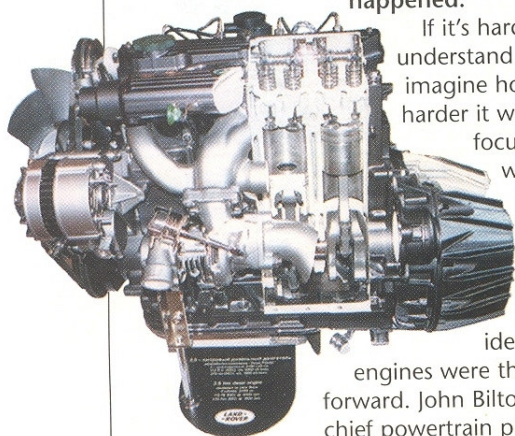


Diesel revolution

The Tdi engine changed the face of Land Rover forever. James Taylor charts its history

Below: Cutaway seen at various Motor Shows revealed basic layout of original Tdi

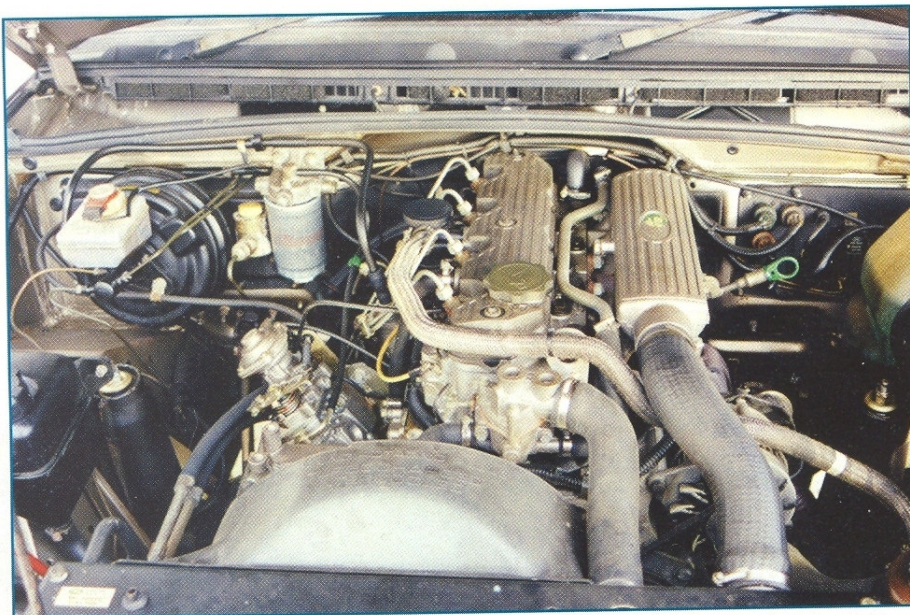
Bottom: Under the bonnet – this is an early 200 Tdi



It's hard now to understand what a major change the original Tdi engine brought about at Land Rover. But let's put it this way: about 15 percent of the company's annual production was diesel-powered in the 1970s, and by 1992, the figure had risen to some 65 percent. Without the Tdi, that wouldn't have happened.

If it's hard for us to understand now, imagine how much harder it was for petrol-focused people working at Land Rover in the early 1980s to get their heads around the idea that diesel engines were the way forward. John Bilton, who as chief powertrain planner was

Without the Tdi, the Discovery would have cost more and might never have sold so well



the man directly responsible for the Tdi concept, told me that it would have been a long battle to get diesel accepted without the enthusiastic support of Managing Director Tony Gilroy and Product Planning supremo Alan Edis.

It's no surprise that the real impetus for change came from the oil crises of the 1970s, and in particular from the second crisis of 1979. All over Europe, manufacturers switched to diesel engines for passenger cars to keep running costs down as oil prices rose, and understanding governments (which did not include ours in the UK) provided tax incentives to ease the transition. Petrol

engines, and particularly thirsty ones like the Rover V8, became unfashionable liabilities overnight.

Land Rover's product planners recognised that they would need a modern diesel engine if they were to make headway with sales in Europe. Then, in 1981, the company's sales in Africa and other developing countries collapsed. This made a new focus on sales in Europe imperative for Land Rover's survival, and so in 1981 the decision was made to work with Perkins Engines on Project Iceberg, a diesel version of the much-loved Rover V8.

For a variety of reasons, that project was abandoned in 1983. So in 1984 the product planners came up with a new strategy. In the short term, they would use the VM four-cylinder diesel in the Range Rover and turbocharge the existing 2.5-litre Land Rover diesel for the utilities. Longer-term, there would have to be a new four-cylinder engine which could replace both of these.

The problem was that Land Rover was strapped for cash. The company had made losses in the early 1980s, and was busily trying to save money by closing its satellite manufacturing plants and concentrating its operations onto the Solihull site. A new engine programme seemed out of the question – unless that new engine could be developed from one which Land Rover already had in production, just as had been attempted with the Iceberg V8.

John Bilton had been keeping an eye on progress with direct-injection fuel systems in the early 1980s, and he proposed developing a new direct-injection cylinder head for the existing Land Rover diesel. Despite its age (the design's roots lay in the original Rover 2-litre diesel of 1957), this engine was a robust and well-respected unit, and of course its manufacturing facilities had been completely renewed in

1980 when the switch had been made to five bearings from the original three. Plans were already in place to increase its capacity from 2.25 litres to 2.5 litres by means of a new crankshaft.

There were huge advantages to this plan. Direct injection promised better fuel economy than the existing indirect-injection system, longer oil life, and easier starting – which would allow the use of a single battery instead of the two needed for older Land Rover diesels. By making the cylinder head of aluminium alloy instead of cast iron, Bilton reckoned that he could also save around 23 kg on the weight of the engine. With a turbocharger and intercooler, really worthwhile improvements in performance and drivability would also be possible.

And so Project Gemini was born. Few people know that in the beginning there were to be naturally-aspirated diesel and even petrol derivatives, all based on the same update. Bilton told me that the petrol engine's cylinder head would have been identical to the diesel's, with the injector ports machined to take the spark plugs. In the event, the petrol and naturally-aspirated diesel Gemini types were never made – although

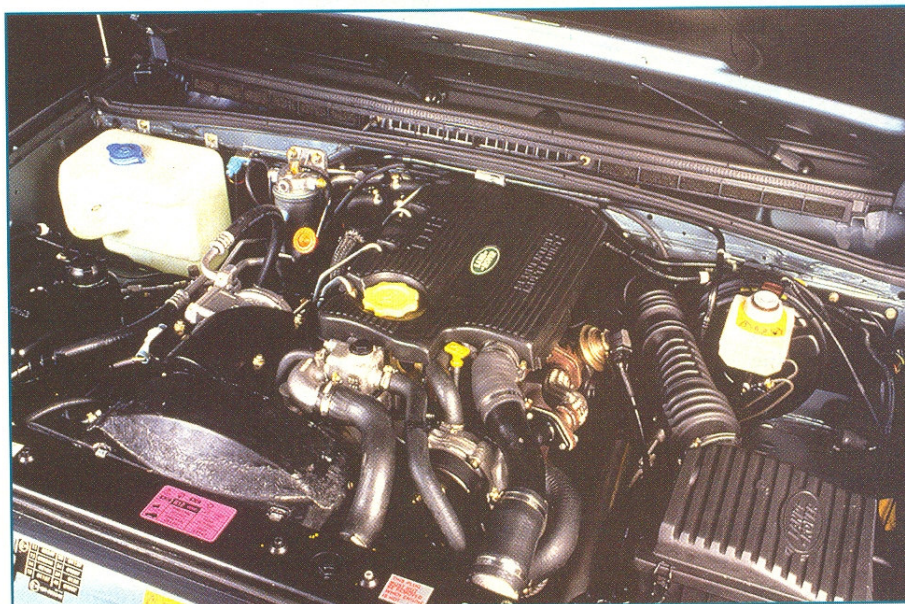
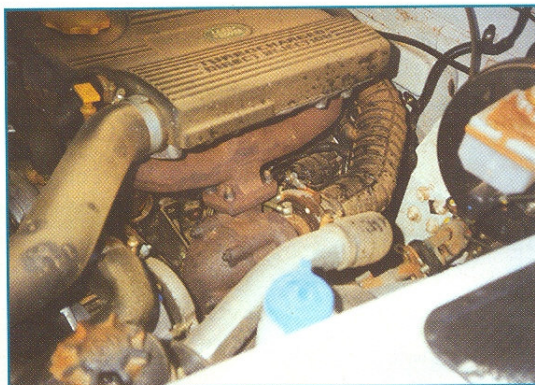
Land Rover did allocate engine prefix numbers for them!

The key factor was always going to be getting support from the major suppliers. Although Ricardo and Lucas-CAV in the UK were approached, they did not put together a convincing business case. So Land Rover decided to work with AVL in Austria, who were already working closely with Bosch on certain vital components. Bilton and Alan Edis had their first discussions with AVL in 1984, by 1985 the project was well under way, and by 1986 the full Gemini product programme had been laid out.

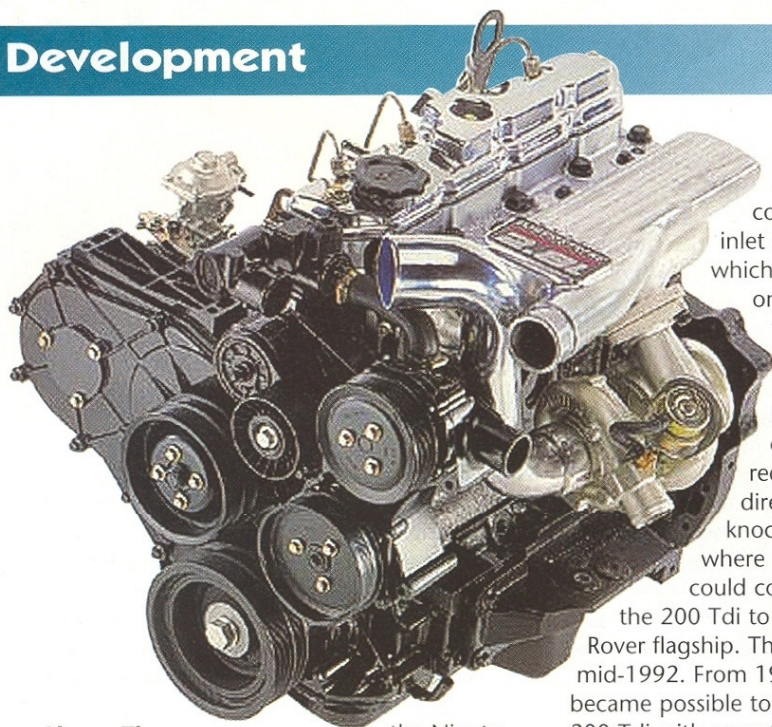
Things went swimmingly. Bosch's new two-stage injectors reduced the noise levels that had always been direct injection's major disadvantage. Bilton remembered a trip to Austria to review progress on

Below: 300 Tdi is still made in Brazil, with minor pipework differences from the UK original

Bottom: Engine bay always looked neater when the 300 Tdi was fitted



Development



Above: The Power Stroke 2.8 engine is recognisably derived from the 300 Tdi

the Ninety which AVL were using as a test mule, and discovering that the design targets of 100 bhp and 180 lb ft of torque would easily be exceeded. The targets were re-set at 111 bhp and 195 lb ft, and in that guise the engine was launched as the 200 Tdi for the Discovery in 1989.

Of course, development never stops. Once the Gemini engine had been signed off for

First came a rubber top cover for the inlet manifold, which was fitted on engines from 1991, and then came a larger rubber cover which reduced the direct-injection knock to levels where Land Rover could confidently fit

the 200 Tdi to its Range Rover flagship. That was in mid-1992. From 1993, it became possible to order the 200 Tdi with an automatic transmission in the Discovery – although the engine did not sparkle in this guise.

To go beyond this level of refinement needed more radical work, however, and the project to develop a refined, second-generation Tdi engine became known as Gemini 2. At about the same time, work began on a militarised version of the Tdi under the code name of Wolf

(the name later given to the Defender XD). This focused mainly on front end

packaging, to make room for the large 24-volt military generator. Prototypes were made and ran in vehicles, but before too long the refinement and militarisation programmes were merged into a single development programme to produce a second-generation Tdi. This

engine was launched in March 1994 as the 300 Tdi, the 3 of 300 coming directly from the project name of Gemini 3.

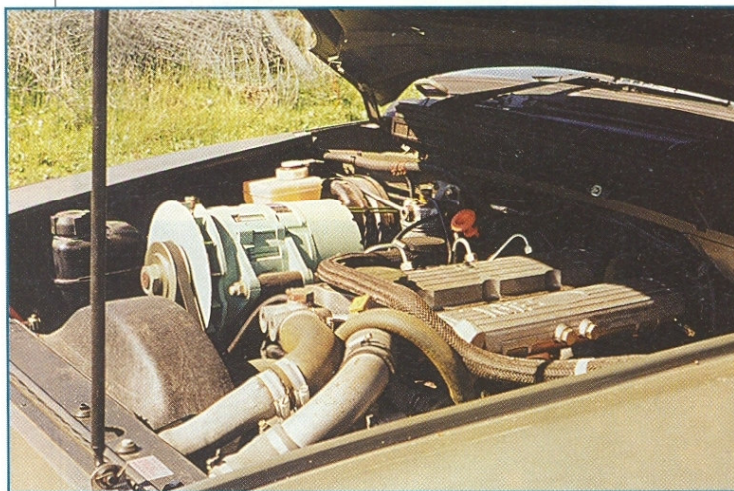
With 208 new or modified components, the 300 Tdi was far more refined than the 200 Tdi it replaced. And, of course, the military development work made it suitable for the Defender XD models developed

initially for the British Army in the mid-1990s. However, Land Rover believed that durability was a key element in the appeal of the Tdi engine, and so the 300 Tdi had no more power or torque than the 200 Tdi.

Defender owners got a better deal, though, as 300 Tdi-powered models had the same 111 bhp and 195 lb ft as the Discovery instead of a de-powered engine as before. Then, a year into production, a new 120 bhp tune with 221 lb ft of torque was introduced to give automatic Discoverys more acceptable performance. To keep emissions within limits, these engines also had Bosch DDE (Digital Diesel Electronics) control systems, but they were never made available elsewhere.

How much power could have been got out of the Tdi? Alex Stephenson, then Director of Powertrain Engineering, once told me that his engineers reckoned on a maximum of 140 bhp if the engine was to be reliable. Of course, that was in 2.5-litre guise; as John Bilton explained, it would have been possible to increase the bore size to give 2.8 litres – although this would have implied siamesing the bores.

In fact, the Tdi did go to 2.8 litres, although it wasn't Land Rover who developed it. When 300 Tdi production gave way to Td5 production in 1998, the engine lines were sold to International in Brazil. Part of the deal was that International would continue to supply Land Rover with 300 Tdi engines as needed – and they are still used in Defenders built in many overseas locations, although they do not meet the latest European emission standards. More interestingly, though, International bought the rights to develop the engine further, and they have turned it into the Power Stroke 2.8, using the latest variable-nozzle turbocharger technology and larger bores. In top-line guise, it pumps out 135 bhp and 277 lb ft – and you can still buy one. ■



Above: A militarised 200 Tdi engine under the bonnet of a Challenger prototype

the Discovery in early 1989, work went ahead on the next stage. This was a detuned version for the Defender, with different manifolding and a high-mounted turbocharger. And although refinement had met the targets which the Product Planners had set many years earlier, work began on making the engine quieter still.