REWRITING THE FORMULATION RULE BOOK

Testing ultra-low-viscosity, enhanced-fuel-economy, concept motor oil

DESIGNED TO MEET CHALLENGES

Professor Gordon Murray working on the T.25 car with Carl Stow, Senior Scientist of Shell Lubricants.

PROFESSOR GORDON MURRAY, TECHNICAL INSPIRATION

With Professor Gordon Murray as technical director, the Brabham and McLaren Formula One teams won 50 Grand Prix and 5 World Championships. Following this success, Professor Murray established McLaren Cars Ltd, which designed and built the McLaren F1 Road Car, a racing version of which won the Le Mans 24-hour race on its first attempt.

GORDON MURRAY DESIGN, INNOVATIVE COMPANY

In 2005, Professor Murray left the McLaren Group to set up Gordon Murray Design Ltd (GMD). The company's first project has been to design a highly innovative, lightweight, low-carbon T.25 city car, which can be manufactured using the revolutionary iStream process.

THE T.25 CITY CAR

The T.25 represents a major breakthrough. It is a city car designed to have world-leading efficiency and ultra-low emissions. The car is also optimised for performance, cost, safety, usability, recyclability and ease of assembly, which gives it many key advantages:

- **low weight and a very small engine** for high fuel efficiency
- **small external dimensions**, which ease congestion and allow 90° to the kerb parking, and, with its unique door-opening system, close-proximity end-to-end parking (two T.25s will fit in most single garages)
- **a reduced environmental impact**, as fewer resources are needed to make each car and it has a low fuel consumption
- **safety**, from impact qualities designed to minimise harm to pedestrians and a Formula-One-inspired safety-cell structure that protects passengers from end and side impacts.

UP TO 6.5% POTENTIAL FUEL ECONOMY IMPROVEMENT DEMONSTRATED WITH CONCEPT ENGINE OIL[1]

Gordon Murray Design Limited (GMD) threw out the rule book to create its revolutionary T.25 city car. At Shell, we have taken the same radical approach when working with GMD to develop and test a concept oil that can reduce urban-cycle fuel consumption by up to 6.5%[2].

AN UNPRECEDENTED CHALLENGE

The European Automotive Manufacturers' Association (ACEA) estimates that new EU carbon dioxide (CO_2) legislation, with its staggered implementation from 2012, will add an average of €1,500 to the cost of each car. Today, new cars sold in the EU emit, on average, 150 g/km of CO_2 per vehicle.

By 2012, with exceptions and exemptions, manufacturers whose cars exceed a target of 130 g/km will be fined on excess-grams-per-kilogramme basis for every car sold.

To balance the higher emission levels from larger cars, smaller cars will need to be well inside the target.

- By 2012, a single "neutral" weight vehicle that is 100 g/km over the target will be fined €9,500.
- By 2020, the target looks set to be even lower at 95 g/km; similar legislation may also be implemented in other parts of the world.

Does this mean reduced original equipment manufacturer (OEM) margins and increased prices for customers, or can dramatic fuel economy improvements be achieved?

Like ACEA, Shell acknowledges that breakthrough technologies will be needed if these ambitious CO_2 emission targets are to be met. These will include both internal-combustion engine technologies, such as start–stop systems, and longer-term breakthrough technologies, for example, completely new power train designs. And the tightening legislation makes investing now in relatively small potential fuel economy improvements attractive. By 2012, even a 1% CO_2 reduction across the European fleet can save the equivalent of €2.25 billion in avoided fines.[3]

We believe that long-term technology partnerships between OEMs and lubricant companies can help to deliver significant lubricant-related fuel economy improvements. To demonstrate the potential benefits, we teamed up with GMD and took a fresh look at lubricant technology.

A CAR FOR THE FUTURE

GMD has responded to the twin challenges of CO_2 emissions and congestion with its T.25 city car, a revolutionary vehicle that rewrites the design rule book.

In Formula One, Professor Gordon Murray's technical expertise helped Brabham to win two world championships and McLaren to secure three consecutive titles. He then went on to head the team behind the famous McLaren F1 Road Car, a racing version of which won the Le Mans 24-hour race.

Professor Murray and his team have used this design experience from the cutting edge of motorsport to create the T.25 city car. In the process, they have challenged conventional thinking and taken a radical new look at familiar problems.

We have done the same with our lubricants and have worked with GMD to test a concept oil that breaks the specification mould and shakes off the constraints accrued over time by modern oil specifications.

[1] Ultra-low-viscosity 0W-10 engine oil developed by Shell.
[2] Based on an urban cycle and compared with a typical SAE 10W-30 engine oil.
[3] Based on the published legislation, known car production levels and the current fleet average CO_2 level.

“TO SQUEEZE MORE FUEL ECONOMY FROM CARS THROUGH ENGINE OILS, WE BELIEVE THAT OIL AND ENGINE TECHNOLOGIES NEED TO BE DEVELOPED TOGETHER”

SELDA GUNSEL, SHELL VICE PRESIDENT FOR LUBRICANT TECHNOLOGY

Testing oil film thickness

CO-ENGINEERING THE LUBRICANT OF THE FUTURE

At Shell, we are confident that greater fuel economy improvements can be achieved through long-term technology partnerships between automotive manufacturers and lubricant companies.

Selecting the best current Shell lubricant for an existing engine design can help to considerably improve fuel economy. To reach the next level of fuel economy benefits, we design a lubricant specifically for a manufacturer's engine and optimise the formulation for piston temperature and other engine parameters. But, engine lubricants need to provide an even greater fuel economy benefit if the new targets are to be met.

To squeeze more fuel economy from cars through engine oils, we believe that oil and engine technologies need to be developed together. This approach will require long-term technology partnerships and rewriting of the oil specifications rule book.

BREAKING THE SPECIFICATION MOULD

Are established industry lubricant specifications suffocating innovation?

Punitive vehicle-related CO_2 emissions legislation could be the incentive that encourages us to reassess lubricant specifications. The number of assessed parameters and the severity of performance limits increases as the specifications evolve; it is very rare for outmoded aspects to be removed completely. This evolution reduces formulation freedom and effectively excludes more innovative formulations, thus making only compromised performance possible.

For example, low-viscosity lubricants, which may be otherwise acceptable in a suitably designed engine, are excluded by current volatility specifications, and the level of dispersant used is limited by seal tests, which many see as being poor or outmoded.

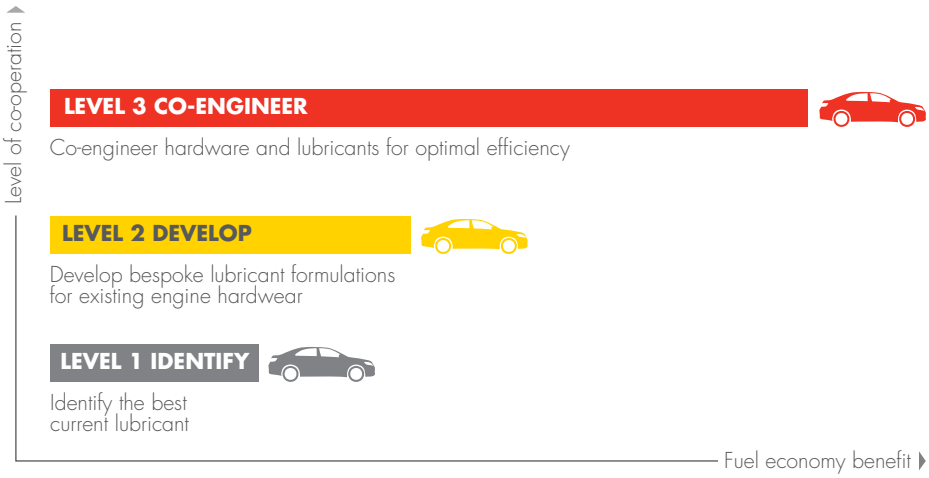
TESTING CONCEPT LUBRICANTS IN THE T.25

What can be done with a clean sheet? Shell and GMD wanted to demonstrate the potential for fuel economy improvement offered by crankcase lubricants. We worked with GMD, using its T.25 prototype, to test a concept ultra-low-viscosity 0W-10 lubricant.

The T.25's fuel economy was carefully measured at an independent laboratory in a series of chassis dynamometer tests using the concept 0W-10 oil and a 10W-30 lubricant, which is a typical European mid-tier product. The tests were run in a random sequence and repeated to ensure that the results were statistically robust.

The T.25 was subjected to an accurate simulation of the New European Driving Cycle combined and urban cycles[4]. The fuel economy improvement was 4.6% for the combined cycle and an impressive 6.5% for the urban cycle (both figures have a 99% statistical confidence). The urban cycle is particularly appropriate for an innovative city car, as it is likely to be the closest to the car's real-world use.

CLOSE CO-OPERATION FOR MAXIMUM BENEFIT



Working together: Long-term partnerships will help to realise the full potential of fuel economy improvement technologies.

FUEL ECONOMY TEST RESULTS

4.6% combined cycle[5]

6.5% urban cycle[5]

CONCEPT OIL

Our 0W-10 concept oil challenges conventional specifications and is not an industry-recognised viscosity grade.

[4] As the test vehicle was a prototype, we had to model coast-down data, but the procedure was an accurate simulation of the true New European Driving Cycle combined and urban cycles using modelled coast down data.

[5] Using a 0W-10 concept oil versus a 10W-30 oil.

"WE HAVE CHALLENGED EVERY ASPECT OF CAR DESIGN TO CREATE THE T.25, INCLUDING LOOKING AT LUBRICANT TECHNOLOGY."

PROFESSOR GORDON MURRAY, GMD CHIEF EXECUTIVE OFFICER AND TECHNICAL DIRECTOR

The T.25 uses a modern, low-friction, 660-cc engine. The fuel economy benefits may be even greater for vehicles with larger engines as more and larger cylinders means more potential to reduce friction.

"We have challenged every aspect of car design to create the T.25 and the environmentally positive iStream manufacturing process," says Professor Gordon Murray, GMD Chief Executive Officer and Technical Director. "The lubricant is no exception. It is a vital engine component that has more potential than most for improving a vehicle's fuel economy and cutting its CO_2 emissions. That is why we are working closely with Shell to test its exciting new ultra-low-viscosity concept oil."

COMMERCIALISING CONCEPT OILS

To get as close as possible to the 6.5% fuel economy improvement demonstrated in the test, a co-engineering approach between the vehicle and lubricant research and development teams is required. The challenge is balancing the friction reduction, the engine protection and the oil life so that the motorist has the benefit of fuel economy without sacrificing reliability. Only by understanding the interactions between the engine components and the lubricants in an integrated way can the balance and full fuel economy benefit be achieved.

By working together, we can solve other challenges to commercialising ultra-low-viscosity oils, particularly given the commercial incentives that the new legislation creates.

What are the advantages of a Shell technology partnership? We bring our lubricants perspective to engine and driveline technology, and use sophisticated mathematical modelling to determine the friction and fuel economy associated with each component. We then develop the ideal lubricant for each component and the optimal oil for the whole engine. For the best results, we work closely with our technology partners to develop the lubricant and engine together. With our formulation expertise, we can then create this optimal lubricant using our research and testing facilities to demonstrate its performance. We also have the blending plants and supply chain to produce and deliver the oil on a global scale.

SIX STEPS TO ENHANCED FUEL ECONOMY

Mathematical modelling of friction, fuel economy and CO_2 emissions

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Lubricants' perspective engine and driveline technology audits

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Ideal lubricant for each component and the optimum for the whole engine

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Formulation expertise to create the optimal lubricant

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Analytical studies, laboratory testing and field trials prove the benefits

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Supply chain for large-scale, global delivery

Technology Partnership: Working with us, from mathematical modelling to global delivery, can add real value.

TECHNOLOGY LEADERSHIP

The development and application of innovative technology sit at the heart of everything Shell does. We invest in cutting-edge laboratories in Asia, Europe and the USA, and recruit top-class scientists. They are the people who develop the products that make a difference to your business, even under the most challenging conditions. What we learn in our collaborations, from the Airbus A380 to Ferrari, we use to create lubricant solutions to meet your business needs.

Shell has over 70 years of continuous lubricants research experience and has introduced many new technologies. For example, in 2008, we were the first company to launch a low-SAPS, fuel-efficient heavy-duty engine oil – Shell Rimula R6 LME – which was developed with Mercedes-Benz.

At Shell, we are increasing our understanding of emerging technologies, such as new component coatings and low-friction piston designs, by taking full advantage of mathematical modelling to examine how they interact with lubricants.

We are also investing in the long-term technology partnerships with manufacturers that will be needed for step-out co-engineering solutions. There are many interesting possibilities, including split-lubricant engines, oils with temperature-controlled viscosities and magnetorheological fluids.

"When I first worked with Shell over 20 years ago in Formula One, we were all obsessed with performance. Shell Lubricants helped to give us race-winning performance and reliability, which is why we recommended using Shell Helix Ultra in our McLaren F1 Road Cars. Like us, Shell is still passionate about performance, but we are now very much focused on efficiency. That is why I called Shell when we were designing the T.25."

PROFESSOR GORDON MURRAY
GMD CHIEF EXECUTIVE OFFICER AND TECHNICAL DIRECTOR

WINNING ROAD TRIALS

The T.25 won both its categories at The Royal Automobile Club's inaugural Brighton to London Future Car Challenge. The petrol-powered T.25, on its first public outing, won awards as the most economic and environmentally friendly, small, passenger internal-combustion-engine vehicle.

The lightweight T.25 achieved 96 mpg (2.9 L per 100 km), despite not yet being fully optimised for fuel efficiency, and beat eight diesel-engine entrants. Using a sample of 16 small passenger cars, GMD calculates an average efficiency increase of 27% for a diesel model. Therefore, had the car been powered by a diesel engine, it could have recorded a staggering 131 mpg (2.2 L per 100 km).

"At the moment, collaboration tends to mean finding the most effective lubricant for the latest, but fixed, hardware design. What collaboration should mean is developing the hardware and lubricant together to give the best overall solution. And, there has never been a more urgent need or rewarding time to work together."

SELDA GUNSEL
SHELL VICE PRESIDENT FOR LUBRICANT TECHNOLOGY

WORKING WITH SHELL

If you are serious about working to improve vehicle efficiency, talk to us about the contribution that engine and driveline lubricants can make.

shell.com

"Shell Lubricants" refers to the various Shell companies engaged in the lubricants business.