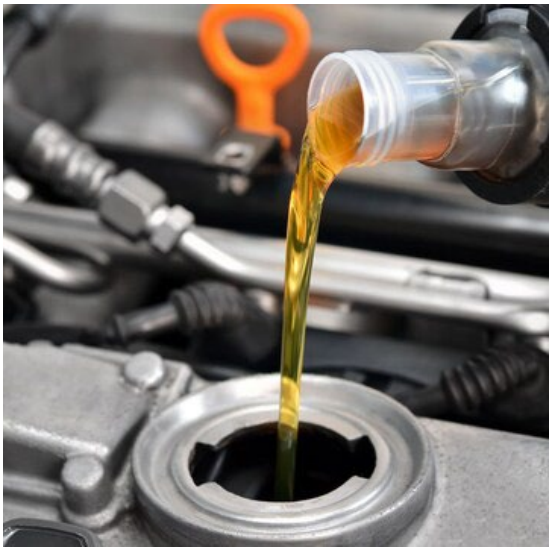
The Right Oil – Russel Walsh

To understand why mechanical equipment needs lubrication it is first necessary to understand friction.



Despite the appearance of smoothness every metallic surface has small peaks and valleys, when two of these surfaces rub together the peaks engage with one another and try to interlock creating resistance, this resistance is what we call friction. A substance to separate each of these surfaces is therefore needed. Failure to effectively do so will result in failure, often premature, of one or both surfaces. Consider what happens if lubrication to a crankshaft fails, both sets of bearings, the big-end and main, will quickly fail, often with catastrophic results.

Types of oil

There are two types of oil commonly available, mineral and synthetic.
Mineral oils are a direct derivative of crude oil but with additives included to improve performance.
Synthetic oils are based upon crude oil but are altered by the addition of complex chemical additives.

Properties

There are several properties that define how an oil performs and does its work.

Properties	Definition
Anti-wear	The ability of the oil to protect parts from wear and tear.
Detergent factor	Assists to keeping parts clean, preventing the build-up of unwanted deposits such as sludge.
Lubrication stability	The ability to reduce friction between moving parts.
Oxidation stability	The ability to resist oxidation, the reaction with oxygen, which can result in the formation of sludge and other unwanted and harmful deposits.
Strength	The strength to maintain its lubricating film when under high pressure.
Thermal stability	The ability to resist breaking down and maintain its lubricating properties at high and low operating temperatures.
Viscosity	The ability of the oil to flow
Viscosity index	The change in the viscosity due to changes in temperature.

Multi grade oils

To overcome the problem of variations in viscosity that resulted from the refining of crude oil, in 1911 the Society of Automotive Engineers (SAE) developed a standard test for measuring the viscosity of oil, Over time this test has evolved but the basic principle still applies. The original tests classified oil as SAE (number), the lower the number the lighter, and more viscous the oil. Example, a SAE 10 was a lot lighter and would flow more easily that a SAE 50 grade. Whilst a lighter oil would work fine in warmer conditions it would loose some of its ability to flow easily in colder conditions, particularly during engine start up. To counter this Viscosity Index improvers (VI) are added to the oil. These allowed the engine oil to remain relativity thin at low temperatures and provide good cold start lubrication whilst at higher temperatures it would remain thick. Example an SAE 10 would remain at this grade regardless of temperature, however the addition of a VI would give the oil a Viscosity of a SAE 30 oil at higher temperatures, it would become a SAE 10W-30 oil at lower temperatures (W) it have the viscosity characteristics of an SAE 10 oil but when warmer its viscosity would be similar to a SAE 30.
The American Petroleum Institute (API) have also developed standards to classify oil; these are based on the intended use of the oil and its performance properties.

Extreme pressure (EP) oils

Gear sets like those used in manual type gearboxes produce high pressure between the mating gears, see https://irtenz.org.nz/assets/Uploads/Technical-torque/Technical-Torque-17-Drive-axle-gears.pdf
The lubricant used in this type of gearbox must be able to withstand this pressure and maintain its important lubricating characteristics. Oils suitable for this type of use an EP oil that contains an additive to enhance its properties to help improve its adherence to metal surfaces thereby reducing the gear metal surfaces coming into to contact with each other whilst withstanding the pressure generated between the teeth.
Hypoid gears, including spiral bevel gears, also require an extreme pressure agent to be present in their oil, often this additive is more active than that found in regular EP oils.

Automatic transmission oils

Oils used in automatic transmissions require many of the same characteristics as oils used in manual transmissions but with some important additions, they:

1. Must be able to flow freely across all temperatures ranges throughout the transmission's components including gears and clutches, i.e. the oil must be viscously stable.
2. Must be able to withstand the elevated temperatures produced in an automatic transmission thus preventing oxidation, the formation of sludge and excessive thinning or thickening. This is the reason vehicles fitted with automatic transmissions commonly include an oil cooler.

3. Automatic transmission oil also acts as a hydraulic fluid transmission power and pressure within the gearbox assisting h operations such as gear shifting. It also includes additives such as detergent to assist in keeping the transmissions clean whilst absorbing moisture.

Automatic transmission oil is often used in power steering systems also.

Hydraulic oils

Oils designed for use in hydraulic systems, other than hydraulic brakes, have many of the same characteristics found in other oils, however, hydraulic oil also has its own specific requirements:

1. It must withstand compression. While most liquid substances will compress under extremely high-pressure, hydraulic oil must have a high resistance to reduce compressibility.
2. Hydraulic oil must have a high resistance to degradation due to absorption of oxygen, i.e. it must be resistant to both oxidation and foaming.
3. Hydraulic oil must be extremely thermally stable and resist breaking down under high operating temperatures. It must also resist the absorption of water that could cause rusting and corrosion of system components, cylinders, valves etc.
4. Must be compatible with any seals used to minimize or prevent oil leakage.

Manufacturer's specifications.

Manufacturers of vehicle components specify what oils are best for their products, these recommendations must be followed. Manufacturers of oil products will often state that their products are compatible with equipment manufacturers specifications, do not take their word for this, check with the equipment manufacturer first.