Power & performance

Jaguar Land Rover's director of powertrain engineering **Ron Lee** discusses the development of the efficient high-performance Ingenium engine

Ron Lee

Engineers at Jaguar Land Rover (JLR) have designed and developed a new range of petrol and diesel engines that will offer the class-leading performance expected of the renowned automotive brand alongside lower emissions and reduced fuel consumption.

The Ingenium family of engines use lightweight modular technology to deliver the balance of efficiency and performance. The engines were developed at JLR's Midlands facilities (Whitley and Gaydon) where powertrain engineers responded to a complex brief that demanded technological innovation in addition to the flexibility to enable application across the range of new JLR vehicles.

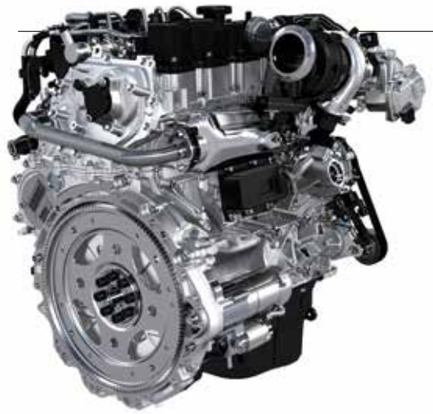
"Clearly the engine had to support our vehicles – that means a whole range of products on a worldwide basis," explains Ron Lee, director of powertrain engineering at JLR. "The engine had to be world class, there is no point in doing something that isn't in line with the best of the competition, and it had to be capable of taking the best technologies both at launch and as technology develops."

The launch of the Ingenium engine follows JLR's decision to invest in its own engine facility. During JLR's association with Ford powertrain engineering was consolidated into a single operation. Since coming out of Ford, JLR determined to develop its own engines in order to support the company's growth and its particular technology requirements. The company invested £40 million to enhance its Powertrain Engineering facility at the Whitley Technical Centre. "Its not a trivial action to develop a new range of engines and develop and engine facility simultaneously," comments Lee.

The Ingenium's architecture, in both the petrol and diesel versions, is based on strong, compact aluminium blocks. These lightweight blocks share the same bore, stroke, cylinder spacing and 500cc cylinder capacity. This helps give the engine the configurability and flexibility around which smaller or larger engines can efficiently be developed to meet future regulatory and competitive requirements. Furthermore, the modular design enables both petrol and diesel engines to share many common internal components and calibration strategies.

From a technology perspective the Ingenium features six key developments designed to reduce friction, add refinement, and improve performance: roller bearings on cam and balancer shafts; computer-controlled variable oil pumps; computer-controlled variable water pumps that adjust coolant flow; simplified cam drive system; crankshafts offset from the centre of the block; and electronically controlled piston cooling jets.

Furthermore, the Ingenium represents a significant step forward in engine lightweighting. "In comparison to our existing diesel engines it offers a substantial improvement in weight," says Lee. "Our engine is all aluminium and is a very competitive weight."



Lee estimates that the Ingenium engine family has been four years in development and during that time JLR's engine team has doubled in size. He says: "We have added to what was a successful team already to give it broader capability and deal with the capacity of work."

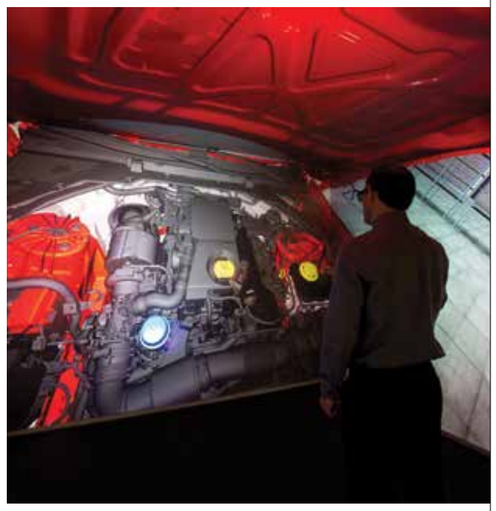
Production is scheduled to commence at the Engine Manufacturing Centre in the Black Country (JLR's first new plant built from the ground up) in 2015 and in advance of the start of manufacturing JLR is managing a recruitment drive in the Midlands region. "Additionally we've got a big training programme that we put everybody through to make sure they've got absolutely the right skills and capabilities coming into the plant," continues Lee. "A new engine plant is the best opportunity you'll ever have to get the most skilled workforce delivering what you want."

"A huge amount of simultaneous engineering is going on between the design engineers of the product and the design engineers of the plant," he says. " Now we are at the stage where the plant is built, everything is installed and working and we are running through production ramp-up checks to ensure the machines are capable."

As one might expect testing is rigorous and by the end of the programme the engine will have undergone more than 72,000 hours of dyno testing and two million miles of road testing. "Some of the tests are gruesome having been developed over years to replicate the worst that people can throw at the engine," elaborates Lee.

Having a new manufacturing facility to move into has liberated the design of the Ingenium allowing engineers to prioritize lightweighting, performance, and reducing CO_2 emissions. "We were able to design Ingenium in this way because we had the rare opportunity to start the project with a clean sheet of paper," comments Lee. "We weren't locked into any of the usual restrictions that force engineering compromises because we had no existing production machinery that would dictate design parameters, no carryover engine architectures to utilize and no existing factory to modify."

"Being configurable and flexible



are the two key strands of Ingenium's DNA because we have future-proofed our new engines from the outset," Lee concludes. "Ingenium will be able to accept new advances in fuel, turbocharging, emissions, performance and electrification technologies when they are ready and accessible to be deployed. Ingenium fulfils our commitment to offer our global customers some of the most advanced powertrains available in some of the lightest vehicles in the premium SUV and performance car segments."

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