investments.

There is little more detrimental to your vehicle's engine than wear, and lubricating oils are your first line of defense. Numerous factors contribute to engine wear, but all can be categorized as one of the following four basic wear mechanisms: abrasive, corrosive, adhesive and fatigue.

Abrasive wear is caused by foreign particles entering the engine, most commonly soot and dirt. Once inside the engine these particles become trapped between moving parts – the piston and cylinder, for example – and grind against their metal surfaces. Wear particles act as sandpaper, continuously rubbing and wearing away metal surfaces by rupturing the oil film separating moving engine parts, resulting in particle-to-metal contact. This contact creates friction and reduces energy efficiency.

Abrasive wear commonly occurs when dirt or other contaminants enter the engine through the air intake system. These contaminants cause excessive wear on rings, pistons and cylinders. Increased cylinder and ring wear can cause blow-by, which decreases compression and causes loss of power. An efficient filtration system can help prevent abrasive wear by blocking contaminants that would otherwise enter the oil sump and find their way into the system.

Corrosive wear is the result of rubbing action on a metal surface in conjunction with chemical attack. Combustion byproducts introduce acids into the oil sump. If unaddressed, these acids can build up in the system and oxidize or corrode the surface of sensitive areas, including lead- and copper-lined bearings and other soft yellow-metal surfaces. As the surfaces begin to corrode, pieces of oxidized metal break free and become wear particles in the system.

The most commonly recognized mechanism is adhesive wear, which occurs when metal surfaces come in contact under conditions of high load, speed or temperature. Surface irregularities, called asperities, touch and weld momentarily, then break off as the surfaces separate. The load applied to the two points of contact is so high that they bend and adhere to one another. Rough metal surfaces with larger microscopic hills and valleys are more susceptible to this type of wear. Adhesive wear can result in scuffing, scoring or seizure.

Fatigue wear originates from situations where the lubricating film is in place, but recurring stress like vibration or shock-loading causes cracks or pits over time. This is a common type of wear found in equipment that frequently starts and stops or changes speeds. Fatigue wear can develop in rolling element bearings as they pass over a stressed area repeatedly and, ultimately, develop cracks that release small bits of metal over time, leaving holes or pits in the surface. These holes or pits grow and connect, resulting in large losses of surface metal and catastrophic damage.

Regardless of equipment type, bearings, gears and cylinders are susceptible to wear, and thus require high-quality lubricant protection. Choosing the proper viscosity for your oil will aid in wear protection by reducing the likelihood of metal-to-metal contact. A full-synthetic base oil provides a naturally higher viscosity index for improved shear stability, again helping to reduce wear by maintaining proper viscosity. Oil film strength is also a key wear-protection property. Adequate film strength provides a lubricant barrier between moving parts, ensuring friction is greatly reduced.

AMSOIL Dealers' ability to identify the symptoms of each mechanism is important in order to diagnose both mechanical and lubrication issues. AMSOIL synthetic lubricants offer outstanding wear prevention to help vehicles last longer, which is something an increasing number of consumers are interested in. ■