PETRONAS

Working together to protect your Car's Hidden Heroes

PETRONAS
Tutela®

Championing the Hidden Heroes.

Ready for the world of tomorrow, today

PETRONAS Lubricants International (PLI) is part of the PETRONAS Group. With 10 blending plants, over 30 sales offices and products distributed in more than 90 countries worldwide, PLI's global network of over 240 scientists, technical professionals and engineers anticipate future mobility challenges and opportunities, then research and develop advanced fluid technology solutions to meet tomorrow's challenges, today.

We strive to deliver maximum value to our customers, the markets in which they compete and consumers – while minimising our impact on the environment, pioneering high performance fluids that are dedicated to emission reduction and manufactured in increasingly low CO_2 environments.

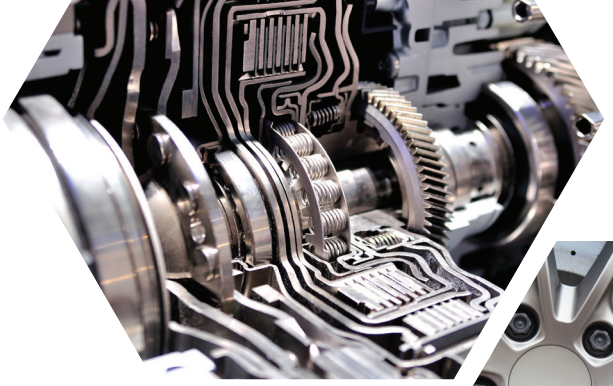
We're an ambitious business, driven by a relentless, restless energy.
What's next? What if?
How can we? Why don't we?

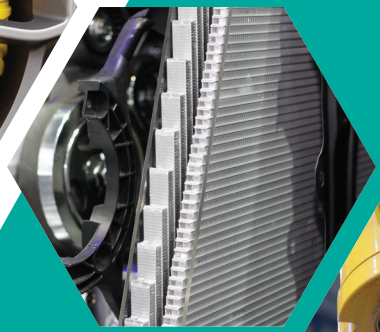
We're unstoppable.
We are PETRONAS.

Meet the Hidden Heroes

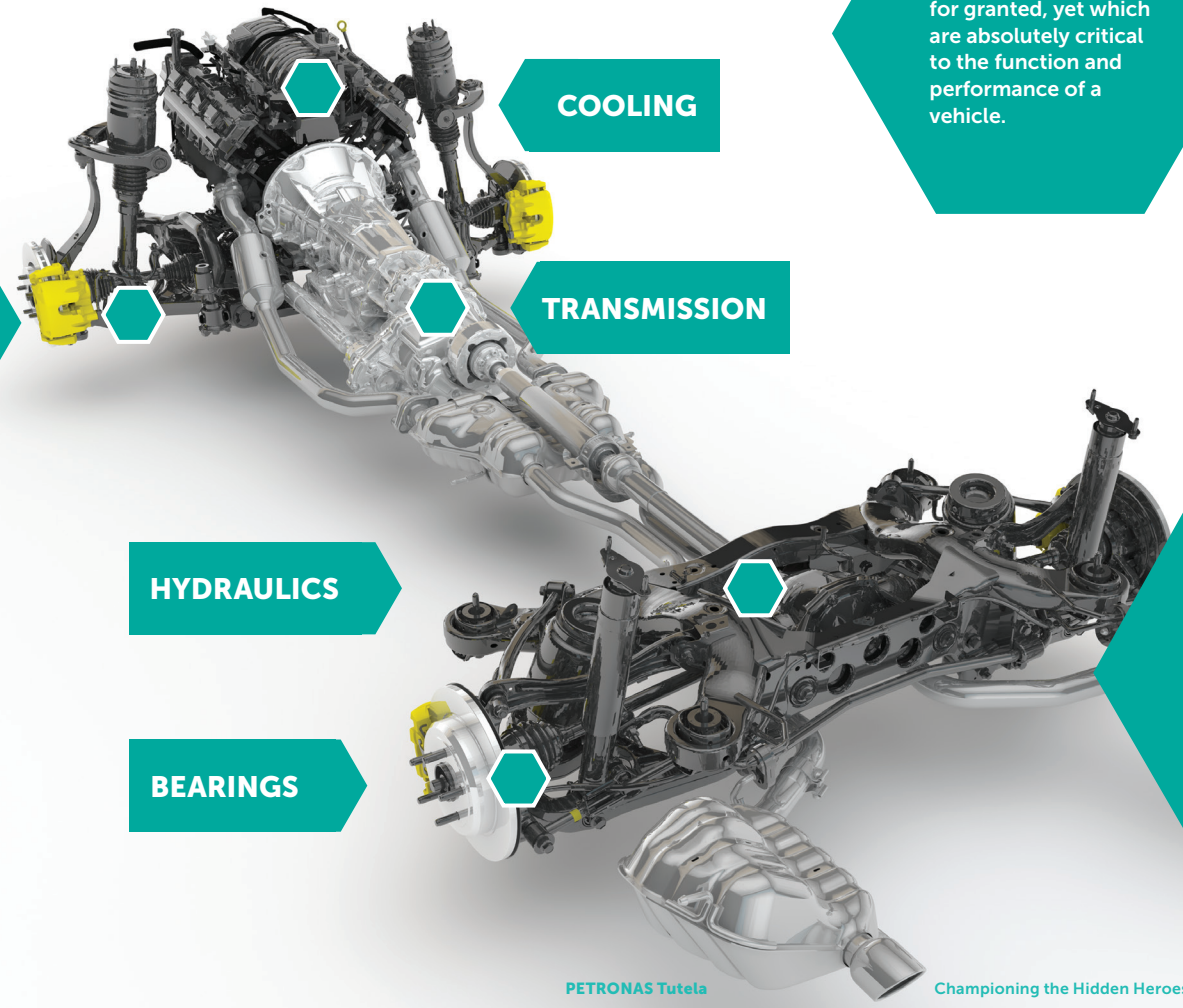
At PETRONAS, we understand that a vehicle's engine is only part of its overall performance story. There are a number of other extremely hardworking systems that are just as critical to a vehicle's efficient, continued performance – systems that demand a technically advanced fluid system, but which are often under-valued and overlooked.

We call these systems the Hidden Heroes – and PETRONAS Tutela is here to champion them all.





Ancillary systems that too often are taken for granted, yet which are absolutely critical to the function and performance of a vehicle.



COOLING

TRANSMISSION

BRAKING

HYDRAULICS

BEARINGS

Each Hidden Hero plays a vital role in a vehicle's safe, effective operation, performing in extremely demanding conditions. The pressures experienced within a Transmission System far exceed those seen anywhere else in the vehicle. The Cooling System has to rise to the challenge of diffusing the heat output of modern engines running hotter than ever, while still delivering in colder, icy climates.

It's a tough job for our Hidden Heroes – and it's only going to get tougher...

The demands on our Hidden Heroes are only going to increase

We live in a rapidly changing world.

As vehicle technologies continue to evolve and improve, so the demands placed on our Hidden Heroes build and grow.

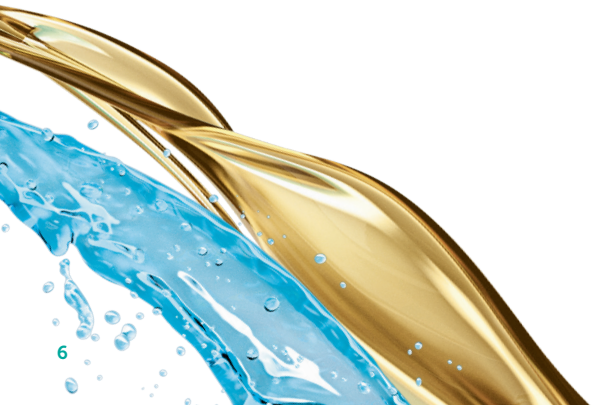
With the number of cars on the road predicted to reach the two billion mark by 2040, along with increased instant deliveries, we can expect more city traffic than ever. This means more stop-start driving, more engines running at higher temperatures, and more stress for transmission systems and fluids.

Add to that the fact that 80% of the world's population will live in cities by 2030, and the issue will only get worse...

But it doesn't end there. Environmental demands mean the number of electric cars on the road will increase, which means transmissions have to operate with higher rotating speeds at constant torque – leading to higher temperatures, greater vibration and oil splash.

Transmission fluids need to offer improved heat resistance and thermal stability – and maintain the protective film between metal surfaces in extreme conditions. They also need to deliver fuel efficient performance to meet the demands for net zero CO_2 emissions.

It all combines to create an ever-increasing, complex cooling challenge for vehicles.



The global number of cars on the road will nearly double by **2040**.

Business Insider, April 2016

125 million electric cars on the roads globally by 2030.

International Energy Agency, May 2018

By 2030, **80%** of the developed world's population is predicted to live in cities.

Roland Berger 'TREND COMPENDIUM 2030' 2011

Net zero CO_2 emissions by 2050.

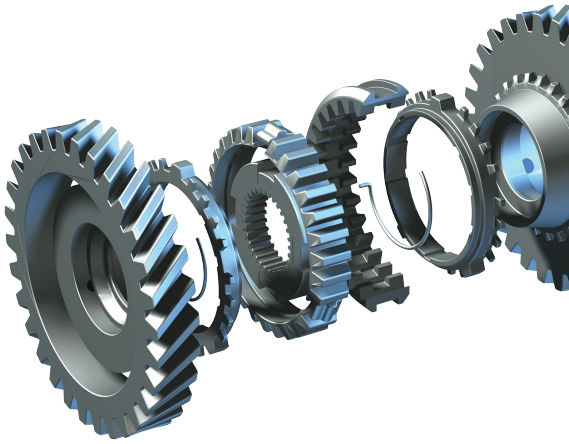
International Institute for Applied Systems Analysis, 2017

The Transmission System: Guardian of the vehicle's power

Meet our first Hidden Hero

Complex and operating under continual pressure at high temperatures, a vehicle's Transmission System is the very definition of a Hidden Hero. And all that stands between the full power of a vehicle driving metal against metal is a thin layer of protective molecules. You can trust PETRONAS Tutela to withstand pressure, enhance performance and efficiency and extend the life of moving parts – today and tomorrow.

- **Improved fuel efficiency** – PETRONAS Tutela transmission fluids combine lower viscosity with strengthened fluid film resistance, to reduce friction and improve fuel efficiency without compromising on protection.
- **Defends against mechanical stress, to help avoid unexpected downtime and extend the working life** – our transmission fluids have anti-wear and anti-pitting properties to help extend the life of the Transmission System, and outstanding shock load resistance to protect the axle.
- **Increased oil drain intervals for commercial vehicles** – PETRONAS Tutela's increased thermal stability and durability allow it to resist thermal and mechanical stress for longer, extending the service intervals and reducing downtime and maintenance costs.
- **Performance even at low temperatures** – PETRONAS Tutela protects the transmission system and provides a smooth gear shift experience from the moment the engine starts up, even in cold and icy conditions.
- **Ready to tackle the increased electrification of the driveline** – PETRONAS Tutela's premium products offer lower electrical conductivity, high heat capacity, high thermal conductivity and low evaporation loss, making them fully compatible with electrical systems.
- **Ready to take on new speeds** – as vehicles continue to increase the number of gears available to drivers, the number of moving components also increases, which means more heat is generated. The lower viscosity and optimised friction characteristics of our newly launched premium products are able to effectively dissipate this heat while compensating for energy losses – we're ready for the speed requirements of tomorrow, today.
- **Multi-purpose fluids for increasingly automated transmissions** – in many transmission systems, the lubricant doubles up as the hydraulic fluid in the actuator and clutch – PETRONAS Tutela transmission fluid's optimised chemistry and viscosity rises to the challenge of multiple applications.
- **Enhanced noise and vibration control qualities** – our transmission fluids have superior anti-foaming properties and oil film resistance, along with optimised friction characteristics, for a more pleasant driver experience, with easier, smoother shift and less noise and shudder.
- **Smoother, more comfortable gear shifts** – with wider Synchroniser compatibility (manual and dual clutch transmission fluids), anti-shudder properties (automatic, dual clutch and continuously variable transmission fluids with torque converter) and torque transfer capacity (continuously variable transmission fluids).



PETRONAS Tutela Automatic Transmission Fluids

Automatic transmissions generate even more intense heat than manual ones, so lubricant fluids often degenerate more quickly. Low levels of fluid or fluid with deposits within the transmission system can cause slipping and shifting issues – and overheating can lead to malfunction and a decrease in the overall life of parts.

PETRONAS Tutela Automatic Transmission Fluids provide enhanced thermal and oxidation resistance to retain a stable viscosity at a wide range of temperatures. This helps optimise transmission efficiency for a range of vehicle types – leading to improved fuel economy. It also extends the fluid's life by preventing the formation of deposits, delivering a smooth, shudder-free drive, and lengthened Oil Drain Intervals for reduced servicing requirements.

PETRONAS Tutela range
Passenger Cars

Performance level	Design principles	Products	Protection	Longer oil life	Fuel economy	Long drain interval	Longer Transmission Life	Smoother Cold Shift	Reduced noise	Approvals and Performance Specifications
700	• Premium fully synthetic fluids • In-warranty current vehicles, and latest out of warranty • Normally up to 6yrs old • Top tier specifications	• Multi ATF 700	◕	◕	◕	●	◕	◕	◕	GM Dexron VI; Ford MERCON LV JASO M315-2013 1A-LV, 1A, 2A; JWS 3309, JWS 3324, JWS 3317 Suitable for Use in most modern cars equipped with 6 to 9 speed automatic transmission (i.e. Audi, BMW, Mini, Chrysler/Dodge/Jeep, Daihatsu, Ford, Fuso, GM, Hino, Honda, Hyundai/Kia, Isuzu, Jaguar, Mazda, Mitsubishi, Nissan, Peugeot, Saab, Seat, Skoda, Subaru, Suzuki, Toyota, VW, ZF 6 to 9 Speed)
		• Multi CVT 700	◕	◕	◑	◕	◕	◕	◕	Suitable for Use in most Belt and Chain CVT (continuously variable transmissions) (i.e. Audi, BMW/Mini, Daihatsu, Chrysler/Dodge/Jeep, GM/Saturn, Honda, Hyundai/Kia, Idemitsu, Mazda, Mitsubishi, Nissan, Punch, Seat, Skoda, Subaru, Suzuki, Toyota (included Hybrids), VW)
		• Multi DCT 700	◕	◕	◑	◕	◕	◕	◕	Suitable for Use in most Belt and Chain CVT (continuously variable transmissions) (i.e. Audi, BMW/Mini, Daihatsu, Chrysler/Dodge/Jeep, GM/Saturn, Honda, Hyundai/Kia, Idemitsu, Mazda, Mitsubishi, Nissan, Punch, Seat, Skoda, Subaru, Suzuki, Toyota (included Hybrids), VW
500	• Premium part synthetic fluids • For older vehicles, normally out of warranty • Normally up to 10yrs old • Mid-tier specifications	• Multi ATF 500	◑			●	◑	◑	◑	GM DEXRON®-VI JASO M315-2013 1A, JASO M315-2013 2A; JWS 3309, JWS 3314, JWS 3317 Suitable for Use in most cars equipped with up to 5 speed automatic transmission (i.e. Audi/Seat/Skoda/VW, Aisin Warner JWS 3309, BMW, Mini, Chrysler/Dodge/Jeep, Daewoo, Ford, Fuso, GM/GMC/Opel/Saturn, Hino, Honda (except in CVTs), Hyundai/Kia, Isuzu, Jaguar, Mazda, Mitsubishi, Nissan, Peugeot, Porsche, Renault, Saab, Scion, Ssang Yong, Subaru, Toyota, ZF 3, 4 & 5 Speed transmissions)

This table is intended to provide an indicative overview of the product benefits.
For more detailed benefit descriptions, please visit the individual product pages.

○ Basic level – most fluids can offer this benefit level.
● Max level – only few premium fluids can offer this benefit level.

PETRONAS Tutela range
Passenger Cars

Performance level	Design principles	Products	Protection	Longer oil life	Fuel economy	Long drain interval	Longer Transmission Life	Smoother Cold Shift	Reduced noise	Approvals and Performance Specifications
300	• Top quality mineral multi-grade oils • For older vehicles out of warranty • Normally up to 15yrs old • Old specifications	• ATF D3	◔				◔	◔	◔	JASO M315-2013 1A, JASO M315-2013 2A GM DEXRON®-IIIG/IIIH, Allison C-4, Ford Mercon®, Bosch TE-ML 09, ZF TE-ML 09
100	• High quality mineral oils • For very old vehicles, out of warranty • Normally over 15yrs old • Very old specifications	• ATF D2	○					○		GM DEXRON®-IID, Allison C-3
		• ATF TASA	○							GM Type "A" Suffix "A"

Product Benefit

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PETRONAS Tutela Manual Transmission Fluids

Manual Transmission Fluids have quite a job to prevent overheating – but they also have additional challenges caused by the amount of metal-to-metal contact in manual transmissions. Sub-standard oils struggle to combat the wearing of components, and can run out quickly – putting components at risk and reducing overall transmission life.

PETRONAS Tutela Manual Transmission Fluids extend component life through their enhanced shear stability for constant film strength and anti-wear protection. Not only this, their enhanced thermal and oxidation resistance properties help retain a stable viscosity, optimising transmission efficiency and even contributing towards fuel economy. Our highly engineered MTF products offer extended Oil Drain Intervals to reduce servicing requirements, and protect the transmission system even in the toughest conditions for a smooth drive and easy gear shift.

Global PETRONAS Tutela
Passenger Cars

Performance level	Design principles	Products	Protection	Longer oil life	Fuel economy	Long drain interval	Longer Transmission Life	Smoother Cold Shift	Reduced noise	Approvals and Performance Specifications
700	• Premium fully synthetic fluids • In-warranty current vehicles, and latest out of warranty • Normally up to 6yrs old • Top tier specifications	• Multi MTF 700 75W-80	◕	◕	◑	●	◕	◕		API GL4 (i.e. Audi, BMW, Citröen, Ford, GM, Nissan, Peugeot, Land Rover, Honda, Renault, Seat, Skoda, Volvo, VW)
500	• Premium part synthetic fluids • For older vehicles, normally out of warranty • Normally up to 10yrs old • Mid-tier specifications	• MTF 500 75W-90	◑		◔		◔	◑		API GL-4
300	• Top quality mineral multi-grade oils • For older vehicles out of warranty • Normally up to 15yrs old • Old specifications	• MTF 300 80W-90	◔				◔	○	◑	API GL-4
100	• High quality mineral oils • For very old vehicles, out of warranty • Normally over 15yrs old • Very old specifications	• MTF 100 SAE 80	○							API GL-4 ZF TE-ML 24A
		• 100 EP SAE 90	○							API GL-5
		• 100 EP SAE 140	○							API GL-5
		• 100 SAE 90	○							API GL-4
		• 100 SAE 140	○							API GL-4

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PETRONAS Tutela Axle Fluids

Axle Fluids have to look after vehicles used in high shock load situations. Failure to protect axle systems can result in axle damage and costly repairs.

PETRONAS Tutela Axle Fluids offer outstanding shock load resistance to protect the axle, particularly in low-speed, high-load scenarios such as those experienced in distribution and construction. Their optimised load-carrying performance and component protection qualities are suitable for axles, differentials and final drives, and they are recommended where recognised industry standards are required.

Global PETRONAS Tutela
Passenger Cars

Performance level	Design principles	Products	Protection	Longer oil life	Fuel economy	Long drain interval	Longer Transmission Life	Smoother Cold Shift	Reduced noise	Approvals and Performance Specifications
500	• Premium part synthetic fluids • For older vehicles, normally out of warranty • Normally up to 10yrs old • Mid-tier specifications	• Axle 500 75W-90	◑		◔		◔	◑		API GL-5, MIL PRF-2105D ZF TE-ML 07A, 08
		• Axle 500 LS 75W-90	◑		◔		◔	◑	◑	API GL-5, MIL PRF 2105D
300	• Top quality mineral multi-grade oils • For older vehicles out of warranty • Normally up to 15yrs old • Old specifications	• Axle 300 80W-90	◔				◔	○	◑	API GL-5; MIL PRF-2105D MAN 342 Type M1, Type M2; ZF TE-ML 07A, 08, 12E, 17B, 19B, NATO O-226
		• Axle 300 LS 80W-90	◔				◔	○	◑	API GL-5 ZF TE-ML 05C, 12C
100	• High quality mineral oils • For very old vehicles, out of warranty • Normally over 15yrs old • Very old specifications	• 100 EP SAE 90	○							API GL-5
		• 100 EP SAE 140	○							API GL-5
		• 100 SAE 90	○							API GL-4
		• 100 SAE 140	○							API GL-4

This table is intended to provide an indicative overview of the product benefits.
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● Max level – only few premium fluids can offer this benefit level.

The Braking System:
Critical safety guardian

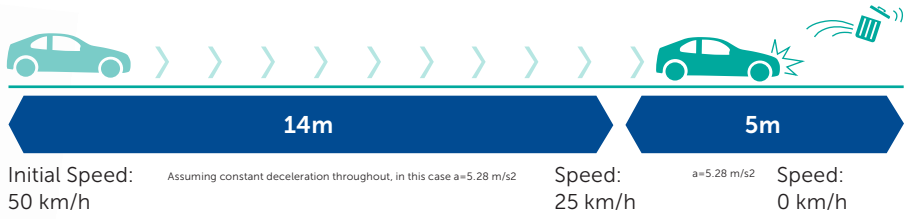
Meet our Second Hidden Hero

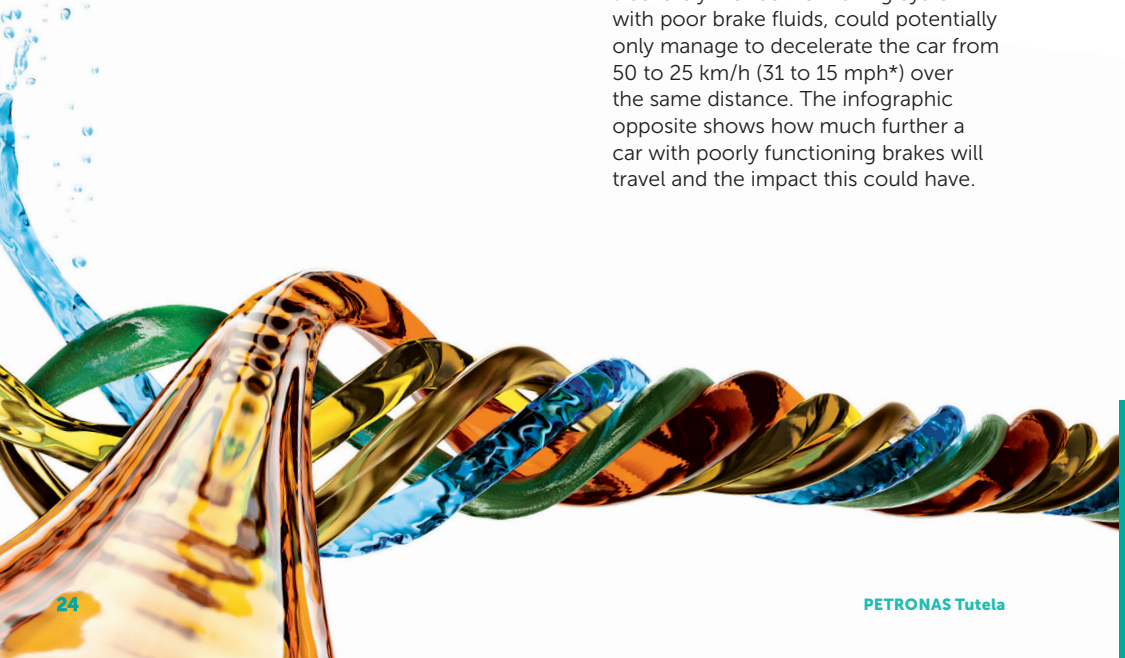
When it comes to safety, nothing is more important than a vehicle's Braking System. A complex structure of hard-working components, it must withstand incredible pressures and extreme temperatures to provide critical control within an instant, preventing damage and maximising safety. That's what makes the Braking System a true Hidden Hero.

A Hero today...

- **A system that can't fail**
  Whatever the weather or conditions, the Braking System needs to perform reliably at all times. Extreme conditions can cause brake fade (loss of stopping power), melting pads, boiling fluids and total system failure – threatening safety. The Braking System simply cannot afford to fail.

- **A highly effective braking system helps to maximise safety**
  Between 2013-2017, an average of 3 people in the UK were injured or killed every day in accidents where defective Braking Systems were a factor[1]. A properly functioning Braking System could fully stop a car travelling at 50km/h (31 mph) within a distance of three-cars length. By comparison, a severely ineffective Braking System with poor brake fluids, could potentially only manage to decelerate the car from 50 to 25 km/h (31 to 15 mph*) over the same distance. The infographic opposite shows how much further a car with poorly functioning brakes will travel and the impact this could have.





[1]http://www.brake.org.uk/facts-resources/15-facts/1255-speed

*This scenario is for illustrative purposes only – deceleration to only 25mph is only likely in a worst-case scenario, such as in the event of downhill deceleration, with a malfunctioning braking system and where brake fluids are well beyond their service life.

A small car can generate

600-700hp of braking power

6x higher braking horsepower compared to engine power, lead times 0-100 km/h takes average 8 - 10s, 100-0 km/h takes average 2s*

The surface temperature of a brake disc and pad could reach up to

142°C

- **Braking Power is greater than Engine Power**
  The power of a Braking System is often overlooked despite working much harder than the engine. For instance, the braking power generated when a 1500kg sedan decelerates from 100 km/h (62 mph) to a complete stop is 5 times more than its engine power (1000 hp compared to 200 hp). And as shown in the visual above, a smaller car can generate around 600-700 hp of braking power – almost as much as the engine power of a large truck.
- **Withstanding extreme thermal stress**
  When the brakes of a vehicle are applied, heat is absorbed into the Braking System. Theoretical modelling via COMSOL Software[2] predicts that if an 1800kg vehicle travelling at 90 km/h brakes for 2 seconds, the surface temperature of the brake disc and pad could reach up to 142°C – potentially overheating the Braking System's components, compromising performance and safety.

...facing even greater stress tomorrow

As vehicles become more powerful, their Braking Systems must be able to keep up – responding quicker, under more stress and heat with the need for better fuel efficiency and lower emissions. Clearly, this Hidden Hero faces bigger challenges than ever.

Manufacturers are under pressure to create smaller and lighter Braking Systems
Future hardware must reduce the 'unsprung weight' of the vehicle, improving suspension, durability and cost-effectiveness. These smaller braking components must also deliver higher braking powers at faster activation times for increasingly powerful vehicles. Quite a challenge.

Replacement of copper in friction materials will lead to higher braking system temperatures in the future
Copper has long been used in brake pads due to its powerful heat dissipation properties, as well as its ability to prevent vibration and squeaking. However, the copper particles formed and discharged while braking are damaging our environment. Manufacturers will need to find a replacement, as overheating of Braking Systems can reduce vehicle performance and cause total brake failure. But the outlook isn't all bad; PETRONAS Tutela Brake Fluid's premium products are prepared for tomorrow's challenges today, having been specially formulated to combat the higher temperatures of copper-free Braking Systems.

Under ever-increasing pressure, Braking Systems will need to adapt – fast. To remain effective as materials change, this Hidden Hero must withstand increasingly higher operating temperatures than today.

Fortunately, PETRONAS Tutela Brake Fluid's premium products are already prepared for these challenges.

*Figures for illustration purposes only.
[2]https://cdn.comsol.com/wordpress/2013/02/Step-by-step-guide-for-modeling-heat-generation-in-a-disc-brake.pdf

Always fully drain and refill your brake fluid to remove water or contaminants - topping up is less effective.

Rely on PETRONAS Tutela Brake Fluids to keep the Braking System safe from harm

The PETRONAS Tutela range of brake fluids has been designed with all the most critical safety features in mind – **protecting vehicles, drivers, passengers and pedestrians in all conditions.**

- **Preventing brake-lock caused by water absorption**
  Most brake fluids tend to absorb moisture from the surrounding air, increasing their water content. At high temperatures, the water boils and forms vapour pockets. Braking energy will then be wasted on compressing the vapour pockets instead of activating the brake pads – and this will lengthen braking action time or even prevent any braking at all. If the braking action is delayed by just 1/10th of a second, the braking distance of a vehicle travelling at 100 km/h (62 mph) increases by 2.8 metres – which could be the difference between stopping safely and crashing. The chemical properties of PETRONAS Tutela Brake Fluid's premium products have extremely high boiling points, helping them mitigate vapour lock failure and prevent accidents.
- **Low viscosity and excellent stability at icy temperatures ensure better performance**
  Brake fluids with high viscosity (thickness) at low temperatures build up the braking response more slowly, delaying activation time. Braking Systems can also become locked as a result of precipitations at extremely low temperatures between -40°C and -50°C. PETRONAS Tutela Brake Fluids are tested on their viscosity properties over a wide temperature range of -50°C to 120°C[3], and all pass or even exceed the requirements of international standards FMVSS 116, SAE J 1703, SAE J 1704 and the ISO 4925. In additional tests, a Braking System was made to brake from 130-0 km/h on a highway 10 times repeatedly. PETRONAS Tutela Brake Fluid's premium products remained stable and effective regardless of temperature, maximising safety.
- **Outstanding protection for maximum safety**
  PETRONAS Tutela Brake Fluids contain highly effective additives which reliably protect essential metals in the Braking System from oxidation and corrosion, provide excellent lubrication to prevent friction and abrasion, and deliver optimum thermal stability. Compatible with a wide range of elastomers to protect against the loss of fluids, our brake fluids ensure that Braking Systems are protected from damage – guaranteeing lasting performance and safety.
- **For maximum safety, ask your mechanic to check your brake fluid every year** – and it's important that you use the brake fluid type recommended by your car's manufacturer. Replacing your brake fluid costs a fraction of the price to replace than other parts of the Braking System, and it's definitely worth the peace of mind.

Important: fully drain and refill your brake fluid – never simply top it up. Your brake fluid does not remove water or contaminants from the Braking System, rendering the system less effective. Completely draining and refilling brake fluids ensures the Braking System gets totally new brake fluids while removing water or contaminant, so it's highly recommended.

[3]Simulated service performance test run at 120°C. Fluidity and Appearance at low temperature test run at -40°C and -50°C.

Global PETRONAS Tutela Brake & Clutch Fluids Range

All product groups

Performance level	Design principles	Suitable for use in:	Product Benefit: Braking Safety	Braking Response	Braking Effectiveness during service life	Clutch Response
DOT Type Brake & Clutch Fluids						
DOT 5.1 LV	• Super premium fluid • For latest hybrid and high performance models operating at higher temperatures • Depends on OEM recommendations • Typically for high performance in-warranty vehicles • Higher tier specifications	1	●	●	●	●
DOT 4 LV	• Premium fluid • Depends on OEM recommendations • Typically for newest generation in-warranty vehicles with electronic control braking systems • High tier specifications	2	●	●	◕	●
DOT 4	• Premium fluid • Depends on OEM recommendations • Typically for in-warranty current vehicles and for older vehicles, normally out of warranty • Mid-tier specifications	3	●	◕	◕	◕
DOT 3	• High quality fluid • Depends on OEM recommendations • For older vehicles, out of warranty	3	●	◕	◑	◕
Mineral Hydraulic and Brake Fluid*						
LHM Plus	• Premium mineral-based hydraulic fluid • Strictly depends on OEM recommendations • For off-road applications and for PSA cars that meet the PSA B71 2710 specification	3	●	◕	●	◕

This table is intended to provide an indicative overview of product benefits.
For more detailed benefit descriptions, please visit the individual product pages.

* Not for use where a DOT fluid is recommended.

○ Basic level – most fluids can offer this benefit level.
● Max level – only few premium fluids can offer this benefit level.

Cooling System: Protector of key engine components

Meet our Third Hidden Hero

A vehicle's Cooling System is critical for controlling temperatures and preserving engine safety. Damage could lead to all sorts of problems. That's why the Cooling System is our Third Hidden Hero. A Hero today...

Maintains thermal balance to protect vehicles from overheating

The consequences of overheating can be extremely expensive, difficult to fix and, in some cases, fatal to the life of an engine. So, by simply preserving the balance of temperature, the Cooling System protects the engine and its components.

Transferring heat to keep engines operating safely

In an engine, only a third of energy produced is used to propel the vehicle forwards. The rest creates unwanted heat. The engine coolant performs a critical heat transfer role to avoid the formation of solids and gases and ensure that the engine operates safely.

Ensuring passenger safety through effective operation in all conditions

A properly operating Cooling System protects parts and engine operation across all conditions and temperature ranges. Once the desired operating temperature is reached, the thermostat adjusts the flow of coolant to the radiator, preventing significant risks to safety.

Helping engines start in extremely cold conditions

The fluid also plays a protective role, preventing the freezing of the engine at low temperatures.

PETRONAS Tutela Coolant empowers the Cooling System

Excellent protection against corrosion to safeguard the Cooling System

One of the biggest Cooling System challenges will be the corrosion of metal components. This erosion forms a hole in the component, leading to severe damage. PETRONAS Tutela Coolant products form a very thin but highly effective protective layer that works tirelessly to defend the Cooling System against corrosion.

Outstanding protection characteristics prevents electrolysis damage

Electrolysis occurs when preventive additives within the coolant wear out, and rust begins to clog the radiator's core tubes – eventually leading to head-gasket failure and catastrophic engine damage. Our improved PETRONAS Tutela Coolant products contain highly effective technologies, working to mitigate electrolysis and ensuring that the Cooling System remains highly functional.

Protecting parts from freezing and reducing the warm-up phase for more efficient engines

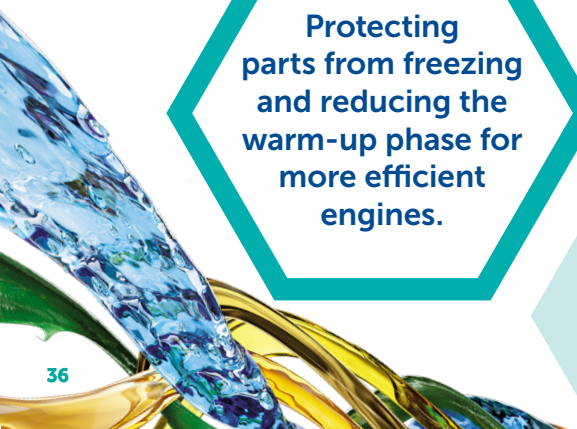
Although water provides sufficient heat transfer, coolants contain a substance called glycol which prevents fluids from freezing and increases the boiling point – this function is critical. Coolant also helps to warm up the components of the engine and raise temperatures into the right range quickly – meaning engines are operational sooner. PETRONAS Tutela Coolant products have been specially formulated to enable highly optimal ratios of glycol and water – so the operational efficiencies of Cooling Systems and engines are at their best.

High quality formulations for a wide range of applications

PETRONAS Tutela Coolants are formulated with high quality additive technologies, covering a variety of applications and specifications for passenger cars, light and heavy-duty vehicles and off-highway machineries. Each technology is tailored to a specific vehicle or engine application and cooling system requirement – broadly speaking, systems produced before the 90s require a conventional IAT coolant, while more modern systems accept long life OAT and HOAT coolants.

It helps to know how each of these additives work so you can understand their role in our products. Always refer to your owner's manual to select the proper technology.

Protecting parts from freezing and reducing the warm-up phase for more efficient engines.



Conventional coolant

Inorganic Acid Tech (IAT)

- Traditionally most conventional coolants are IAT-based, where protection against corrosion starts immediately, forming a protective film over the surface of the metal.
- IAT-based coolants are normally drained every two years, depending on the vehicle's user manual, where it is suitable for applications such as older vehicles including off-road machinery and equipment.

Long life coolants

Organic Acid Tech (OAT)

- OAT-based coolants offer long life protection due to the nature of the additive technology, making them more suitable for vehicles manufactured since the 1990s and later.
- These coolants are normally drained every five years, depending on the vehicle's specific requirements.

CAT ELC

- These are formulations originally designed for Caterpillar machinery but is also suitable for use in similar vehicle types.
- ELC stands for 'Extended Life Coolants' reflecting the product's ability to keep working over an extended drain interval - offering protection for hard working, heavy duty industrial applications.

Hybrid Organic Acids Tech (HOAT)

- HOAT is a 1st generation hybrid technology coolant, merging the long life benefit of organic acid inhibitors and rapid protection of inorganic chemistry. Suitable for vehicles manufactured since the 1990s.
- HOAT-based coolants are normally drained every five years, depending on the vehicle's requirements.

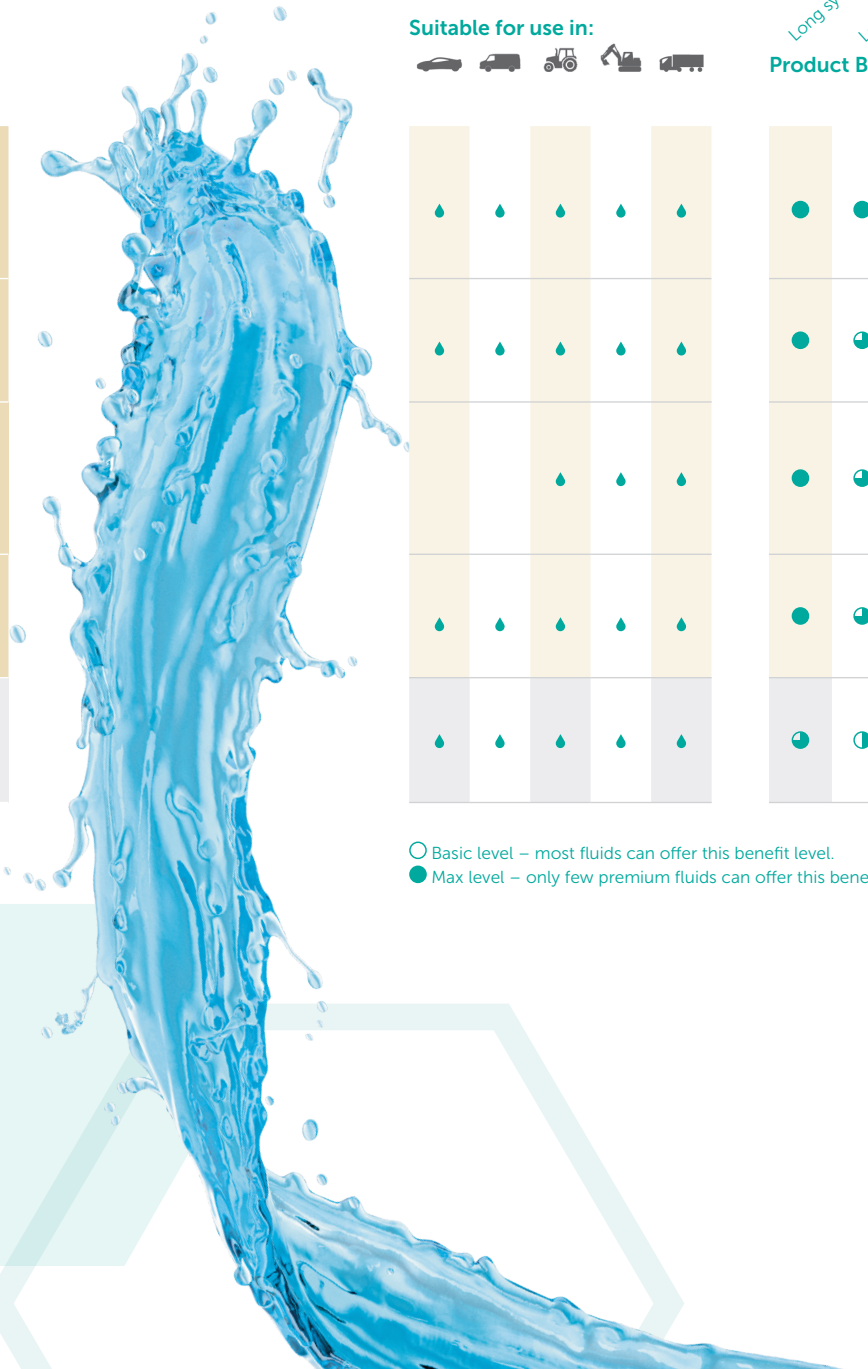
Silicate Organic Acids Tech (Si-OAT)

- Si-OAT is a new generation hybrid technology coolant providing both instant corrosion protection and long-life benefits.
- Si-OAT provides optimised electrical conductivity and resistivity compared to traditional coolant technologies, making it suitable for the latest generation and hybrid vehicles.
- Si-OAT coolants are normally drained every five or six years, depending on the vehicle's requirements.

Global PETRONAS Coolants Range

All product groups

Product	Design principles	Suitable for use in:	Long system life	Long coolant life	Corrosion protection	Antifreeze protection	Overheating protection
			Product Benefit				
Coolant LL-Si	• Extra Long Life Si-OAT technology • For latest generation vehicles including hybrids • Asian, American and European passenger cars and commercial vehicles • Protection against overheating and freezing -38°C to 125°C*		●	●	●	●	●
Coolant LL-G	• Long Life HOAT technology • Asian, American and European passenger cars and commercial vehicles • Protection against overheating and freezing -38°C to 125°C*		●	◕	◕	●	●
Coolant LL-ELC	• Extended Life Coolant OAT technology • For construction, quarrying, mining and agricultural machineries or heavy-duty engine coolant systems • Specifically developed for Caterpillar machineries • Protection against overheating and freezing -37°C to 132°C*		●	◕	◕	●	●
Coolant LL	• Long Life OAT technology • For passenger cars, commercial vehicles, agriculture and construction machineries • Protection against overheating and freezing -38°C to 125°C*		●	◕	◕	●	●
Coolant	• Conventional technology • For older passenger cars, commercial vehicles, agriculture and construction machineries • Protection against overheating and freezing -38°C to 125°C*		◕	◑	◑	●	●



○ Basic level – most fluids can offer this benefit level.
● Max level – only few premium fluids can offer this benefit level.

This table is intended to provide an indicative overview of product benefits.
For more detailed benefit descriptions, please visit the individual product pages.

*Ready to use 50/50 dilution with 15 psi (1 bar) radiator cap.

Performing at all temperatures

Today's modern engines demand much more of coolants – relying on their ability to provide effective heat transfer, freezing and boiling protection and preventing corrosion of the cooling system.

PETRONAS Tutela Coolants deliver above and beyond in all of these areas, so you can relax knowing your vehicle is fully protected.

Coolant/Water Dilution %	Boiling Point °C Atmospheric	Boiling Point °C With 15 psi (1 bar) radiator cap	Freezing Point °C	Boiling Point °F Atmospheric	Boiling Point °F] With 15 psi (1 bar) radiator cap	Freezing Point °F
33% Coolant / 67% Water	104 °C	125 °C	-20 °C	219 °F	257 °F	-4 °F
40% Coolant / 60% Water	107 °C	128 °C	-25 °C	225 °F	263 °F	-13 °F
50% Coolant / 50% Water	108 °C	129 °C	-38 °C	226 °F	265 °F	-36 °F
60% Coolant / 40% Water	112 °C	132 °C	-52 °C	234 °F	270 °F	-62 °F

These are mean values provided for indicative purposes only.
Do not exceed 60% coolant/water ratio.

www.pli-petronas.com