FORD MOTOR COMPANY AND PSA PEUGEOT CITROËN DIESEL ENGINE CO-OPERATION: PHASE FOUR

COOPÉRATION AUTOUR DE NOUVEAUX MOTEURS DIESEL ENTRE FORD MOTOR COMPANY ET PSA PEUGEOT CITROËN: PHASE 4

October 5, 2005

5 octobre 2005

PSA PEUGEOT CITROËN

Press Kit

October 5th 2005

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CHAPTER ONE

HISTORY OF THE CO-OPERATION

Just over seven years since the signing of a four-phase co-operation agreement between PSA Peugeot Citroën and Ford Motor Company for the joint production of light, efficient and clean diesel engines, the two companies today announced Phase 4 of the co-operation.

This consists of a new family of 2.2-litre diesel engines for light and medium commercial vehicles, and a brand new 2.2-litre diesel engine for the upper mid-range and executive cars of the two partners' brands.

Timeline

In September 1998, PSA Peugeot Citroën and Ford Motor Company signed a large scale agreement to co-operate in the field of diesel engine production. The agreement included the joint design and production of four families of common rail direct injection diesel engines.

Three successful phases later, the two partners are now the world's leading manufacturers of diesel engines and will have built over four million diesel engines between 2002 and 2005.

The aim of this co-operation has been to deliver a world-class range of diesel engines while providing industry-leading economies of scale. The engines have showcased the engineering expertise of the two organisations and have enabled them to reach customers in the volume segments and also in the highly specialised and demanding niche segments.

The diesel engines have consistently shared four characteristics. Outstanding fuel economy, excellent refinement with low levels of noise intrusion, clean combustion and outstanding performance.

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Key Dates

Below is a summary of the key phases of development of Ford Motor Company's and PSA Peugeot Citroën's joint engine agreement.

Phase 1 of the co-operation was a 1.4 litre (1,399cc) common-rail turbo-diesel engine and used by Ford in the Fiesta and Fusion, by Peugeot initially in the 206 and later in the 307 and by Citroën in the C2 and C3. This was first announced in 2001. A 1.6 litre (1,590cc) common-rail diesel engine was also part of the Phase 1 announcement and, together with the 1.4-litre variant, is now used in a wide variety of Ford Motor Company and PSA Peugeot Citroën applications.

Phase 2 of the co-operation was a 2.0 (1,998cc), four cylinder common-rail turbo-diesel 16 valve unit, announced in early 2003 and also used in a wide variety of Ford Motor Company and PSA Peugeot Citroën applications.

Phase 3: While the first two phases of the project were led by PSA Peugeot Citroën, Phase 3 was led by Ford Motor Company. This was the production of a high performance V6 six-cylinder 24-valve unit, announced in June 2003. The first product to benefit from this engine was the Jaguar S-Type, followed by the Peugeot 607. Since then, it has also been installed in the Land Rover Discovery, Range Rover Sport and the new Jaguar XJ and will be fitted in the Peugeot 407 Coupe and the Citroën C6 when both cars are launched on the market.

Phase 4: 2005 sees Ford Motor Company leading production of a family of 2.2-litre common-rail diesel engines for use in Ford Motor Company and PSA Peugeot Citroën light and medium commercial vehicles. PSA Peugeot Citroen leads production on a separate 2.2-litre engine for the companies' upper mid-range and executive vehicles.

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CHAPTER TWO

NEW CLEAN, FUEL EFFICIENT DIESEL ENGINES FOR LIGHT AND MEDIUM COMMERCIAL VEHICLES

A 'smart' 2.2-litre common-rail diesel commercial vehicle engine with the ability to think for itself is announced today, the latest stage of a Ford Motor Company/PSA Peugeot Citroën joint diesel engine co-operation agreement.

With the announcement of this fourth phase of the agreement, Ford Motor Company and PSA Peugeot Citroën now have a full range of high tech, efficient and clean common-rail diesel engines servicing the needs of both parties.

Joint investment on the new program of common rail diesel engines for light and medium commercial vehicles totals €120 million. While the design was Ford-led, PSA engineers were involved at every stage of the engine's development.

The co-operation between Ford Motor Company and PSA Peugeot Citroën has proved to be a huge success so far, as engines from the co-operation now feature in vehicles in the small, medium and large car sectors (including large and small MPVs), and now commercial vehicles. This is a significant achievement, taking just eight years from first inception, and resulting in engines produced in large volumes.

The four-stage co-operation was first announced in 1998 and expanded upon in 1999, and both parties are optimistic there will be future co-operation between Ford Motor Company and PSA Peugeot Citroën.

From the beginning of the co-operation to the end of 2005 more than four million diesel engines will have been produced for a number of different applications as part of this agreement, leading to an upgrading of capacity at the two major plants where the engines are produced.

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Ford Motor Company and PSA Peugeot Citroën clearly understand the importance of having a state-of-the-art commercial vehicle diesel engine which has not been derived from a car unit. For both companies, van sales play a crucial role in their sales success in Europe.

Diesel engines have proved massively popular in Europe for many decades – indeed 95 per cent of commercial vehicles sold on the continent are diesel powered. For Ford Motor Company and PSA Peugeot Citroën, diesel popularity carries an even greater significance, as 98 per cent of all their light commercial vehicle sales in 2004 in Europe were of diesel models – thus making the need for a class leading engine essential.

The trend is also evident in passenger vehicles. Today some 44 per cent of the sales in the passenger car market in Europe are of diesel variants, while in Austria, France and Belgium more than 55 per cent of all new car sales in recent years are of diesels.

This new Ford Motor Company/PSA Peugeot Citroën engine will not just be the first engine specifically designed for light and medium commercial vehicles to be produced under the agreement, it also meets Euro 4 emissions requirements (mandatory for light trucks in 2006).

Environmental considerations and the need to produce 'green' diesel engines were uppermost in the minds of the engineering team – for instance this new engine produces just half the amount of Nitrogen Oxide emissions compared with the engine from which it was developed. Carbon Dioxide emissions are reduced by 20 per cent and particulates are down by 40 per cent.

VEHICLE APPLICATIONS

The 2.2 light commercial common-rail diesel engine will be used by Ford of Europe in its front-wheel-drive Transit from 2006, and by PSA Peugeot Citroën in its upper range LCVs (Boxer and Jumper). Work began on the new commercial vehicle engine in 2001 and was led by Ford Motor Company engineers at the Dagenham Diesel Centre in Essex in association with PSA Peugeot Citroën. Although the new engine is based on an existing engine architecture, it introduces a large number of technical innovations, raising the bar even higher for engine technology in the commercial vehicle sector.

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The new 2.2-litre light and medium commercial common-rail diesel engine will be offered by Ford Motor Company and PSA Group brands in five different outputs, which all meet Euro 4 emission legislation.

Offering a variation of power levels from the same family of engines ensures the commercial vehicle operator can choose the engine that is right for them: lower power for regular town or city driving, or higher power for long distance cruising.

TECHNICAL INNOVATION

All versions of this engine are 2,198cc in displacement, dual overhead camshaft (DOHC), four cylinders 'in line' with four valves per cylinder head (16 valves in total). The engines feature high grade aluminium alloy cylinder heads with an iron cylinder block.

The engine will be offered in five configurations: 85PS (torque: 250Nm), 100PS (torque: 250Nm), 110PS (torque: 285Nm), 120PS (320Nm), and 130PS (torque: 310Nm). The engine has been developed to minimise overall weight, which is a real benefit for a commercial engine installation.

New fuel injection system

The new engine employs the latest generation common-rail direct injection system, which has ensured the engine family meets Euro 4 compliance and further improves reliability.

The fuel injection system has an innovative pilot learning process. This intelligent process guarantees that the small 'pilot' injection quantity so critical to low noise and emissions on modern high pressure common-rail engines, is delivered accurately across all cylinders for the life of the vehicle.

This level of control is achieved by periodically injecting five discrete injection events per cycle instead of the normal pilot and main injections. The engine management system then compares the engine operation and will fractionally adjust the pilot quantity to minimise noise and emissions.

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The high pressure fuel injection system used ensures fuel is available at high pressure at each cylinder injection point. At critical points of the engine stroke, the electronic control of the injector valves allows very fine jets of fuel to be sprayed into the combustion chamber. This makes the combustion process clean and efficient, thus lowering emissions, improving fuel economy and increasing torque on each firing of the cylinder.

Another feature which has helped reduce Nitrogen Oxide emissions by half is a high-flow, electronically controlled Exhaust Gas Recirculation (e-EGR) system which reduces combustion temperatures, and is mapped to the operating conditions of the engine and cooled by a water based heat exchanger. The electronic system allows better controllability, lower and more consistent emissions, and complete elimination of black smoke.

The e-EGR incorporates an anti-contamination system, which uses smart electronics to monitor the engine's efficiency and to correct itself when necessary. The e-EGR can carry out this process regardless of the driving cycle of the vehicle, and ensures robustness regardless of how the vehicle is used.

Power improvements

The new 2.2-litre engine's wide range of available power and torque configurations ensures that there is an appropriate offering to meet the individual needs of commercial vehicle operators. All versions provide excellent driveability in town and higher powered versions provide sustained cruising ability over long distances.

The entry and mid level engines use a fixed geometry turbocharger, while the higher powered engines rely on a variable geometry turbo.

Using a fixed geometry turbocharger will allow both Ford of Europe and PSA Peugeot Citroën to offer a highly competitive entry point for their commercial vehicle ranges, without compromising on quality.

The variable geometry system offers greater torque at lower speeds, while the turbo adapts to the needs and driving characteristics of the driver.

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This is achieved by the electronic control of the vane angles of the turbocharger, as it allows accurate control of boost pressure over a wider operating range. The electric control ensures greater responsiveness and improved and more accurate boost control than before.

The medium and high power engines employ gallery cooled pistons to cope with the higher power density.

Significant weight reduction

Compared with the unit that provided the base architecture for the new engine, a 12kg reduction of weight has been achieved, thanks to an optimised block structure and the use of the latest finite element computer analysis. This also allows for better noise performance. The fuel injector pump now runs directly on the camshaft rather than off the engine block itself, which contributes another significant weight loss. The camshaft is also driven by a simplex chain that is light and is quiet.

Weight reduction has also been achieved by the use of a lighter front end accessory drive, which powers the alternator, power steering pump, vacuum pump, water pump and air conditioning compressor. This weight loss delivers driveability and fuel economy advantages for the commercial vehicle customer, especially with a lightly loaded vehicle, and there are is also an increase in payload capacity for the driver with a regularly heavily laden vehicle.

Common-rail reliability and durability

Optimised reliability and durability appropriate to commercial vehicle usage were key considerations for both Ford Motor Company and PSA Peugeot Citroën. The use of a latest generation high-performance common-rail fuel injection system, which has demonstrated a very high level of reliability and robustness in a commercial vehicle application, meets this requirement.

In the interests of improved efficiency, power output and to meet Euro 4 emission requirements, the combustion system has been carefully engineered, with the use of new intake ports in the cylinder head and a new piston bowl geometry.

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The new system has a higher injection pressure capability at lower engine speeds, which provides higher torque levels at low engine speeds.

Ford engineers at the Dagenham Diesel Centre have worked hard to improve the swirl and flow rate through optimising the design of the intake port, while maintaining the robustness of the system. This has provided better emissions and increased performance.

INCREASED CUSTOMER RESEARCH AND TESTING

Ford Motor Company and PSA Peugeot Citroën have taken research into the needs of their light and medium commercial customers to a new level, undertaking 100,000 hours of testing on this engine family.

Uniquely for a commercial vehicle engine programme, the development of these engines used 'real world' data taken from customers' vehicles around Europe using data loggers (similar to 'black box' flight recorders). These were installed in vehicles for between six to twelve months. The data collection monitored key parameters such as engine and vehicle speed, fuelling, throttle position, EGR Valve performance, among others. Around 100,000 hours and 4.9 million kilometres of driving data was generated during the data-logging period.

The Ford Diesel Test Methodology team used the customer usage information to develop a wide variety of new customer correlated dynamometer tests aimed at proving out the robustness of the engine. This information was also shared with suppliers to help with their component and systems development.

This information has been instrumental in helping engineers develop an engine family totally geared to the needs, uses and driving habits of its customers.

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DESIGNED, DEVELOPED AND BUILT IN THE UK

The state-of-the-art Dagenham Diesel Centre in the UK is a purpose-built facility dedicated to the development of clean, efficient diesel engines meeting not only the demands of Ford customers and PSA Peugeot Citroën's, but also the need to be kind to the environment by reducing emissions.

The Ford estate at Dagenham is home to the company's diesel engine design and manufacture operations, with €825 million invested there over the past three years. Diesel engine development and production at Dagenham employs some 2,350 engineers and production workers. This year the site will manufacture almost 700,000 diesel engines.

The Dagenham Diesel Centre building is part of Ford Motor Company's Dagenham estate (and the first new building on the site for more than 30 years) and it was opened in November 2003 by British Prime Minister, Tony Blair. The new 2.2-litre commercial vehicle diesel engine is the second powertrain from the Ford Motor Company and PSA Peugeot Citroën co-operation to be designed and developed at the Dagenham Diesel Centre.

All 2.2-litre common-rail turbo-diesel commercial vehicle engines produced for Ford Motor Company and PSA Peugeot Citroën under this joint co-operation programme were also designed at the Dagenham facility. They will be built at Dagenham at the rate of up to 200,000 engines a year.

TIMESCALES

Engine production will start at Dagenham in October 2005. The engine will be installed in Ford of Europe and PSA Peugeot Citroën vehicles during 2006.

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TECHNICAL SPECIFICATION OF THE NEW 2,2l COMMON RAIL DIESEL COMMERCIAL VEHICLE ENGINE

Model (PS)	85	100	110	120	130
ENGINE SPECIFICATION					
Fuel type	Diesel	Diesel	Diesel	Diesel	Diesel
Combustion system	HPCR	HPCR	HPCR	HPCR	HPCR
2 or 4 stroke	4 Stroke	4 Stroke	4 Stroke	4 Stroke	4 Stroke
No. of cylinders	4	4	4	4	4
Cylinder configuration	In line	In line	In line	In line	In line
Installation in vehicle	East West	East West	East West	East West	East West
Aspiration	FGT	FGT	FGT	FGT	VGT
Displacement (cc)	2,198	2,198	2,198	2,198	2,198
Bore	86	86	86	86	86
Stroke	94.6	94.6	94.6	94.6	94.6
Compression ratio	17.5:1	17.5:1	17.5:1	17.5:1	17.5:1
Firing order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2
Camshaft location	DOHC	DOHC	DOHC	DOHC	DOHC
Direction of rotation, viewed from front	Clockwise	Clockwise	Clockwise	Clockwise	Clockwise
Displacement per cylinder	0.5495	0.5495	0.5495	0.5495	0.5495
Stroke/bore ratio	1.1	1.1	1.1	1.1	1.1
Bore/stroke ratio	0.909	0.909	0.909	0.909	0.909
ENGINE PERFORMANCE					
Max. power (kW)	62.5	74	81	88	96
Speed at max. power (rpm)	3500	2900 - 4000	3500	3500	3500
Specific power (kW/litre)	28.43	33.7	36.85	40.04	43.68
Max. torque (Nm)	250	250	285	320	310
Speed at max. torque (rpm)	1500-2200	1500 - 2800	1750-2250	2000-2300	1600-2500

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CHAPTER THREE

NEW 2.2-litre DIESEL TOPS CO-OPERATION HDi/TDCi FOUR-CYLINDER RANGE

The ongoing success of the co-operation between PSA Peugeot Citroën and Ford Motor Company is further illustrated by the introduction of an all new 2.2-litre diesel engine for passenger cars.

The new 2.2-litre HDi/TDCi diesel engine resulting from the co-operation agreement between PSA Peugeot Citroën and Ford Motor Company was designed to meet the highly ambitious challenge of offering the excitement and driveability of the best 2.5-litre diesel engines on the market, combined with superior environmental performance (complying with Euro IV emission standards and being equipped with a particulate filter), enhanced fuel efficiency and lower CO_2 emissions.

The engine will be used on a number of platforms for upper mid-range and executive cars produced by both manufacturers.

Other challenges integrated in the specifications included the ability to offer excellent pedestrian protection and the low noise intrusion that customers expect from these models.

Because downsizing had proven so effective in the previous phase of their co-operation, PSA Peugeot Citroën and Ford Motor Company opted to keep the new engine small, setting the displacement at 2.2-litres to reduce fuel consumption and CO_2 emissions, without sacrificing any of its performance features.

As the latest addition to the line of four-cylinder diesels produced by the carmakers' cooperative venture, the 2.2-litre HDi/TDCi leverages the competitive advantages of the Trémery facility, the world's largest diesel engine plant which has been home to a large proportion of the HDi/TDCi family of diesel engines from the beginning of the co-operation.

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The new engine will also capitalize on the extensive skills of the plant's workforce, hired and expanded since the facility first began deploying common-rail technology for PSA Peugeot Citroën in 1998.

Although the 2.2-litre version was not initially included in the 1998 framework agreement between PSA Peugeot Citroën and Ford Motor Company, its development reflects the excellent health of the co-operation and further illustrates the two Groups' ability to work together in developing state-of-the-art diesel engines.

2.2-LITRE HDI/TDCI INNOVATIONS

Extreme Conventional Combustion System (ECCS)

The HDi/TDCi 2.2-litre engine has a brand-new ECCS combustion chamber that reduces emissions of regulated pollutants at source by 30 per cent while improving performance and running noise. This combustion chamber has a large diameter and low compression ratio, which produces a more uniform air/fuel mix.

The size of the combustion chamber limits the amount of fuel in contact with the walls, thereby ensuring that fuel combustion is more efficient. Piston geometry and design have been tailored to create a 25 per cent larger diameter combustion chamber compared with the previous engine generation. The use of aluminium with very high mechanical and thermal properties is a key feature to achieve such a piston design.

Remarkably, the new ECCS system did not require any changes in the production tooling for the PSA Peugeot Citroën DW family of engines, common to the other engines produced in this plant. The special geometry also significantly reduced swirl in the combustion chamber, thereby reducing heat loss to the walls and improving the engine's efficiency. As a result, fuel efficiency under all driving conditions has been improved by 2% compared to the previous generation, meanwhile the driveability offered has increased sharply by 25%.

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A third-generation, common-rail injection system with pressure increased to 1,800 bar

The combustion system is combined with an all-new Bosch third-generation common-rail injection system whose pressure has been raised to 1,800 bar, an increase of 33% over the first generation's 1,350 bar.

The high injection pressure and the new Bosch piezoelectric injectors with seven 135 µm nozzles—compared with five in the first generation—enable up to six injections per engine cycle, thereby making fuel injection more precise and improving injection duration. This in turn enhances management of the introduction rate, or the ratio of the amount of diesel injected to the injection duration. The injection spray is finer, which reduces emissions, since the air/diesel mix is even more uniform.

Superior environmental performance with maintenance-free particulate filter technology

As the jewel in the crown of the two carmakers' four-cylinder, common-rail diesel line up, the 2.2-litre HDi/TDCi had to set the standard for environmental protection.

Ultimately, all the cars powered by the new engine will be equipped with maintenance free diesel particulate filter technology. PSA Peugeot Citroën will use additives-based PF technology that has demonstrated its robustness and efficiency on more than a million vehicles worldwide, while Ford Motor Company will use catalyst-based PF technology.

Variable geometry single turbo and parallel sequential dual turbo

To enhance driveability—and in particular the torque delivered at low revs—a world first for a four-cylinder diesel engine was developed: a parallel sequential dual turbo.

A small, low-inertia turbo means that the engine is responsive even at low revs. Since it is too small to cover the entire engine operating range, a second turbo of the same size kicks in at 2,700 rpm. Both turbos are fully managed by the engine management system.

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Alongside Honeywell Turbo Technology, PSA Peugeot Citroën and Ford Motor Company have filed five patents for this innovative technology, which makes torque available at low revs and responds immediately when the turbo comes on line.

The maximum torque of 400 Nm is reached at 1,750 rpm. A third-generation electrically controlled variable geometry turbo was also developed for applications which do not require the bi-turbo ultimate boost at low engine speed. Electrical control enables precise, fast management of the turbo's variable geometry to optimize boost pressure at each engine operating point.

ENGINE COMPONENTS

The compact HDi/TDCi 2.2-litre engine meets the requirements of cross-platform applications and protects vulnerable road users (in particular pedestrians).

The carefully engineered dimensions significantly reduced overall engine height by 40 millimeters. In addition, enhanced engine performance led to the development of a new upper engine portion that comprises:

- The cylinder head with a single cooling flow, which also reduces heat loss, is made from an aluminum-copper alloy. The properties of the material deliver enhanced thermo-mechanical performance. The simple, uniform water system cools the cylinder head precisely, reducing the amount of water used and simplifying the process.

- A patented double-wall crankcase was developed specifically for the project to reduce the radiated noise from the engine by three decibels, which is very significant in terms of customer perception. The crankcase's technological challenge was to produce its unique technology directly in the foundry.

- Two counter-rotating balance shafts reduce vibration to a minimum.

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- A fast response throttle in intake system is actuated when engine is shut-off to avoid any vibration when the driver stops the car.

- A two-part high-capacity oil pan extends the oil change interval to 30,000 kilometres, reducing downtime for vehicle maintenance. In addition, the timing belt and the serpentine belt that drives engine accessories are designed and sized to ensure a maintenance-free life.

DESIGNED, DEVELOPED AND PRODUCED IN FRANCE IN THE WORLD'S LARGEST DIESEL ENGINE MANUFACTURING PLANT

The 2.2-litre HDi/TDCi will be manufactured at the PSA Peugeot Citroën Trémery plant in France, which is the world's largest diesel engine production facility.

The new engine will be able to benefit immediately from the production experience at the plant, where most of the co-operative venture's engines are made (1.2 million units in 2005).
In addition, the latest stage of co-operation has introduced new production practices for the new engine that can be extended to the entire family:

Batch production

Several hundred identical engines follow each other on the line, thereby avoiding any assembly errors caused by changing from one model to another.

The Red Card system

The Red Card method is already used for the 1.4-litre and 1.6-litre HDi/TDCi engines.
Engines are checked after each assembly station: in case of quality issue detection, the complete engine is scrapped. No reworking can be performed on the line, so that extremely high quality is built into every engine from the outset.

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Potential output of 200,000 units a year

The 2.2-litre HDi/TDCi line is located on the same line as the 2.0-litre engine, with a specific capacity for the 2.2-litre engines increased to 200,000 units a year, compared with current production levels of 70,000 a year for the existing 2.2-litre engine, illustrating the new heightened ambitions and confidence in this engine.

Other production sites

The entire engine is assembled at the PSA Peugeot Citroën Trémery plant, where the main parts (cylinder heads, crankcases, crankshafts, camshafts and connecting rods) are also machined. The cylinder head is produced at the PSA Peugeot Citroën facility at Charleville-Mézière, the crankcase at the Sept-Fons foundry, and the balance shaft at the Borny mechanical component plant.

INVESTMENT AND R&D SPEND

The overall investment for designing and producing the new 2.2-litre HDI/TDCI engine reached €212 million. R&D expenditures amounted to €127million while production investments for the new engine totaled €85 million, of which €54 million is for the Trémery plant. The carefully managed budget reflects the use of existing production tooling, with the only addition of very specific required improvements.

However since the beginning of the co-operation the overall investment in the Trémery plant to fulfill the goals of both companies amounted to €730 million. Today, the Trémery plant employs 4637 engineers and production workers. The success of the diesel engine line up produced in Trémery led to the creation of 1800 jobs (long term contracts).

EMPLOYMENT AND TRAINING

More than 300 people will be assigned to production of the new top-of-the-line four-cylinder engine. The use of already carried over and quality proven tooling resulted in only 3,300 hours of training for the operators to adapt their skills to the changes in workstations and production tooling specific to the new engine.

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HDI/TDCI 2.2-litre ENGINE FOR PASSENGER CARS : TECHNICAL PROPERTIES

ENGINE (PS)	**156-170**	**170**
Fuel type	Diesel	Diesel
Combustion system	ECCS	ECCS
2 or 4 stroke	4 Stroke	4 Stroke
No. of cylinders	4	4
Turbo	Mono	Twin
Cylinder configuration	In line	In line
Installation in vehicle	East West	East West
Aspiration	VGT	Biturbo sequential parallel
Displacement (cc)	2,178	2,178
Bore	85	85
Stroke	96	96
Compression ratio	16.6:1	16.6:1
Firing order	1-3-4-2	1-3-4-2
Camshaft location	DOHC	DOHC
Direction of rotation, viewed from front	Clockwise	Clockwise
Displacement per cylinder (cc)	544.5	544.5
Stroke/bore ratio	1.13	1.13
Bore/stroke ratio	0.885	0.885
DPF System	Yes	Yes
PERFORMANCE		
Max. power (kW)	115-125	125
Speed at max. power (rpm)	4000	4000
Specific power (kW/litre)	52.8-57.4	57.4
Max. torque (Nm)	400	400
Speed at max. torque (rpm)	2000	1750

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