



Transmission lubricant transformed

While most engineers will be familiar with the viscosity grades and ACEA sequences for engine oils, transmission lubricants exist in a parallel universe where nothing is quite the same. Unsurprising really, as engine oils need to cope with the high temperatures and contaminants produced by combustion, while transmissions require varying properties depending on whether they are used in an (automated) manual gearbox (with or without synchromesh), an automatic transmission, or a drive axle.

Even the way in which viscosity is measured is different. The lower 'W' number on multigrade engine oils is determined by a cold cranking test simulating an engine start at winter temperatures, while the higher number denotes its viscosity at operating temperatures. By contrast, gear oil viscosity is measured after the oil has been held at temperatures of -40°C to -12°C (depending upon grade) for 16 hours by the Brookfield Test, which measures the torque required to shear the oil. Clive Webber, technical support chemist at Texaco Lubricants, explains: "Some otherwise acceptable gear oils could

Lubricants form a vital but sometimes ignored role in vehicle powertrains. Richard Simpson explains the latest developments

crystallise if exposed to prolonged cold temperatures, hence the 16-hour chill before testing."

While the ACEA sequences are now the accepted standard for engine oils in Europe, gear oils were covered by API (American Petroleum Institute) classifications of GL (gearbox lubricant) 1 to 5. But, for all practical purposes, standards GL 1 to 4 are obsolete now, and only a small range of GL 4 lubricants are available (the equipment to test to this standard no longer exists).

NOT ONE-SIZE-FITS-ALL

So, does that mean it's now a case of one lubricant fits all across a mixed fleet? Sadly, not. "It all starts to fall apart with individual manufacturers' manual transmissions," Webber admits. "Every OEM now writes their own spec, which includes both industry-standard tests and their own. For factory 'first fill' status, they also insist on field trials that can go on for years. One real issue is making the lubricant compatible with the manufacturer's

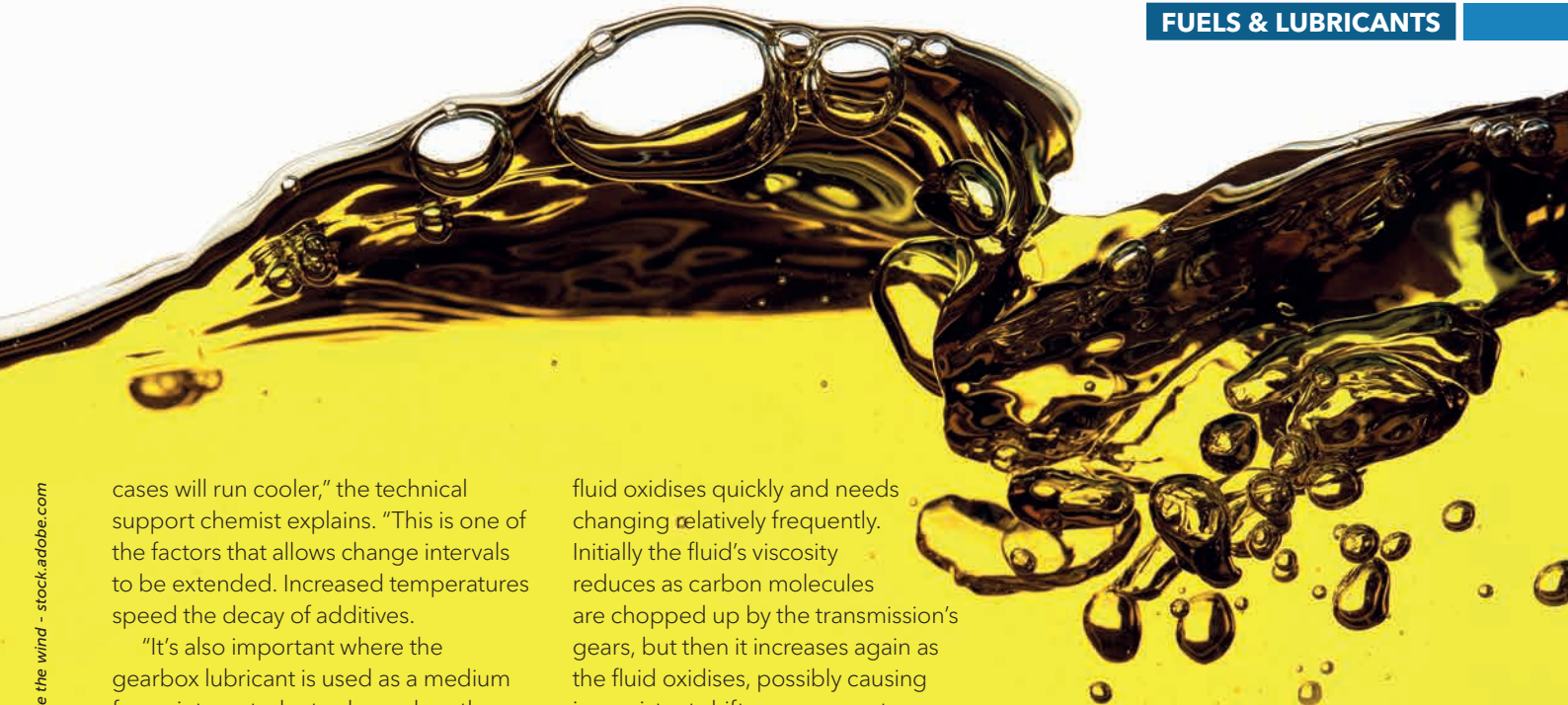
chosen synchroniser material: an oil that is too slippery or sticky can lead to problems with gear engagement and disengagement." Volvo and ZF, for instance, have three each: 97305/97307/97318, and TE-ML02B/02L/02E, respectively.

Compatibility is another factor, he adds. "Older mineral-based oils had a tendency to cause 'seal swell', so gearbox manufacturers specified a small amount of clearance into seal dimensions... Some still do, and for those manufacturers we use an additive specifically to cause seal swell. It's a mistake to assume an oil will be backwards compatible and suitable for older vehicles from the same manufacturer.

"Operators may find that different oils are recommended for the same vehicle, depending on the nature of its service and the change interval the customer is happy with. Vehicles operating in harsh conditions will need more frequent changes, and engineers will often try to synchronise transmission and engine oil changes. Typically, transmission oil change intervals can be between 120,000 and 360,000km, but some can be extended to 450,000km or more."

Just as with engine oil, there is a choice of mineral or synthetic lubricants. Mineral lubricants are made from Group I or II base oils, and semi- and full synthetics from Group III or IV. "Synthetic lubricants have more thermal stability than mineral-based oils, and in some





© Love the wind - stock.adobe.com

cases will run cooler," the technical support chemist explains. "This is one of the factors that allows change intervals to be extended. Increased temperatures speed the decay of additives.

"It's also important where the gearbox lubricant is used as a medium for an integrated retarder such as the ZF Intarder. The gearbox lubricant is subjected to an incredible amount of churning when the retarder is actuated, and heat rises very quickly. Retarders that run a separate oil supply, such as Voith, often specify a C4 engine oil as a retarding medium, as it has greater resistance to heat than transmission oil."

AXLES

Thankfully, drive axle requirements are generally less diverse and complex. Webber adds: "SAE J2360 incorporates API MT1 – a standard originally developed for American manual truck transmissions without synchromesh – and the GL5 standard. Oils meeting this standard are suitable for most drive axles."

Advances in lubrication technology are key to transmission manufacturers being able to increase the durability of their products while extending service intervals. "Twenty-five or 30 years ago, GM Dexron III was the fluid standard for our on-highway transmissions," recalls Sean McGrath, channel and customer support manager, Allison Transmission, UK and Ireland. "This was a predominantly mineral-based fluid that was, and still is, widely available. But the subsequent introduction of synthetics has been of great benefit: much more so for automatic transmissions than manual gearboxes.

"Allison has transitioned away from mineral fluid, although Dexron III-type fluids are still approved. But, compared to modern synthetics, mineral-based

fluid oxidises quickly and needs changing relatively frequently. Initially the fluid's viscosity reduces as carbon molecules are chopped up by the transmission's gears, but then it increases again as the fluid oxidises, possibly causing inconsistent shifts, component varnishing and even eventual failure," says McGrath.

He continues: "Synthetic fluids are very resistant to shear down and are thermally stable, allowing change intervals to be extended considerably. Thermal stability is far more important for fluid in automatic transmissions than it is in manual gearboxes. This is because it is not just a lubricant: it's a working hydraulic fluid and a vital component of the transmission. It applies the pressure to actuate the clutches, and when the transmission is not in lock-up mode, it drives the vehicle via the torque converters. All of this generates a lot of heat, and the fluid viscosity needs to not react to changes in temperature, but remain stable to ensure consistent performance from the transmission in all conditions."

Allison gives approved fluids standard numbers, prefixed by the TES acronym. TES 389 is the oldest approved specification and equivalent to Dexron

III. TES 295 is a full-synthetic fluid which has been approved for on-highway applications for the last 20 years, and, as Castrol TranSynd, was the factory-fill lubricant.

"Its performance was remarkable," McGrath says. "Allison tested with an RCV fleet in Germany that ran on the same fluid unchanged for seven years. At the end of the trial, there was no discernible wear on the transmissions, and the fluid itself was still in-spec."

But, last year, Allison introduced an even higher specification: TES 668, which takes advantage of the latest developments in fluid technology. Factory fill is now PetroCanada DuraDrive HD Synthetic 668 (pictured, left). A quantifiable advantage to the operator is in extending oil change intervals. Where TES 389 may need changing after 12,000 miles or six months' use, TES 668 can run for a minimum of 75,000 miles in severe conditions and up to 300,000 miles in general application.

"Allison's published intervals for TES 668 are quite conservative," McGrath says. "Our customers in the off-highway segment use oil condition monitoring, and tailor change intervals to their specific operation. We encourage bus and RCV customers to do the same."

But there is one task that should not be put off, he warns. "It is vital to change the filters at the recommended interval, irrespective of fluid condition. They need to be changed more frequently than the extended-life fluid does." **TE**

TIPS AND TRICKS

A simple test for water contamination in oil is to heat a hotplate to 120°C, and drop some oil on to it. Contaminated oil will spit fiercely as the water boils off.

Chemical reactions speed up as temperature increases. An increase of just 10% over the normal working temperature can halve the effective lifetime of an oil, as additives are depleted and deposits accumulate.