SHELL BRAKE AND CLUTCH FLUIDS

World-class chemistry for advanced vehicle hydraulic systems

Shell Chemicals

Vital safety components

Shell Brake and Clutch Fluids are vital safety performance components for manufacturers of cars and light commercial vehicles worldwide. They are integral to the safe, efficient and long-term performance of vehicle hydraulic systems and have to operate in demanding and continuously changing operating conditions.

Shell Brake and Clutch Fluids are specified for 'First Fill' by major international car makers, including prestigious high performance marque Ferrari, and for 'Service Fill' by a range of other manufacturers. Our position as a leading global supplier is built on technical performance, consistent quality and global supply security.

World-class chemistry...

Shell Brake and Clutch Fluids are based on established glycol ether/polyglycol formulations and advanced additive packages. Our experience in this chemistry stretches back to the first hydraulic formulations in the 1950s.

Today, through an optimum balance of key parameters – boiling point, viscosity, lubrication, chemical compatibility and service life – our formulations offer proven advantages for hydraulic performance characteristics including:

- **Low compressibility**

  They retain the essential qualities of incompressibility under extremes of high and low temperature, ensuring pressure on a brake or clutch pedal is transmitted instantly and consistently through the hydraulic system.

- **Superior boiling point**

  To provide enhanced thermal protection against 'vapour lock', the boiling point of all Shell grades maintains a safety margin well in excess of internationally agreed specifications (see Figure 1). This is achieved without compromising on viscosity performance or other parameters.

  When requirements for boiling point are particularly stringent, the use of Shell Brake Fluid DOT 4 Ultra should be considered. Shell scientists developed this ultra high boiling point product to meet the demanding specifications set by Ferrari, for some of the world's most powerful supercars, and it is suited to all high performance/premium vehicles.

  Eventually, over time, a braking system will absorb moisture through brake lines and seals, effectively lowering the boiling point of the fluid and increasing the risk of vapour lock and subsequent reduction in braking performance (see Figure 2). The ability of Shell Brake and Clutch Fluids to mix with water on a molecular scale avoids the local formation of water droplets or vapour bubbles within the fluid, which can seriously impair safe braking.

Brake fluids research and development is carried out at the state-of-the-art Shell Technology Centre in Amsterdam, the Netherlands.

Further protection against vapour lock can be provided by a water scavenging mechanism incorporated into DOT 4 and DOT 5.1 grades. This acts as a chemical 'sponge', soaking up water and keeping the fluid 'drier' for longer. As the water is chemically bonded to the fluid, it has minimal negative impact on the boiling point, resulting in more effective braking power over the service life of the fluid.

- **Viscosity control**

  Sophisticated anti-lock braking (ABS), dynamic and stability (ESP) systems incorporated into modern vehicles place additional emphasis on the ability of a hydraulic fluid to maintain low viscosity and flow through very narrow channels. These requirements are described by the ISO 4925-Class 6 specification.

  To meet these increasing demands Shell developed and introduced Shell Brake Fluid DOT 4 ESL (Extended System Life), a new formulation designed to maintain consistent low viscosity under all temperatures and conditions. This excellent low viscosity performance permits the use of advanced braking control systems without the need for expensive pre-charge pumps.

Stopping power, staying power

Shell has been at the forefront of automotive fluid development since the dawn of motoring, pioneering technical advances in fuels, lubricants and hydraulic fluids. Shell scientists working at world-class technology centres are the driving force behind a constant quest for improved performance and enhanced product life.

Shell's technical partnership with Ferrari, spanning over 60 years, has led to the development of products offering the highest levels of performance. Knowledge gained from Formula One and from the development of Ferrari GT road cars helps to power and protect motorists all over the world today.

for advanced vehicle hydraulic systems

At the same time care has been taken not to 'over-design' the viscosity properties, to avoid the risk of leakage from brake components or a reduction in hydraulic characteristics and lubricity.

Compatibility with other materials

Shell Brake and Clutch Fluids are compatible with an increasingly complex range of vehicle hydraulic systems, and advanced new materials being adopted by system manufacturers in pursuit of weight savings or production/performance advantages.

This compatibility provides important protection for rubber, metal, polymers, elastomers and alloys, helping to maintain the integrity of braking systems in a number of ways:

Corrosion protection

Advanced chemical inhibition packages developed by Shell over years of testing, analysis and independent verification protect a wide range of metal brake components from corrosion, without compromising the performance of the fluid.

Through careful tailoring of the chemical composition of the base glycol ether and inhibitor packages, Shell Brake and Clutch Fluids are able to meet specific corrosion inhibition requirements of a range of different automotive manufacturers.

Swelling/shrinkage control

Excessive swelling or shrinkage of rubber seals and hoses due to continuous contact with an incompatible hydraulic fluid poses the threat of leakage from the braking system. Shell products are blended using a glycol ether formulation that controls the swelling or shrinkage of rubbers.

Again, the margin of swelling/shrinkage control built into Shell products is well in excess of the minimum requirements of international standards.

Shell Brake Fluid DOT 4 Ultra was developed to meet the demanding requirements set by Ferrari for some of the world's most powerful supercars.

Polymer compatibility

After extended periods of exposure to brake fluids, polymers used in components such as fluid reservoirs may show signs of degradation and discolouration.

A special package of additives developed for the Shell Brake Fluid DOT 4 ESL grade is designed to protect the integrity of brake system components for an extended period of use, including superior performance with rubbers and polymers. The system compatibility of DOT 4 ESL has been validated by third party certified laboratories and major component suppliers.

Excellence in manufacturing and supply

Shell is an integrated producer, with full control of the manufacturing process, technology and supply chain. Shell Brake and Clutch Fluids are manufactured in a world-class production facility in the Netherlands which, as one of Shell's chemical manufacturing centres of excellence, is continually upgraded to raise quality and consistency.

Shell Brake and Clutch Fluids are produced in accordance with the ISO/TS16949 automotive quality assurance standard, which encompasses the manufacturing and process technology. This is backed by Shell's global supply and distribution network and expert chemical logistics, providing security and flexibility in supply.

Lubricity

The lubricity qualities of Shell Brake and Clutch Fluids help to prevent premature wear and abrasion of metal and rubber components in hydraulic and brake systems. They also eliminate the phenomena of 'slip-stick' on contact surfaces between moving hydraulic parts, including master cylinders, brake cylinders and ABS/ESP units, which can lead to noisy operation.

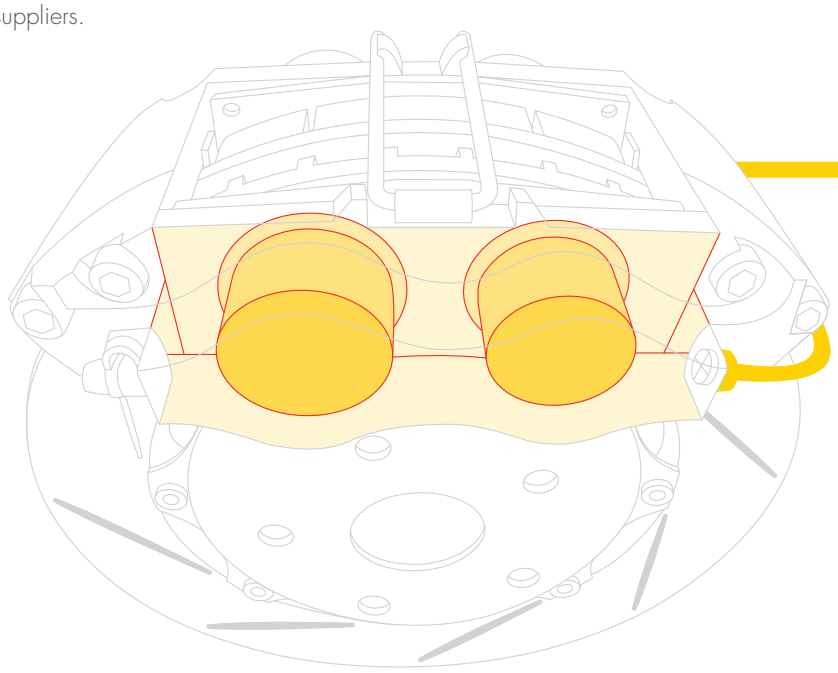
The replacement of metal by plastic parts to save weight has raised the importance of this issue, particularly in clutch systems which are more prone to this problem due to the longer pedal stroke and greater potential for 'squeaking'.

In designing Shell Brake Fluid DOT 4 ESL, special attention was given to lubricity performance. Its excellent lubricity and low noise characteristics have been demonstrated in extensive application tests carried out by major hydraulic component suppliers. Under accelerated ageing conditions DOT 4 ESL passed industry rig tests with the highest possible score.

Shell Brake and Clutch Fluids are manufactured at Shell's world-class chemical manufacturing facility in the Netherlands.

Long term performance

Shell Brake and Clutch Fluids are designed with enhanced chemical and thermal stability control to enable them to maintain their performance and protective properties over extended service intervals and under extreme operating temperatures.



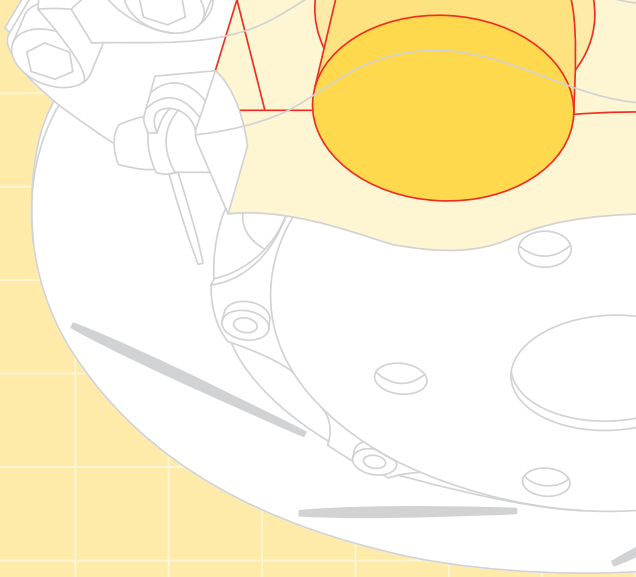
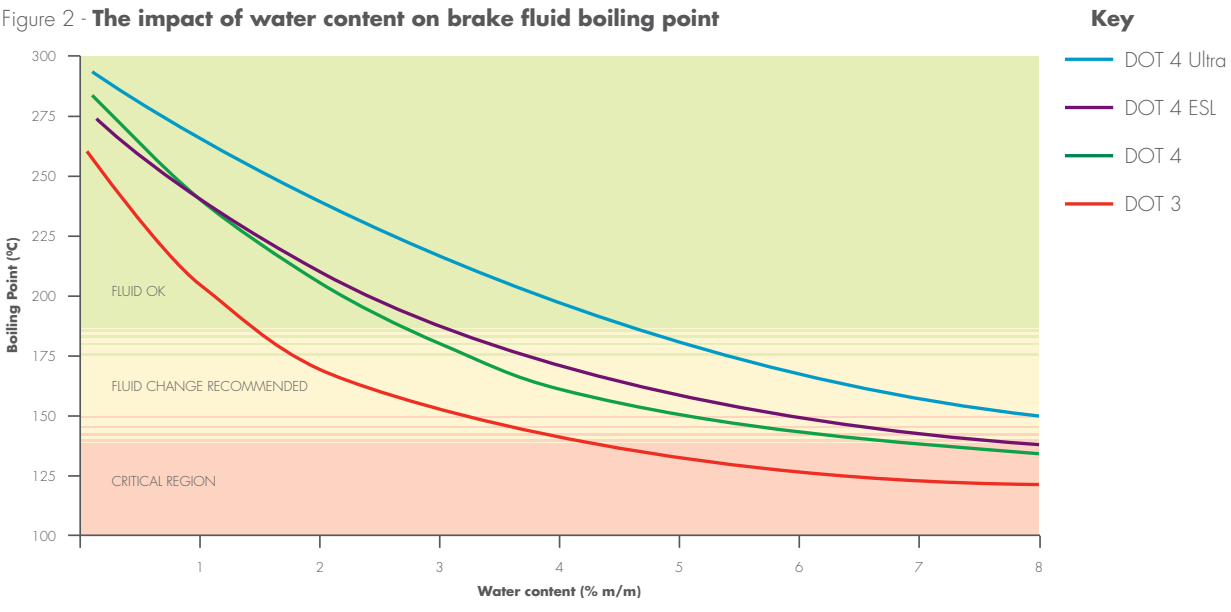


Figure 1 - **The Shell Brake and Clutch Fluids grade range**

International Standard	Shell product	Market/Application	Boiling Point		Kinematic Viscosity at -40°C (mm²/s)
			ERBP (°C)	Wet ERBP (°C)	
FMVSS 116 - **DOT 3** ISO 4925 - CLASS 3 SAE J1703	**DOT 3**	High performance DOT 3 product, particularly suited to the aftermarket.	> 238	> 140	≤ 1500
FMVSS 116 - **DOT 4** ISO 4925 - CLASS 4 SAE J1704 ISO 4925 - CLASS 6*	**DOT 4**	Premium DOT 4 product with enhanced service interval performance.	≥ 260	≥ 155	≤ 1200
	BF40	First and Service Fill product with excellent corrosion performance, designed specifically for the French OEM market.	≥ 265	≥ 165	900-1050
	DOT 4 Super NV	A superior high performance DOT 4 fluid for OEM and aftermarket applications with high boiling point, long service intervals and high safety margin.	≥ 280	≥ 180	≤ 1500
	DOT 4 ESL* (BF40 Plus)	A high performance, low viscosity brake and clutch fluid with superior materials compatibility ideal for ABS, electronic stability and traction control systems – suitable for OEM applications.	≥ 265	≥ 170	≤ 750
	DOT 4 Ultra	An ultra high performance brake and clutch fluid for premium and high performance cars.	≥ 280	≥ 190	≤ 1300
FMVSS 116 - **DOT 5** ISO 4925 - CLASS 5-1 (non-silicone fluids)	**DOT 5.1**	High performing DOT 5.1 fluid with low viscosity at cold temperature and long service intervals, for OEM and aftermarket applications.	≥ 260	≥ 180	≤ 900

Figure 2 - **The impact of water content on brake fluid boiling point**



All seven Shell Brake and Clutch Fluids grades meet or exceed every international standard, including those set by The Society of Automotive Engineers (SAE), International Organisation for Standardisation (ISO) and the Department of Transport/National Highway Traffic Safety Administration (DOT/NHTSA). Shell takes an active interest in standards development through its participation in SAE and ISO committees.

Shell Chemicals

SHELL BRAKE AND CLUTCH FLUIDS

Brake fluid should be changed at least every three years, or otherwise subject to the vehicle manufacturer's recommendation.

The Shell Brake and Clutch Fluids range has grades to meet the needs of all applications and markets. Please use the details below if you are interested in finding out more.

Contact
For all enquiries please contact:
brakefluids@shell.com

Further information
For more information visit:
www.shell.com/chemicals/brakefluids

708568-CSL-04/2011