DIESEL international

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2013 DIESEL OF THE YEAR

MTU 6R 1500
Power density, high torque and technology at the top. The six inline by Mtu is the Diesel of the year 2013. Find out all details inside. Here's the engine of the future

Compact engines

Doosan

Final without filter

DIESEL international April 2013

CONTENTS

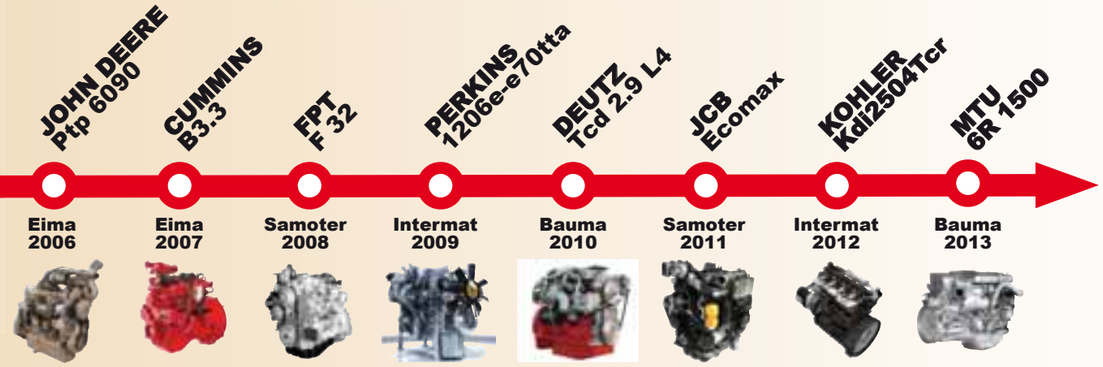
BEST IN CLASS

Developed from the Dd 16 Detroit Diesel for the Mercedes Euro 6 trucks, the Mtu 6R 1500 was awarded the Diesel of the year. Thanks to the absence of Dpf

An automotive engine applied to the industrial sector. This is the Diesel of the year 2013: the Mtu 6R 1500, a 15.6-litre 6-cylinder engine that dispenses 460 kW for a torque value of 2,900 Nm. Thanks to the Scr and the Egr, this engine has been certified Tier 4. Amongst its advantages, of notice is the absence of the Dpf that allows for smaller size and lower consumption. Top features are the turbocompound and the last-generation common rail.

2013 DIESEL OF THE YEAR

Mtu 6R 1500



TRACTOR OF THE YEAR

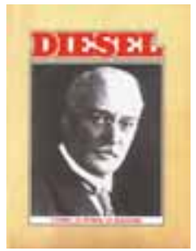
The Tractor of the Year® is an international award that, yearly, a group of European journalists, specialized in agricultural machinery, gives to the best tractor of the year. Twenty independent technical magazines are members of the jury and valuate open field tractors, specialized tractors (orchard/wineyard) and the design of both categories. Before including each tractor in the final shortlist of the nominees, the jury members must have had the opportunity to evaluate it under field conditions. The prize was an idea of **TRATTORI**

The winners:

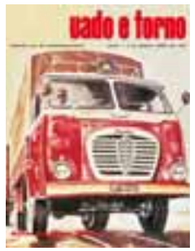
1998 Fendt Vario
1999 Fendt Favorit 700 Vario
2000 Case IH Magnum Mx
2001 Case IH Cvx
2002 John Deere 8020 series
2003 New Holland Tm 190
2004 Fendt 930 Vario Tms
2005 MF 8480 Dyna-Vt
2006 McCormick Xtx 215
2007 John Deere 8530
2008 New Holland T 7060
2009 Massey Ferguson 8690
2010 NH T 7070
2011 Fendt 828 Vario
2012 John Deere 7280 R
2013 Deutz Agrotron 7250 Ttv

www.tractoroftheyear.com

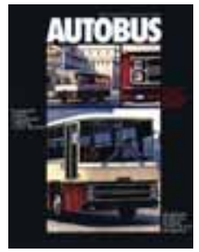
Vado e Torno publishing group at a glance. Our passions: trucks, bus&coach, tractors, engines. This is how *Diesel International* was born



Development, manufacturing, use and applications of the diesel engines are the main themes of Diesel. Published for the first time in 1986, Diesel stems from the experience of the Vado e Torno magazine. A mass-media style for a very specific group of readers: engine designers and specialists, engine application experts and retailers. A balance of text and photos, Diesel puts the emphasis on the aesthetic side of the engine and at the same time on the high-tech side. Pictures of engines and applications are enhanced by graphs, tables and Diesel own tech indexes. Diesel's documentations on many segments of the market, both Italian and foreign, are essential for the professional readers.



When Alfa Romeo introduced the 'Mille' model and the 'millepiedi' truck and trailer, Vado e Torno was already a well established magazine. When in 1962 the first trucker's union was founded, Vado e Torno was in print. A long time has passed, since trucks were naphtha run, the steering wheel was on the right side and there where two drivers in the cab. Since then, in the past 50 years, Vado e Torno punctually recorded the technical evolution of trucks and trailers: a field in which Italy is still today one of the most important European countries. Vado e Torno is on the top of editorial sector media with news about technical, economical and legislative evolution of goods transport by road. The main topics are the review of the technical improvements of trucks and trailers.



Born in 1975, in the middle of the fuel crisis, Autobus was at first a special issue dealing with the Italian big buses plan. Immediately afterwards it became bi-monthly and by 1991 monthly. For the bus world it was an exceptional period: in the whole of Europe buses were thought to be the only way to resolve the problems of the big cities urban traffic and pollution. But it only lasted a short time: in 1994 the biggest crisis in the history of buses sales began. But Autobus keeps growing steadily: each year more complete, with more pages, news, road tests. Autobus remains nowadays the only monthly magazine in Italy. Readers are private and public bus operators. Autobus is a totally independent magazine and it covers all international show.

When Trattori came to light, more than 100 magazines where already published in the Italian market: some were and are very authoritative, but none of them was centered on the tech side of the machines. Trattori was the first, then other followed in Europe. But Trattori remains with a strong leadership, due to a very important factor: the technical know-how in all kind of machines. Tractors and all agricultural machines, used on a daily basis by land owners, are introduced in articles featuring images, graphs, tables and operative costs. Comparisons between similar models of different brands, market analysis and the most complete price lists of every model on sale in Italy give to Trattori a sure leadership in the editorial agricultural field.

Agreements, joint ventures and partnerships. Big companies are becoming increasingly international. China and the Pacific become the primary objectives.

NEWS FROM THE WORLD

Something is changing

Cummins continues to invest in the Chinese market thanks to agreements with local manufacturers. Deutz Ag ends a bitter 2012 because of European markets in crisis. Ftp Industrial introduces Vgt on Claas tractors. Scania goes electrical with Siemens. Wärtsilä focuses on efficiency

Last March, the first **Cummins** L9.3 engine rolled off the production line at Guangxi Cummins Engine Company Limited (Guangxi Cummins), the 50:50 joint venture between Cummins and LiuGong Machinery, marking the official start of operations in Liuzhou, southern China.
The 9.3-liter engine is designed and built in China specifically for construction equipment to meet the demand of both LiuGong and other equipment manufacturers. The engine is available in multiple versions to meet various off-road emissions standards.
Deutz Ag has published its financial results for 2012. The difficult economic climate meant the Cologne-based engine manufacturer was unable to repeat its record performance from 2011, which had been one of the best years in the Company's history.
Deutz Ag took orders worth €1,237.1 million (2011: €1,479.3 million) in 2012. The weak performance of the economy in Europe and of the capital equipment sector in China depressed demand for Deutz Ag engines last year. Deutz Ag sold almost 179,000 engines in 2012, which was 22.5 per cent fewer than in the previous year. The Deutz Ag Group's revenue decreased by 15.5 per cent to €1,291.9 million in 2012. Average revenue per engine increased owing to the greater proportion of higher-value engines.
Fpt Industrial will provide Claas with a new Stage IV (Tier 4 Final) engine specifically developed for Claas new Axion 800 series, providing an 8% increase in torque versus the previous model and a flat torque curve up to 500 rpm. The Nef 67, 6 cylinders in line with a displacement of 6.7 litres and power ratings from 161 to 204 kW, features state-of-the-art technologies, such as a second generation Common Rail injection system and an e-Vgt. In order to be compliant with the stringent Stage IV/Tier 4 Final emission legislations, the Nef 67 adopts the Fpt Industrial patented and cutting-edge high efficiency Scr technology, without Egr and maintenance free due to the absence of Dpf.
Caterpillar has announced the availability of Cat C27 Acert and C32 Acert petroleum engines that meet Epa Tier 4 Final emissions standards four years ahead of regulatory mandate. Ideal for OEMs who manufacture mid-sized equipment for pressure pumping, cementing and well fracturing operations, these engines achieve ground-breaking emission reductions, while maintaining the reliability and durability demanded in the petroleum market.
Ricardo will collaborate with Weichai on a pre-concept study for the new family of engines of configurations, ranging from in-line 6-cylinder to V16 variants. The new engine is aimed at achieving internationally competitive levels of performance and fuel economy as well as durability and cost of ownership.
Scania and Siemens have entered into a partnership which involves the integration of Siemens technology to power vehicles with Scania's expertise in the electrification of power trains in trucks and buses. The partnership means that Sweden may become the world's first country with electrically powered trucks and electrified roads for commercial use.
Wärtsilä has introduced GasReformer, a unique product which uses steam reforming technology to convert associated gas to a quality that can be used as fuel in Wärtsilä's range of gas fuelled engines. The Wärtsilä GasReformer is yet another example of the company developing highly efficient products and demonstrating integration capabilities which ensure environmentally and economically optimised solutions.

Peter Bush

TOGNUM FOR THE FUTURE

One billion to grow

In two years, this big German company will be writing cheques for a billion euros to invest into improving production, research and development. This is how one grows

Tognum has announced their intention to invest a billion euros by 2014. This value appears to be higher than that announced two years ago by the two big companies that share the Mtu scene. In particular, 600 million euros will be allocated to long-term research and development, as well as a further 140 for the expansion of the European, Asian and US plants. The central Friedrichshafen hub is also under examination, where the development of a new production plant is in its final stages, and where in the next year a new test area will be developed. In addition, the German Group foresees the investment of 90 million euros for a new plant in Stargard (Poland). A cheque for 40 million euros will be sent to the USA to expand the Aiken plant (South Carolina). Asia will benefit too, in particular Singapore, where an active construction site is building a logistics and sales centre for a total investment of 17 million euros. **E.T.**

A plant opening in Poland. A new logistics hub is under development in Singapore. Of notice, the head quarters, where a new production hub and test area will be built. The German company has great interest in the fast-growing American market and expands the Aiken plant (South Carolina).

NEWSFLASH

BorgWarner manufactures the supercharge systems for Mercedes Om 934-936 engines, which, with the onset of Euro 6, substitute the 900 series. The unreleased B-series will be in charge of engaging the displacements of the 5.1 and 7.7-litre by Star.

Hyundai e Cummins have announced a new partnership for the production in Korea of industrial engines with power between 112 and 224 kW. Hyundai Cummins engine (Hcec) will be set up in Daegu, in Korea, and the production will begin by 2014. The new plant will have a 50,000 unit/year capacity. Hcec will provide medium range engines (5.9-litres to 8.9-litres) designed for excavators, rubber loaders and industrial machinery by Hyundai.

THE FULL LINE FOR THE AFTERTREATMENT

Pirelli Ambiente and Clean Diesel Technologies give rise to the joint venture Eco Emission Enterprise that becomes the commercial arm for the two 'founding' companies in Europe. Synergy and product complementarity are the strong points for the new business that will be set in Italy

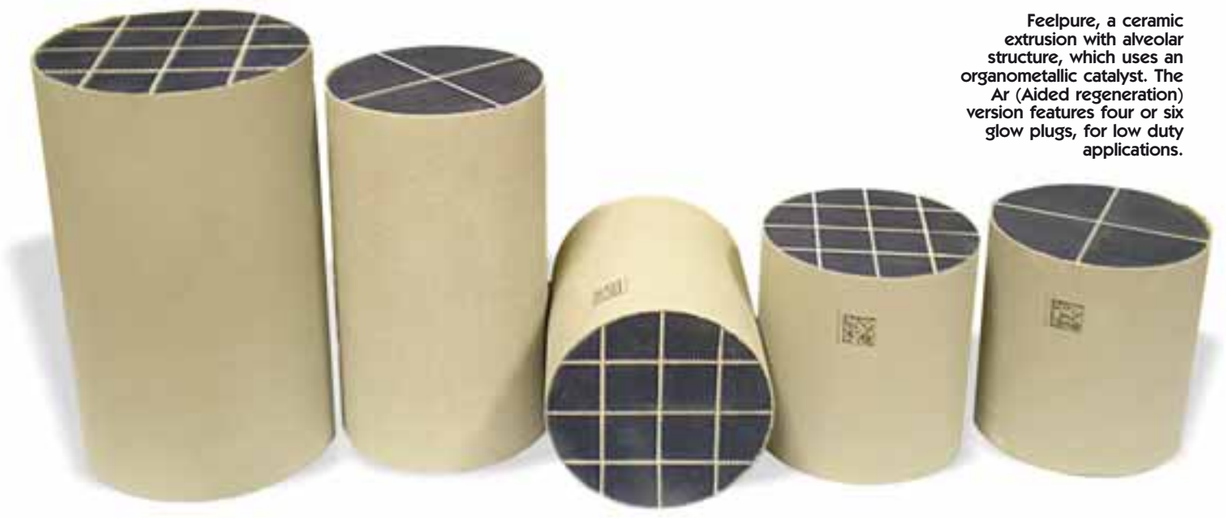
The Eco Emission Enterprise, a joint venture constituted by Pirelli Ambiente and the American Clean diesel technologies (CDTI) was launched last March. The new joint venture was intended for the commercialization, in Europe and in the Csi countries, of the companies' devices for the management of emissions. Through Eco emission enterprise, the two societies "aim at reinforcing their leadership in the technologies for the management of polluting emissions generated by diesel and fuel vehicles, both on road and off road, in the first equipment segment and in the aftermarket". Not only: Eco emission enterprise will also, and mainly, be the commercial platform in which the carborundum substrates produced in Romania by Pirelli&C Eco technology will be gathered, as well as the solutions for the control of emissions from CDTI, in fact making it into the two partners' commercial branch for the European market. The true value of this operation lies precisely in the integration and product complementarity, focusing on the combination of the two catalogues to become the only reference for the commerce.

«The Pirelli Eco Technology Feelpure is also available in the Platinum version, permeated with precious metals, and consequently with no additive, and Downo, that combines Scr and Dpf»

The first plant is definitely an appealing market where Eco Emission Enterprise will be active. On one hand, thanks to the history and automotive tradition of CDTI (e.g. Honda) and on the other, thanks to a well established brand (Pirelli) that in these years has invested in research and development, coming up with high-quality solutions. For example, the Feelpure, a ceramic extrusion with alveolar structure, which uses an organometallic catalyst. The Ar (Aided regeneration) version features four or six glow plugs, for low duty applications. The Feelpure is also available in the Platinum version, permeated with precious metals, and consequently with no additive, and Downo, that combines Scr and Dpf.

«CDTI is a vertically integrated manufacturer and supplier of systems and products designed for the management of emissions, that focuses on the heavy and light diesel vehicle markets»

CDTI is a vertically integrated manufacturer and supplier of systems and products designed for the management of emissions, that focuses on the heavy and light diesel vehicle markets. CDTI uses the Mixed phase catalyst (Mpc) technology, the Aris and platinum plus catalytic technologies and other technologies to provide sustainable solutions that ensure the reduction of emissions, an increase in the energetic efficiency, and a reduction in the particulate coming from diesel engines in on road and off road applications. CDTI is set in Ventura, California, and operates in the USA, Canada, the UK, France, Japan and Sweden. **I.P.**



Feelpure, a ceramic extrusion with alveolar structure, which uses an organometallic catalyst. The Ar (Aided regeneration) version features four or six glow plugs, for low duty applications.

The manufacturer's responses are also clear: on construction sites too there is the need for devices that will capture the graphitic combustion residues, just as it happens 'on the road'.

To the left, Hjs. Down, from left to right, the swiss Baumot and the italian one, Pirelli Eco Technology. Up, another italian player, Bersy. In the middle of the page, Dinex. On the left, after Bersy, Puritech. On the top, the other swiss, Hug, and an application.

Filtering soot before the Final

APPROACHING ZERO TOLERANCE

It is now clear that also in construction the particulate filtration will be present on machinery and on genset on building sites. The approach for regeneration is active. The tendency is to focus on the Dpf and Scr pair as a global solution. These are the sector's protagonists

Just prior to the Tier4 Final it has become clear: starting from the first January 2014 those who will produce engines with 0.02 g/kWh exhaust of particulate will be allowed on both the American and European market. The manufacturer's responses are also clear: on construction sites too there is the need for devices that will capture the graphitic combustion residues, just as it happens 'on the road'. Amongst the off-road applications, the most common systems are those that trigger regeneration through engine glow plugs, burners or pre or post-oil injection. Some of the Dpf manufacturers have redeemed from this approach, like Hjs, that could present at Bauma the upgrade of its Crt technology (Continuously regenerating trap).
Another common tendency amongst the manufacturers is the integration of Dpf and Scr, that had already been shown at the Samoter two years ago. The integrated retrofit (named 'Scrt') actually enables to attack both fine particles and nitrogen oxides upon exhaustion.

Baumot

The Swiss specialist has adopted aggressive policies for the heavy automotive, especially for buses, taking over Twintec and Interkat (strategic synergy for the development of Dpf-Doc-Scr integrated systems), and re-launches on the off-road. There are two 'active' versions: the Ba-F uses a burner, the Ba-H a coil, while the Ba-A uses the organometallic additive and is applied to fuels with sulphur levels above 350 ppm.

Dinex

In Denmark, the whole production process has been implemented in house. The DiPex is a cordierite filter, permeated with rare-earth elements, and an alveolar structure; the Di-Sic, on the other hand, is compatible with fuels with sulphur levels of 50 ppm and uses the Fbc(fuel born catalysed). A post-combustion triggers the regeneration and is suitable for applications such as wheel loaders and all the machinery that works at low loads. Dinex too is focusing on the filter and post-treatment pair: with a patented lining implementing thermal insulation.

Eminox

The British firm from Gainsborough is one of the European brands for anti-pollution devices and uses Fbc as well as Crt and Scr for NOx and catalysts. The Art (Active regeneration trap) abbreviation identifies the Eminox system for low temperatures. In the catalogue we also find the Scrt system, that has been tested on London buses.

Hjs

Germans are experts on Crt and will probably deliver an important message in Monaco. Full range for Hjs, that uses the Scr, also coupled with Dpf. The Cb2 (Catalytic bypass burner) system was conceived for engines with two-stage supercharge. The system downstream to the turbo, between the rotor and the filtrating unit, comprises two catalysts and a burner.
For 'lazy' applications the Ar (Active regeneration) formula is also available: a coil receives the signals of back pressure sent by the control unit.

Hug

There is rumour that in Elsau, in Switzerland, the prospective of Euro 6 under discussion. For now, the Mobiclean R is available in four versions: Basic, Advanced, Electro and Flame. The latter uses a burner for pre-injections (it works at low speeds on applications such as cement mixers and compactors), and the Electro has a resistor for regeneration with the engine swithed off (for example on fork lifts). The systems for post-treatment with urea were initially been developed by Hug on stationary machinery.

Pirelli Eco Technology

The Feelpure is a ceramic extrusion with alveolar structure, that utilises an orgometallic catalyst. The Ar (Aided regeneration) version uses four or six glow plugs, for low work load applications. The Feelpure is also available in the Platinum version, permeated with precious metals, therefore without additive, and Downox, which combines Scr and Dpf. Pirelli has just started a joint venture (Eco emission enterprise) with the American industrial giant for Cdti catalysts.

Puritech

Within the German portfolio, the Dpf family of beehive filters with constant regeneration through catalytic lining, designed for medium loads, is divided into two classes that differ with the addition of a pre-filter on the Dpf-2. The Dbs/Das series use both spontaneous and additive-mediated regeneration and the oil-injection in the pre-filter variation, when it is required by back pressure.

Fabio Butturi

China. According to the latest official data, the production in 2010 exceeded 3.5 million units. Only five years earlier, in 2006, the estimate was under two million units. For 2011 the available indicators allow an estimated drop of 5-7 percent. This decrease has persisted in 2012 with a loss of between 3 and 5%.

MAIN AND SECONDARY ACTORS

Chinese Companies	2006	2007	2008	2009	2010	%
Shangdong Weichai Huafeng power	180,597	290,460	328,687	378,768	771,451	25.3
Guangxi Yuchai machinery	357,166	506,940	508,706	663,876	730,790	23.9
Faw	230,751	305,563	339,916	440,773	518,743	17
Dongfeng	270,980	274,662	299,240	317,311	452,375	14.8
Cnhtc	144,406	155,172	164,194	187,547	235,525	7.7
Yangzhou diesel	83,937	93,414	99,054	118,278	127,472	4.2
Shanghai diesel	60,469	61,758	65,140	69,269	108,053	3.5
Lovol	12,000	18,000	25,000	32,000	40,000	1.3
Yto	19,000	21,000	25,000	29,000	35,000	1.1
Chongquing Cummins	10,025	13,050	16,515	12,318	17,367	0.6
Beinei	1,300	2,865	4,186	2,864	4,591	0.2
Nantong diesel	5,180	3,600	4,280	4,200	4,200	0.1
Nanchang Kama	3,045	774	461	3,727	4,112	0.1
Wuxi power engineering	1,386	2,003	2,058	1,442	2,156	0.1
Total	1,380,242	1,749,261	1,882,437	2,261,373	3,051,835	100
Annual variation %		27	8	20	35	
Cummins joint venture	105,315	144,290	178,093	141,018	240,367	7.9

Source: Cicema 2001

BIG NUMBERS AND FEW PLAYERS

A decline in the truck sector penalises the big Chinese manufacturers. A hugely productive market almost entirely shared by two big companies: Yuchai and Weichai. Ricardo, Avl, Fev, Bosch land on Chinese soil loaded with new technologies

Cicema (Chinese internal combustion engine manufacturer association) is the bureau that reunites all Chinese engine manufacturers and divides production into six segments, based on the cylinders, the engine speed, and on the type of fuel (see table). And it is under the 'Diesel multi cylinder with bore between 100 and 160 mm' label that the most important match is played. According to the latest official data, the production in 2010 exceeded 3.5 million units. Only five years earlier, in 2006, the estimate was under two million units. For 2011 the available indicators allow an estimated drop of 5-7 percent. This decrease has persisted in 2012 with a loss of between 3 and 5%. The decline is essentially due to the truck segment, which was subjected to a slow-down of over 10% in 2011 and 8% in 2012. Supplies for the bus sector are more positive (7 % more) and for earth movement machinery (between 5 and 8 %). The structure retraces the practical mix that is typical of more progressed areas, North America and Europe; the automotive applications play the strongest part, followed by the off-road and by stationary applications; truck and bus account for 70%, 25% for agromotors and construction site machinery and 5% for stationary marine and exports.

COMPARING CHINESE AND EU

	On road			Off Road	
Level	Ue	China	Level	Ue	China
Euro I	1992	2000	Stage I	1999	2007
Euro II	1996	2003	Stage II	202	2009
Euro III	2000	2007	Stage IIIA	2006	
Euro IV	2005	2010	Stage IIIB	2011	
Euro V	2008		Stage IV	2014	
Euro VI	2013		Stage V	2020	

The table shows the high flexibility of the Chinese market compared to Europe.

This is the 'free land'

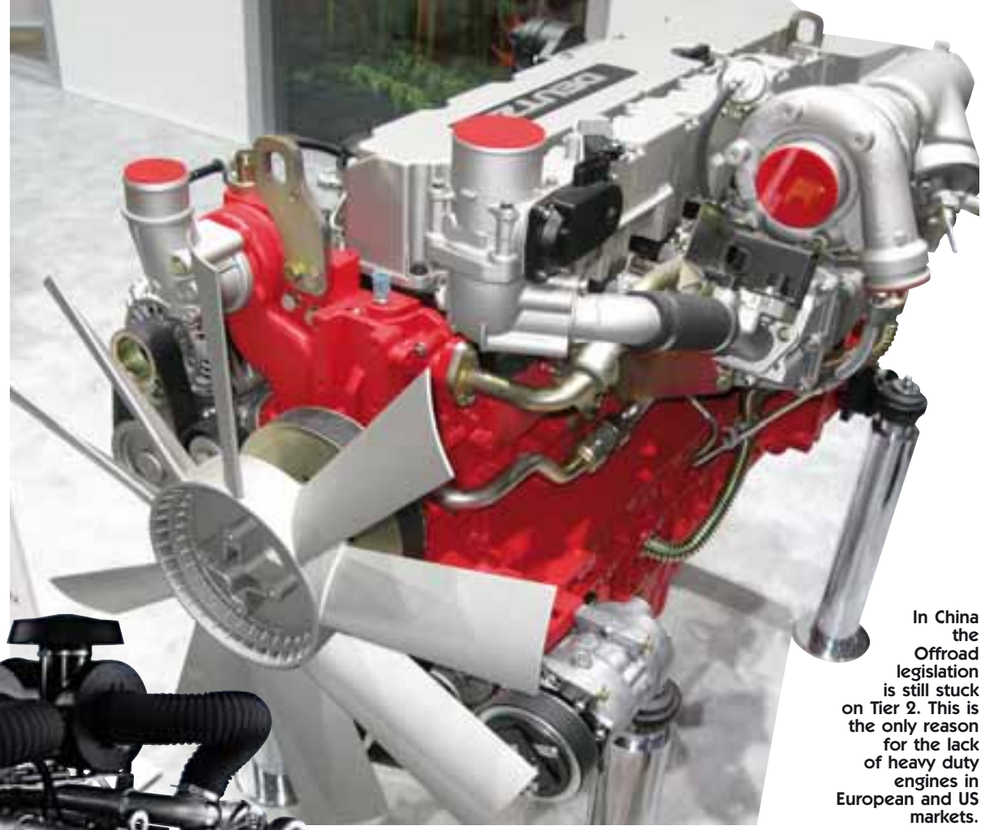
The ratios between captive and free market, however, are different. More than half of the automotive is supplied by independent motorists or in any case external, the medium-high power tractor market, on the other hand, is almost entirely captive and the earth movement is substantially free. Despite its size, the market remains fairly concentrated: the first fourteen manufacturers accomplish 88% of the total production, the first four 70%, which becomes 85% for the first eight.

Two big: Weichai, Yuchai

The top positions are occupied by manufacturers that focus mainly on road transport (Weichai and Yuchai) or that are part of groups dealing in automotive. To encounter a manufacturer that is oriented towards the off-road we have to go down to seventh position with Shanghai diesel. In China too if there were no legislation regarding emissions, the market would be in calmer waters. On the contrary, the consequences of these rules on the industry have been enormous: the acceleration of technological progress has generated a huge market for high rank suppliers (Ricardo, Avl, Fev, Bosch). The innovation has come about in two paths: through joint ventures with Western manufacturers, Cummins. Fpt, Deutz, or through the improvement of the existing products. For the road sector, the gap in terms of emissions has stabilised in eight years and two variance levels. A more complex situation is that of the off-road: to date the internal market is still subject to stage II, with mechanic-injection engines, while in Europe the stage IV is imminent.**P.J.O**

THE WEST VENTURES IN CHINA

Joint ventures prove to be the only way to produce in China. All Western companies have landed in China and are now producing for the internal market, with the true intention to export abroad. In these pages a short history of the top in this field



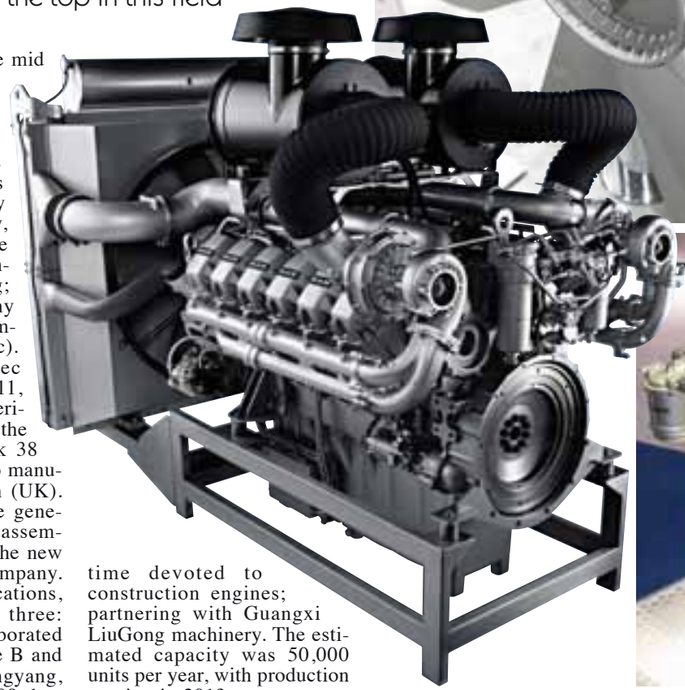
In China the Offroad legislation is still stuck on Tier 2. This is the only reason for the lack of heavy duty engines in European and US markets.

Caterpillar is based in 21 manufacturing plants and distribution centres, plus five plants for components of earth-moving machinery and two re-manufacturing units. For diesel engines the first step is the consequence of the acquisition of Mak, that in 1994 had started a joint venture for medium-speed engines and stationary applications. In 1994 a joint venture with Shanghai diesel (Sdec) was launched, for the production of the 3,300 series. The licence sales began in 1998, but in 2007 the licence contract expired and Sdec carried on the production independently. The affair was even more eventful for Perkins, which in 1997 began a joint venture with Tianjin Engine Works, named Perkins Engine Tianjin Limited (Petl) for the production of the 1,000 series. The duration of the joint venture is marked by several legal disputes, to the point that in 2007 the split was made official. Its Chinese partner is now called Lovol and is part of the Foton group (1,000 and 1,100 series). In 2008 they announced the opening of a plant in Wuxi, the Perkins Shibaura engine, for the production of the 400 series; the same year the investment expanded with the foundation of the Perkins power system technology, also in Wuxi, and in 2011 they proceeded with the production of series 1,100.

CUMMINS

Cummins, based in China since 1975, marked the beginning of importing machined components. From the mid 90s, the period of engine production through joint ventures began. During the initial phase, Cummins' and its partner, now known as Chongqing Machinery & Electric Company, created a joint venture in 1995 between Cummins and Chongqing; a state-owned company named Chongqing Cummins Engine Co (Ccec). To this day the Ccec manufactures the M-11, Nt-855, K 19, K 38 series. More recently also the K50, Qsk 19 and Qsk 38 models, which are also manufactured in Darlington (UK). Since 2007 the engine generators have not been assembled by Ccec, but by the new Cummings Beijing company. For automotive applications, Cummins split into three: from 1995 they collaborated with DongFeng for the B and C series, first in Xiangyang, then in Wuhan. In 2009 they endorsed the Ism-11 series in Xi'an together with Shanxi , for a production capacity of up to 50,000 units per annum. In the same year, the first 4-cylinders of the series Isf 2.8-3.8 litre engine size were released from the Bfec factory (Beiqi Foton Cummins engine), producing 400,000 units per annum; an investment of $426m.

At the end of 2011 the establishment of a new corporation was announced, this



time devoted to construction engines; partnering with Guangxi LiuGong machinery. The estimated capacity was 50,000 units per year, with production starting in 2013.

DEUTZ

From the mid 70s the series F1 911 and F1 413 are manufactured under licence in China. Their developments, now free from licence restrictions, are now manufactured by Beijing Beinei diesel engine, that, to date, offers the 912 and 913 series (15000 units/year). The 413 and 513 series, on the other hand, are still manufactured by Hebei Huabei diesel engines, which also offers the liquid cooled Bf6M1015. Twenty years after the onset of the licences, Deutz established a new joint venture: the Weifang Weichai-Deutz Diesel Engine. All the product and process technologies of the 226 MWM series were transferred to this venture, with a production that in 2011 exceeded the 40,000 units per annum. In 2006 a new partnership is constituted with Faw, and named Deutz Dalian engines, for the 2012

and 1013 series for vehicular use. The first products were released in 2009 and today the official production capacity is 200,000 units per year. In 2011 a new joint venture was announced, still devoted to the 2011 series, but for offroad. They partnered with the Shandong Changlin machinery group, with an estimated capacity of 65,000 units and production scheduled to start in 2013. The latest news speculates a third agreement with Shandong Changlin, for the production of the Tier2- and Tier3-homologated 2011 units in Linyl, to be exported to markets compatible with these steps.

FPT INDUSTRIAL

In 1984, supported by the Ministry of Machine Manufacturing, two agreements for the licensed production of farming tractors were established between Cnh and Saic (Shanghai auto industry co.), the first resulting in the Shanghai New Holland, the second with a company in Luoyang (which is no longer in existence).

Meanwhile, Naveco was created in 1996 from the equal agreement with Nanjin automobile works, to introduce the Daily light vehicles and for the production of the Sofim 8140 engine in Euro II. In 2007, Nanjing auto merged with Saic, and that is how, in 2007, the joint venture Saic Iveco Hongyang was founded, with the intent of manufacturing the Nef and Cursor series engines (200,000 units/year). The expected foreign investment was 150 million euros. The production was set in ChongQing, with the first engine released in 2009 and in 2011 the production was estimated at 20,000 units. The collaboration scene was completed with Hadong Teksid, the major Chinese engine block manufacturer, and with Shanghai Meridian, that produces magnesium castings. The presence of Fiat reflected the break line between the two phases in the group's history, and the final stage appeared to be pointing to a substantial symbiosis between Fiat and its very powerful local partner, Siac.

JOHN DEERE

The first joint venture, established with Good Union with the intention of producing combine harvesters, dates back to 1997. In 2000, a new joint venture with Tianjin tractor works followed, the John Deere Tiantuo, for the production of medium-powered tractors, over 60 kW. A new agreement was signed with Ningbo Benye Tractors in 2007, for the production of ultra-compact small tractors, ranging between 15 and 37 kW. In 2008 it is Xzhou Bohui's turn, this time for building sites, for the production of excavators. However recently, no more than two years ago, the way of investing has changed: Cervo bypasses co-owned firms to focus on direct investments.

The first outcome of this strategy shift came to shape at the production site in Harbin, devised for the development of harvesting machinery, while in the Teda area (Tianjin economic development area) a second unit of earth-moving machinery production was established. The same area will hold the production of engines that was announced in 2011 and will set forward in 2013, with an expected investment of $60m. This will therefore be the sixth engine production unit of the group and the seventh Cervo plan in the middle ground.

MAN

According to the Nuremberg firm, the brightest star in the Chinese sky is Weichai, the key motoring partner for diesel engines designed for stationary applications, that has nevertheless also been involved in the production of engines for vehicular use, which at the moment are still not in planning phase. Weichai, only ten years old, was founded after the merging of numerous firms, among which the Weichai factory, founded in 1953, that in the 80s had established a partnership with Steyr, resulting in the production of the Wd615.

60% of the earnings come from heavy vehicles, thus justifying the partnership with Man, while 30% is assimilated by construction and the remaining 10% by marine production.

VOLVO

Volvo Penta was the first business unit to face the Chinese market. In 2000, in fact, a new plant for the assembly of engines and power generators was inaugurated in Wuxi. The partner is Wuxi diesel engine works. For the earth-moving sector a joint venture with Shandong Lingong construction machinery co. was established (Lingong), intended for the production of tyred excavators. Another unit, entirely under the control of Volvo construction equipment, collaborated with it in Shangai for the production of compact and caterpillar excavators. In 2003, Volvo initiated a joint venture with Cnhtc (China National Heavy Transport co.), but in 2009, the poor success of the operation led to the termination of the venture and so was entirely taken over by Cnhtc. In January, Volvo signed an agreement with the Chinese vehicle manufacturer, Dongfeng Motor Group Company Limited (DFG), to acquire 45% of a new subsidiary of DFG, Dongfeng Commercial Vehicles (DFCV), which will include a major part of DFG's medium and heavy-duty commercial vehicles business. Upon completion of the contract, the Volvo Group will become the world's largest manufacturer of heavy-duty trucks. A collaboration, which is no novelty, but is strengthened by almost twenty years of work with Nissan diesel, which today is part of the Swedish group.

SCANIA

The Swedish firm has established itself in primis commercially, focusing on the bus sector, consenting in 2007 to a joint venture with Jiangsu Alfa bus for production. As far as lorries are concerned, the focus shifted to Brasil and India, while for diesel engines an agreement for the distribution was signed with Shanghai Boden Engine Co. The agreement mainly addressed stationary purposes, in particular, power generators, as well as post-sale support.

Catherine Morrison

Engines gasoline made in China

THE FOUR STROKE ARMY

The internal market is linked to the diesel monocylinder. But something is changing. The massive production is focused on export with very important players, Briggs&Stratton and Honda. And there is the components sector. Where the big supply

The famous terracotta soldiers, that have been guarding for more than two thousand years the grave of the first Chinese emperor, all look alike at first. However, at a closer look, it is possible to appreciate that each one of them is different. The same goes for the over hundred, according to official records, Chinese 4-stroke internal-combustion engine manufacturers. All similar at first: recurrent design, over head valves, horizontal engines with tilted cylinder, forced lubrication. All in all, the rough copy of the Honda engines. The Japanese style is not visible only on the product layout but also on the overall offer: not only engines, but also elecrical generators, motor pumps, lawnmowers, motor hoes.

Four million in 2006

Recent reliable data show a production of over 4 million engines in 2006. Considering that the exportation of internal combustion engines, electrical generators and lawn-mowers towards the USA and Europe have complexively shifted from 3 to 7 million units, it is reasonable to estimate that in 2012 the production will have exceeded 10 million units. And what about the internal Chinese market? Huge for diesel and minor for the 4-stroke petrol engines, here named Gpe (General purpose engines). The demand is established by Oem, that assemble for exportation. Only for electrical generators we are witnessing the substitution of diesel generators (horizontal belt coupled with alternator) with more compact and portable internal combustion group, whereas for other applications it happens only overseas.

The mechanization of low power in China has been oriented from the beginning to the use of monocylinder diesel engines with horizontal cylinder and evaporative cooling. The launch of internal combustion engines for agricultural and industrial applications can be dated to the mid 90s, when the Tianjin Institute developed a range of new 2-stroke models for portable machinery and 4-stroke models for self-propelled and electrical generators. As far as the Ohv models are concerned, the 4-strokes are essentially inspired to small Honda Gx series engines, while the Sv models are closely related to the B&S engines. The company that produces 4-stroke engines more or less retrace the modern approach of the lean-manufacturing. The aluminum die-cast components are manufactured and laboured by external suppliers; other components like pistons, piston rings, valves, carburetors are supplied by specialized manufacturers that produce for the motorcyclist industry. In general, suppliers are not exclusive. Very often they are adopted by several manufacturers, including international ones. The production of crankshafts and piston rods is often carried out by external suppliers. The production plant is therefore essentially a unit for assembling, testing and shipping of complete engines.

Chinese peculiarities

In addition to its structure, the Chinese industry shows two other peculiarities. The symbiosis between motorcyclist production and that of Gpe internal combustion engines is very strong. Two are the main location areas for this industry: the costal area North and South of Shanghai, in the Jangsu and Zhejiang provinces, and the ChongQing area. In the Shanghai surroundings the production activity began after 1995. Thanks to a higher openness to foreign markets, many companies have become accustomed exporters.

Vincenzo Ziliotti

According to reliable sources the Chinese production for petrol monocylinder engines has reached 10 million units in 2012 (the vast majority for exportation). A step foreward compared to previous years.

PETROL COMPARISON

		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
PRC export to US (1)	US$	2,656,819	1,823,846	7,926,444	87,949,375	101,646,277	240,355,776	224,698,295	282,549,951	379,242,905	525,509,067	512,376,329	609,919,139
PRC export to US	Units	32,753	14,756	99,671	1,447,160	1,732,605	2,442,155	1,269,581	2,359,903	3,053,148	3,986,614	3,783,678	4,528,635
PRC export to UE-15 (2)	Euro	766,000	2,486,000	7,737,000	19,585,000	52,108,000	79,113,000	111,499,338	136,549,000	130,691,337	133,246,959	203,819,405	216,110,149
PRC export to UE-16	Units	3,240	17,585	168,057	353,571	741,838	1,168,467	1,438,243	2,059,386	1,971,644	1,634,347	2,439,958	2,825,662
B&S Engine sales	US$	1,592,564,000	1,291,649,000	1,366,977,000	1,428,411,000	1,617,409,000	1,739,184,000	1,648,224,000	1,447,051,000	1,459,882,000	1,414,113,000	1,406,749,000	1,399,532,000
Honda power products sales	Units	4,057,000	3,884,000	3,929,000	4,584,000	5,047,000	5,300,000	5,876,000	6,421,000	6,057,000	5,187,000	4,744,000	5,509,000
	ex-rate $ to €	1.085	1.116	1.060	0.885	0.805	0.805	0.797	0.731	0.683	0.719	0.754	0.718
		35,993	32,341	267,728	1,800,731	2,474,443	3,610,622	2,707,824	4,419,289	5,024,792	5,620,961	6,223,636	7,354,297

(1) Gen Set Petrol driven. Lawn mower self-propelled. Lawn mower pushed (2) Spark ignited engines up to 10 kW. Power tillers. Non-electric mower. Gensets, petrol up to 75 kva.

WHICH IS THE INDUSTRIAL FUTURE?

Once the Stage 3B chapter is closed, the legislator outlines the new steps for emissions. With the onset of level IV the polluting emissions will be drastically reduced. Will the Scr-Egr ticket be sufficient? Surely the consumption will have to be taken into account by increasing the efficiency

The 'history' of engines assembled on off-road machinery and vehicles began in the mid 90s. The basic directive that defines stages I and II dates back to 1997 (97/68/Ec), and it began to be applied as of 1999-2001 with a gradual entry into force according to power range. The first revision came about with the 2002/88/Ec directive, while the second happened in 2004 (2004/26/Ec), setting the IIIA, IIIB and IV limits for the so called Nrmm (Non-road mobile machinery), and the IIIA and IIIB for traction engines and the IIIA stage for engines used for internal waters circulation.

The third phase, in 2010 (2010/26/Ec), improved the IIIB stage and introduced the IV, to become operative in 2011 and reach at maximum output in 2014.

The IIIB stage is already operative for all the mobile applications with powers between 56 and 560 kW, while for the 37-56 range, it will come into force in 2013. The IV stage will set off between 2014 and 2015, resulting in a substantial equalisation of the emission values for engines in the 130 and 560 range across the USA, Japan and Europe.

The IV stage will set off between 2014 and 2015, resulting in a substantial equalisation of the emission values for engines in the 130 and 560 range across the USA, Japan and Europe.

HISTORY OF EXHAUST

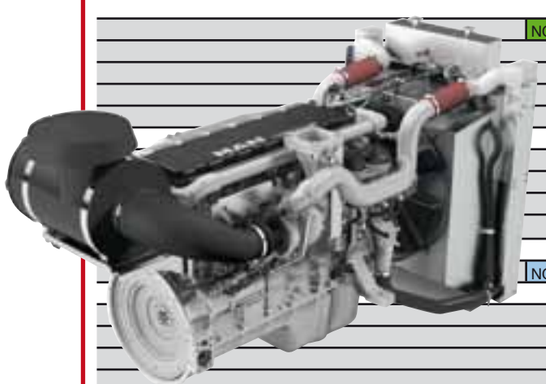
1999 – 2000 – 2001 – 2002 – 2003 – 2004 – 2005 – 2006 – 2007 – 2008 – 2009 – 2010 – 2011 – 2012 – 2013 – 2014 – 2015 – 2016			
			Power (kW)
			>560
NOx: 9.1 / PM: 0.54	NOx: 6.0 / PM: 0.2	NOx + HC: 4.0 / PM: 0.2	130 = < 560
NOx: 9.2 / PM: 0.70	NOx: 6.0 / PM: 0.3	NOx + HC: 4.0 / PM: 0.3	75 = < 130
Mtz 99 NOx: 9.2 / PM: 0.85	NOx: 7.0 / PM: 0.4	NOx + HC: 4.7 / PM: 0.4	56 = < 75
Mtz 99 NOx: 9.2 / PM: 0.85	NOx: 7.0 / PM: 0.4	NOx + HC: 4.7 / PM: 0.4	37 = < 56
	NOx: 8.0 / PM: 0.8	NOx + HC: 7.5 / PM: 0.6	19 = < 37
			< 19
	NOx + HC: 4.0 / PM: 0.2	NOx: 2.0 / PM: 0.025	RC A, B > 130
	NOx + HC: 4.0 / PM: 0.2		RL A 130 = < 560
		NOx: 4.0 / PM: 0.025	R B > 130 (Loco)
		NOx: 6.0 / PM: 0.2	RH A > 560
		NOx: 7.4 / PM: 0.2	RH A > 2000. > 5L
	NOx: 6.0 / PM: 0.2	NOx + HC: 4.0 / PM: 0.2	Const 130 = < 560
	NOx: 8.0 / PM: 0.3	NOx + HC: 4.0 / PM: 0.3	Const 75 = < 130
	NOx: 7.0 / PM: 0.4	NOx + HC: 4.7 / PM: 0.4	Const 37 = < 75
	NOx: 8.0 / PM: 0.8	NOx + HC: 7.5 / PM: 0.6	Const 19 = < 37
	NOx: 9.8 / PM: 1.0		
			SV (litres) and kW
	NOx + HC: 7.5 / PM: 0.4		< 0.9 and P= < 37 kW
	NOx + HC: 7.2 / PM: 0.3		0.9 < 1.2
	NOx + HC: 7.2 / PM: 0.2		1.2 < 2.5
	NOx + HC: 7.2 / PM: 0.2		2.5 < 5
	NOx + HC: 7.8 / PM: 0.27		5 < 15
	NOx + HC: 8.7 / PM: 0.5		15 < 20 and P > 3300 kW
	NOx + HC: 9.8 / PM: 0.5		20 < 25
	NOx + HC: 11.0 / PM: 0.5		25 < 30

NRMM

RAIL

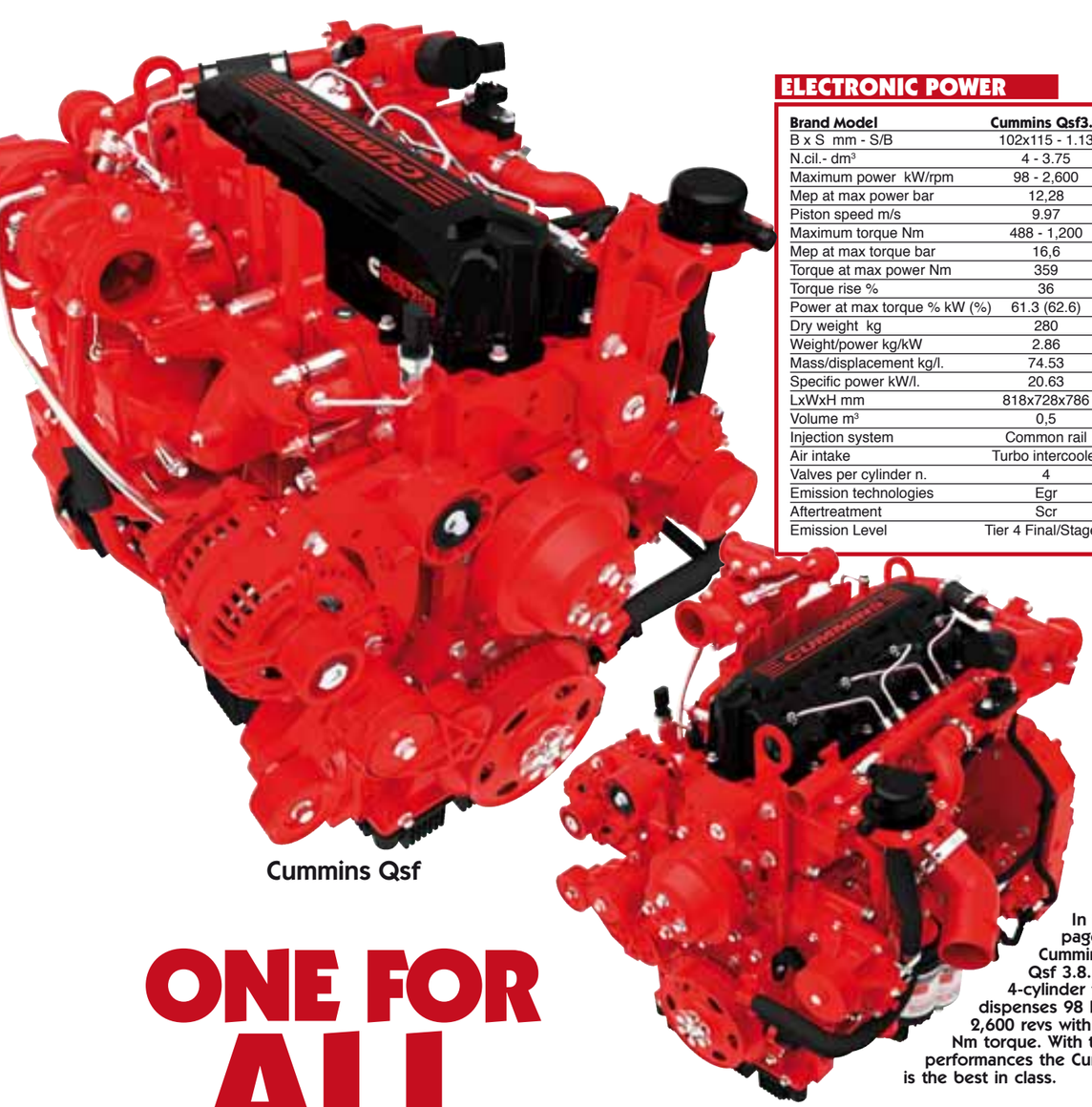
CONSTANT SPEED

MARINE



The secret is transferring

In Europe the legislation regarding engines implemented on Nrmm and on on-road transportation vehicles shows a strong convergence, to the point that transferring the technologies from road purposes to other applications becomes the usual evolutionary procedure in diesel products in all their applications. New classes appear for the automotive and are then transferred to the more humble worlds of industrial, stationary and marine machinery. **Miguel Valdes**



Cummins Qsf

ELECTRONIC POWER

Brand Model	Cummins Qsf3.8
B x S mm - S/B	102x115 - 1.13
N.cil.- dm³	4 - 3.75
Maximum power kW/rpm	98 - 2,600
Mep at max power bar	12,28
Piston speed m/s	9.97
Maximum torque Nm	488 - 1,200
Mep at max torque bar	16,6
Torque at max power Nm	359
Torque rise %	36
Power at max torque % kW (%)	61.3 (62.6)
Dry weight kg	280
Weight/power kg/kW	2.86
Mass/displacement kg/l.	74.53
Specific power kW/l.	20.63
LxWxH mm	818x728x786
Volume m³	0,5
Injection system	Common rail
Air intake	Turbo intercooler
Valves per cylinder n.	4
Emission technologies	Egr
Aftertreatment	Scr
Emission Level	Tier 4 Final/StageV

In this page, the Cummins Qsf 3.8. It's a 4-cylinder that dispenses 98 kW at 2,600 revs with 488 Nm torque. With these performances the Cummins is the best in class.

ONE FOR ALL

Manufactured in the Dongfeng plant, China, the 3.8-litre 4-cylinder arrives in Europe. Originally developed for on-road applications, it is now proposed for industrial use. Final without filter

At the 2013 Bauma, Cummins will launch its Qsf 3.8, a 3.8-litre 4-cylinder engine manufactured in China in collaboration with Dongfeng. The emissions are Tier 4 Final/ Stage IV thanks to Egr and Scr but the absence of a particulate filter. The range spanning between 63 and 98 kW is commended to the new 4-cylinder, making it the link between the minor Qsf 2.8, presented in its industrial version at Bauma 2010, and the 4.5-litre 4 cylinder engine. The 'new' 3.8-litre engine by Cummins is designed for automotive, with four valves per cylinder and second generation common rail. Both of these technologies ensure high torque values. The top model, for example, dispenses 488 Nm, way higher than the maxi compact engines now ready for the Tier 4 Final launch. For sure, in its favour is an engine volume higher than the average for this section. The only compact to reach these values is Kubota, which, however, following a more conservative business philosophy, blocks power at 85 kW and torque to around 420 Nm.

Series A bye bye

With the A Series exiting the catalogue, after not particularly impressing the European market, Cummins revisits the lower section of its offer by introducing Chinese-manufactured units. The power level has shifted up, leaving the segment for aspirated engines of Kukje origin uncovered. The appearance of the 2.8 and 3.8-litre engines has in fact demolished the legendary 3.3-litre by Komatsu, an engine that had led the way to the Interim and Final in the over 56 range.

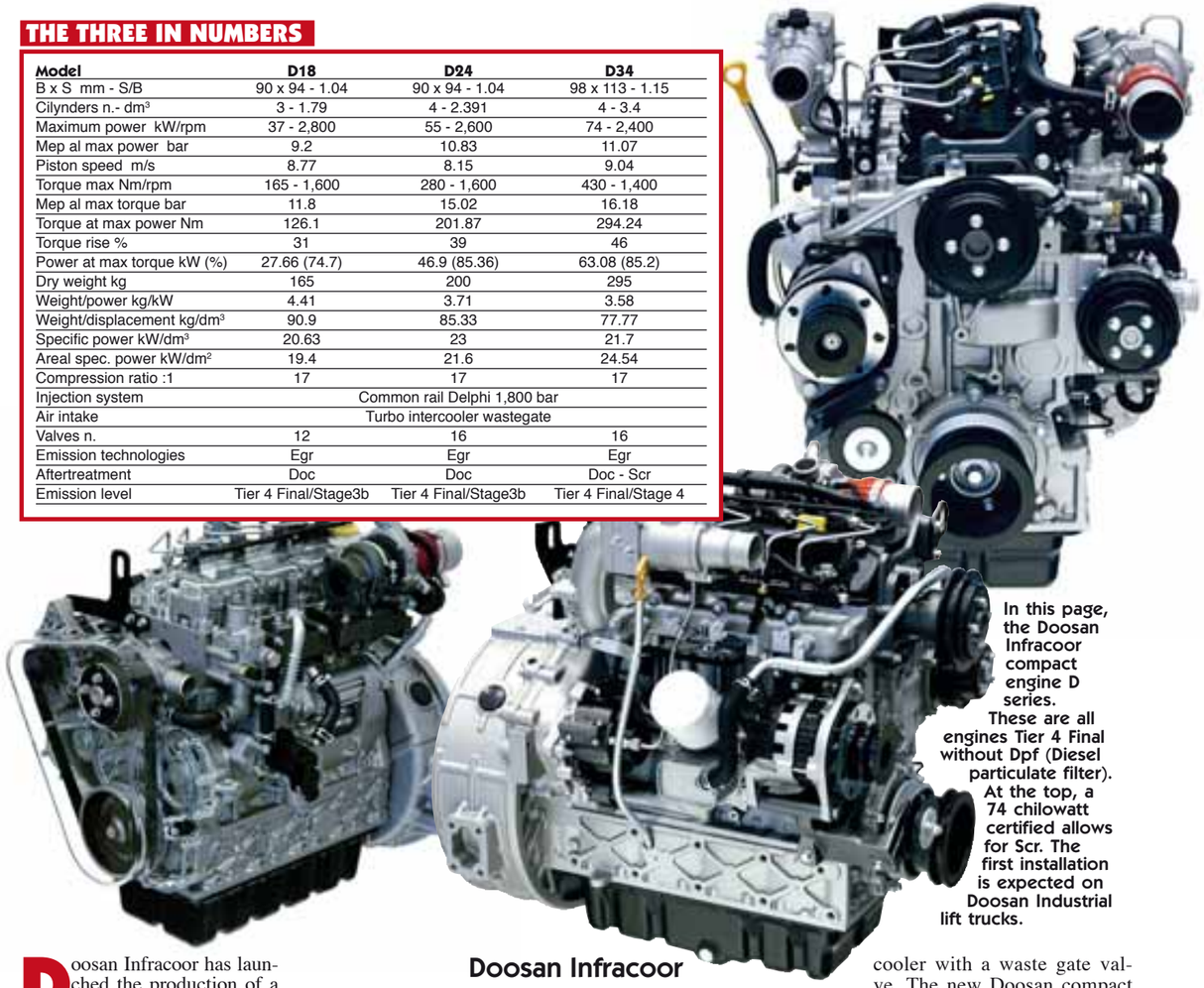
What're competitors doing?

This engine is still on the market, but has been downgraded to the 45-63 kW range (it reached 82 kW for a torque of 420 Nm). The same segment is covered by competitors with lower engine volumes; here the three-cylinder seems to have come back in fashion. Not insofar as litre-volume applications, apart from John Deere, but for volumes of 700-750 cc.

Jon Williams

THE THREE IN NUMBERS

Model	D18	D24	D34
B x S mm - S/B	90 x 94 - 1.04	90 x 94 - 1.04	98 x 113 - 1.15
Cilynders n.- dm³	3 - 1.79	4 - 2.391	4 - 3.4
Maximum power kW/rpm	37 - 2,800	55 - 2,600	74 - 2,400
Mep al max power bar	9.2	10.83	11.07
Piston speed m/s	8.77	8.15	9.04
Torque max Nm/rpm	165 - 1,600	280 - 1,600	430 - 1,400
Mep al max torque bar	11.8	15.02	16.18
Torque at max power Nm	126.1	201.87	294.24
Torque rise %	31	39	46
Power at max torque kW (%)	27.66 (74.7)	46.9 (85.36)	63.08 (85.2)
Dry weight kg	165	200	295
Weight/power kg/kW	4.41	3.71	3.58
Weight/displacement kg/dm³	90.9	85.33	77.77
Specific power kW/dm³	20.63	23	21.7
Areal spec. power kW/dm²	19.4	21.6	24.54
Compression ratio :1	17	17	17
Injection system	Common rail Delphi 1,800 bar		
Air intake	Turbo intercooler wastegate		
Valves n.	12	16	16
Emission technologies	Egr	Egr	Egr
Aftertreatment	Doc	Doc	Doc - Scr
Emission level	Tier 4 Final/Stage3b	Tier 4 Final/Stage3b	Tier 4 Final/Stage 4



In this page, the Doosan Infracoor compact engine D series. These are all engines Tier 4 Final without Dpf (Diesel particulate filter). At the top, a 74 chilowatt certified allows for Scr. The first installation is expected on Doosan Industrial lift trucks.

Doosan Infracoor

MADE IN KOREA

3 and 4 cylinder engines with a 600 cc swept volume per cilynder and a 4 one of 3.4 litres. For the first two only Egr and Doc. The top category, that reaches 74 kW and is certified, allows for Scr

Doosan Infracoor has launched the production of a new range of Tier 4 Final/Stage 3b compact engines. The first installation is expected on Doosan Industrial lift trucks.
The range comprises three models; the smallest is a 1.8-litre 3-cylinder engine (D18) with a maximum power of 37 kW at 2800. The D24 is a step up, with an additional cylinder compared to the D18 and an engine size of 2.4 litres. In this case the power reaches 55 kW at 2,400 rpm. The top of the category is the D34, a 74-kW at 2,600 rpm 4-cylinder engine. For the D18 and D24 the cylinder bore and stroke measure 90 x 94 mm respectively, while the top of the range, the D34, measures 98 x 113 mm. The torque value for the 3-cylinder is 165 Nm, however, the Korean manufacturer also offers the 113- and 154-Nm versions. The 4-cylinder D24, on the other hand, offers a maximum torque of 280 Nm and, for different ratings, also of 235 Nm. The 3.4-litre spans from 410 and 430 Nm. The model is equipped with a Diesel particulate filter, but only with Doc and a Scr system, the latter available only for the 3.4-litre.

The common features are four valves per cylinder, exhaustion gas recirculation, the common rail injection system developed by Delphi that performs at a maximum injection pressure of 1,800 bar and the turbo intercooler with a waste gate valve. The new Doosan compact engines have several rivals on the market. Nevertheless, segmentation, engine size and the absence of a particulate filter render them highly competitive with Kohler Kdi (despite the lack of a mechanical version for Doosan).

Torque at the top

The compact engines, developed in Reggio Emilia, excel on the entire range with greater machine torque values by 10-15 %. The new engines will be manufactured in the Incheon plant (South Korea). The first models were released from the production line in October 2012. The production capacity at the end of 2013 was estimated to approximately 50 thousand units/year, and estimate that will reach 100 thousand units in 2015 following a considerable incorporation performed by Bobcat. **John Robins**

Hatz comes up with a whole host of new products at this year's bauma in Munich. In addition to the exhibition highlight, the world premiere of a water-cooled 4-cylinder engine with Bosch common rail system, the serial production Intelligent Power Pack (iPP), as well as the L-series with separable DPF, will be presented.

TECHNICAL SHEET

Model	Hatz 4H50Tic
Bore x Stroke mm - S/B	84*88 - 1.05
Cylindes n.- displacement cc	4 - 1,950
Maximum rating kW/rpm	56/2,400
Mep at max power bar	14.65
Specific power kW/l	28.72
Areal specific power kW/dm²	25.28
Piston speed m/s	7.04
Maximum torque Nm/rpm	240/1,600
Mep at max torque bar	15.79
Specific torque Nm/l	123.09
Areal specific torque Nm/dm²	108.32
Torque at max power Nm	223
Torque rise %	0.08
Power at max torque % - (kW)	71.86 (40.23)
Work range rpm	800
Dry weight kg	173
Weight/power kg/kW	3.09
Mass/displacement kg/l	88.73
L * W * H mm	680*540*595
Volume m³	0.218
Power density kW/m³	256.31
Density t/m³	0.79
Power density kW/m³	8.92
Emissions	IIIB/4F
Injection system	Common rail
Specifications	2V turbo afterc. Egr
Min. cons.spec. - n g/kWh	210

The new Hatz tendency kicks off in Monaco

A REAL NOVELTY

The H series signifies a turning point for Hatz. Four 1950 cc cylinders, 56 kW and 240 Nm max, with common rail and Egr. The renewed L/M series, too, sponsors Egr and adopts Dpf. The iPP and the water-cooled 1D81 genset get underway

Before playing the renovation card, it waited to be in the 'familiar' spotlight of the Bauma, in the immediate proximity of the Tier 4F. Hatz supporters will, however, be paid back for such a delay. Under the well varied 'news' voice, its strong point is the much-awaited monoblock, which could barely be seen in the previous model by Bauma issued in 2010 (it could literally be peeped at through a small slot).
The standard bearer for Ruhstorf is a 2-litre 4 cylinder engine. The H series will be officially baptised (also by name) in Monaco. Fully equipped with the 1800 bar Bosch common rail, the H series ratifies the final renounce to the air-cooling system, although it inherits from the past the two valves, ensuring aeration of the engine, which in fact is stably set on a linear and solid structure with simple supercharging. The 1951 cc engine will challenge a crowd that has adopted the common rail, except for Isuzu and Perkins, and will confront

the Made In Italy champions: Vm and Lombardini. With a maximum power of 56 kW and torque value of 240 Nm, already available at 1600 revs, it is competing directly with the Kdi series by Kohler/Lombardini and the Vm with a 750 cc displacement. Unlike Perkins, Kubota and Deutz, the IIIB/4F has been developed without the particulate filter. Amongst the declared sensitive data, the specific consumption is 210 g/kWh with a time-interval of 550 hours.

Restyling for all

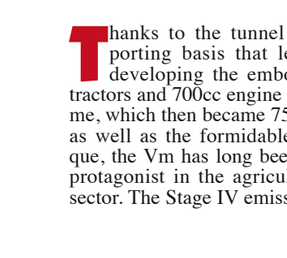
The 3 and 4 cylinders in the L and M series have undergone restyling to be placed in the 'emissionated' range: the L/M 43, coded that way, uses recirculation, which was inherited from the L/M 42, and adopts the silencer with integrated downstream Dpf .
The 3.5 kVA generator with a variable load-dependent rotational speed is called iPP (intelligent Power Pack). The genset is equipped with the mono 1B30 with vertical shaft and a permanent magnet generator, available at 50 Hz and 230 Volt. Hatz mainly focuses on the European market.
Speaking of mono, the strongest player from Hatz, the 1D81, will be launched in a hydro concept version, with a newly designed air-cooled head.

Fabio Butturi

TORQUE AT THE TOP

Brand Model	Vm R 754	Vm R 754
Bore x Stroke mm - S/B	94 x 107 - 1.14	94 x 107 - 1.14
Displacement (cylinder/liters)	4 - 3	4 - 3
Maximum power kW/rpm	74 - 3,000	84 - 3,000
Mep at max power bar	10.7	11.54
Specific power kW/dm³	24.9	28.3
Areal specific power kW/dm²	26.7	30.2
Piston speed m/s	10.7	10.7
Mass kg	260	260
Mass/power kg/kW	3.51	3.1
Mass/displacement kg/dm³	87.5	87.5
L * W * H mm	705x599x753	705x599x753
Emission level	Tier 4 Final	Tier 4 Final
Injection system	common rail	common rail
Air intake	turbo intercooler	turbo intercooler
Emission technologies	Egr - Scr - Dpf	Egr - Scr - Dpf

In this page, the Vm 754 Tier 4 Final. The particulate filter (closed) is well visible, coupled with the Scr system. The common rail governs injection.



Three litres made in Italy

FINAL 4 YOU

Post-treatment with urea solution, Egr and Dpf are the ingredients for the reduction of emissions to the Tier 4 Final. The specific performances are the best of the category

Thanks to the tunnel supporting basis that led to developing the embossed tractors and 700cc engine volume, which then became 750 cc, as well as the formidable torque, the Vm has long been the protagonist in the agricultural sector. The Stage IV emissions, surpassed thanks to the partial transfer of the automotive technologies, has been under exam by the Cento technicians.
Amongst the reaffirmations we find the common rail, already in use since the previous step (it substituted the Bosch rotation pump), the Egr and particulate filter, that is here paired with the Scr, and finished off by the Doc. A package, that of Doc, Dpf and Scr, that appears extremely flexible and able to adapt to all Oem needs. Apart from the peripheral devices, the Vm approaches the market with a typical industrial engine mark. The two valves per cylinder are reintroduced, as well as the hydraulic tappets and fixed-geometry turbocharger, which did not give in to the automotive details that are imposed on the complex Vgt.

Extremely compact

Fair play also for resolving difficulties regarding heat dissipation, which were overcome, again, with a uniflow head offering an extremely compact engine to the market. Power and torque levels are exactly the same as the current versions found in the catalogue. At the top, the 84 kW with 420 Nm, or the 140 Nm/litre: values that crown the compact from Cento as the best in its class.

Gloria Steinem

WHO IS VM?

Vm Motori was founded in 1947. The Company specialises in the design and production of diesel engines for a variety of uses. Vm Motori's engines were initially targeted towards the industrial, agricultural and marine industries. In 1990 Vm Motori launched the turbotronic engine featuring an electronically controlled injection system and Egr. This engine, widely considered to be the cleanest light duty diesel engine in the world, was notable for having produced best in class performance and emissions results.
Vm Motori stood out in the industrial field for the development of compact engines that have made history, and still do, for specialised agricultural tractors with overhang engine. The products of the Cento company feature a specific power for a particularly noticeable torque.
www.vmmotori.it

THE LUCKY THIRTEEN

Fpt Industrial, thanks to twin-turbo, becomes the best in class. With its 2,900 Nm the performances are those of bigger sized engines. John Deere, the other biturbo, is right behind

It is practically impossible to distinguish the automotive version from that of the industrial in the 13 litre range. With the exception of some minor adjustments, the technologies that are used in the two different applications are essentially the same.
In fact, some models display solutions that not even the golden world of on road is able to express (here it is worth mentioning John Deere and the Ftp twin-turbo). With the shift to IIIB, all players have pointed their finger toward supercharging systems. Today, for example, Cummins and Scania make use

of the variable geometry turbo. John Deere goes further with a sequential twin-turbo with one of the two turbos being a Vgt. Man also has two blowers, but in this case the German model displays two fixed turbos. Nevertheless, the true protagonist s the 13 litre Industrial Ftp, the best in its class with 500 kW.

The last generation

On this grid it is possible to appreciate the first strides of the latest generation of common rail. John Deere, for example, relies on the Denso pump capable of a maximum pressure of 2000 bar. While Cummins and Scania show the 2,400 bar Xpi that they themselves have developed together.
Amongst the innovations, of note is the Mtu 1,300 range, a series of 6-cylinder inline engines (bore and stroke measures are still top secret) with an engine volume of 12.8 litres. The top of the range dispenses 380 kW at 1,700 revs with a torque of 2,300 Nm at 1,400. No astonishing performances from the 12.8 litre German engine, that might improve along the way.
The Mtu 1,300 is a truck-engine manufactured by Detroit Diesel (Dd13), available in the Mercedes Euro 6 version. A novelty for Scania too, that presents the unprecedented version of the 6-cylinder inline with an engine volume of 12.7 litres that appears to be less aggressive than its 16-litre older brother (the best in its class for trucks). Here, the Swedish engine dispenses 405 kW, a value of power that is in line with the majority of its competitors, but that is not sufficient to challenge neither the Ftp Industrial nor the 13-litre by John Deere, which is able to reach 448 kW at 2,100 revs. A few pegs down we have the 12.4 litre sequential twin-turbo by Man, resting just under 400 kW. These are followed by the bulk of the group, reaching between 370Kw and 390Kw. ■

NINE FOR 13 LITRE

Brand	Caterpillar C13 Acert	Cummins Qsx 11.9	Deutz Tcd 12.0 V6	Fpt C13 Ent Scr	John Deere 6135Hfc95	Man D2676	Mtu 1300	Scania Dc13 070A	Volvo Tad1365Ve
									
I.D.									
Bore x Stroke mm - S/B	130 x 157 - 1,21	130 x 150 - 1,15	132 x 145 - 1,10	135 x 150 - 1,11	132 x 165 - 1,25	126 x 166 - 1,32	-	130 x 160 - 1,23	131 x 158 - 1,21
Cylindes n,- displacement cc	6 - 12.5	6 - 11.9	6 - 11.9	6 - 12.8	6 - 13.5	6 - 12.4	6 - 12.8	6 - 12.7	6 - 12.7
Maximum rating kW/speed	388 - 2,100	373 - 2,100	390 - 2,100	500 - 2,100	448 - 2,100	397 - 1,800	380 - 1,700	405 - 2,100	405 - 1,900
Performance									
Mep at max power bar	18.1	18.2	19.1	22.63	19.3	21.7	-	18.5	20.4
Piston speed m/s	10.9	10.5	10.2	10.5	11.6	10	-	11.2	10
Maximum torque Nm/rpm	2,380 - 1,400	2,170 - 1,400	2,130 - 1,400	2,900 - 1,500	2,656 - 1,600	2,500 - 1,400	2,300 - 1,400	2,430 - 1,500	2,646 - 1,200
Mep at max torque bar	24.4	23.3	22.9	28.9	25.1	25.8	23	24.5	26.6
Torque at max power Nm	1,763	1,695	1,774	2,272	2,038	2,107	2,136	1,842	2,038
Power at max torque % - kW	90 (350)	85,3 (318)	80,1 (312)	91,17 (455)	99,4 (445)	92,4 (367)	88,8 (337)	94,30 (382)	82,2 (333)
Work range rpm	700	1,100	1,100	600	1,100	800	700	1,100	900
DETAILS									
Specific power kW/l	31.05	31.2	32.7	38.8	33	31.9	29.6	31.7	31.7
Specific torque Nm/l	190.45	181.6	178.9	255.23	196	201.3	179.4	190.7	207
Areal specific power kW/dm2	48.7	46.86	47.5	58.25	54.57	53.07	-	50.88	50.06
Areal specific torque Nm/dm2	299	272.5	259.4	337.84	323.5	334.2	-	305.1	327.2
RULER AND BALANCE									
Dry weight kg	1,143	1,175	995	1,430	1,550	1,015	1,140	1,050	1,237
L * W * H mm	1,272x996x1,132	1,490x990x1,100	899x925x1,116	1,365x912x1,213	1,305x873x1,550	1,630x893x1,046	1,375x980x1,260	1,406x889x1,108	1,148x868x1,237
Volume m3	1.43	1.3	0.93	1.51	1.77	1.52	1.7	1.38	1.23
Weight/power kg/kW	2.95	3.1	2.6	2.86	3.5	2.6	3	2.6	3.1
Mass/displacement kg/l	91.46	98.7	83.6	39	114.4	81.7	89	82.4	96.8
Power density kW/m3	270.6	286	419.4	331	253.1	261.2	223.5	293.5	329.3
Density t/m3	0.8	0.9	1.07	0.95	0.88	0.67	0.67	0.76	1.01
Displacement/volume l/m3	8.7	9.1	12.8	8.53	7.65	8.17	7.54	9.23	10,39
SPECIFICATIONS									
Emission level	Tier 4	Tier 4	Tier 4	Tier 4	Tier 4	Tier 4i - Stage IIIB	Tier 4	Tier 4	Tier 4
Injection system	Heui	Common rail Xpi	Common rail	Common rail	Unit pump	Common rail	Common rail	Common rail Xpi	Unit pump
Specifications	4V - Egr - Dpf - Scr	4V - Egr - Dpf - Vgt - Scr	4V - Scr - Egr - Dpf	4V - Scr-2T	4V-Egr-Dpf-2T Vgt Scr	Scr o Egr-Dpf	4V - Scr	Egr - Dpf - Vgt	4V - Scr
Indexes									
Torque	11.7	5.8	11.8	11.9	11.3	10.5	9	11.6	12
Performance	6.9	7.4	7.7	11.2	9.5	9.6	9.3	8.3	9.4
Stress	2.4	2.5	2.6	2.6	3	2.7	2.5	2.7	2.7
Lightness	1.2	1.2	1.3	1.3	1.1	1.2	1.2	1.3	1.2
Density	3	3.4	3.7	3.1	2.9	2.8	2.6	3	3.3
Diesel Index	25.2	20.3	27.1	30.1	27.8	26.8	24.6	26.9	28.6

The table on the left is a snapshot of the industrial 13-litre offer. With the shift from IIIA to IIIB the injection systems have been monopolised by the common rail. Bosch is still on top, but Delphi has won some important market shares. With the Tier 4, the turbocharge systems become more and more important. They can improve the performances and lower emissions and consumption. Not only: the increase of the power density is noticeable. Fpt Industrial, for example, shows the same performances of a 16-litre.

4.4 litre IIIB version

GERMAN POWER

Man and Mercedes lead the group. Man does it with an engine developed for truck, that features a double overhead camshaft. Along the same line Mercedes, that plays the Om 924 card: an engine designed to substitute the 900 series and approach the Euro 6 automotive market

It is difficult to determine who owns is the legacy of the 1-litre swept volume, the most common compression-ignition engine in the world that has become the symbol of the diesel school in Europe. The first production on the market, at the end of the 1930s, was rallied between Perkins and Deutz, two manufacturers that quite rightly became the symbol of industrial diesel.
Over the years this type of engine has changed dramatically. Firstly by increasing the swept volume from 900 cc to the current 1,100-1,200 and, additionally, by adopting a series of technologies aimed at facing the market demand for specific levels of power and the legislation on emissions.
To date, 10 manufacturers are involved in the Final market (this does not include Caterpillar, as it is represented by Perkins), actively challenging the performances.

Chip, Scr and Egr

All engines are under electronic control using a common rail taking over the injection system. Essentially all of these adopt the Egr and Scr ticket (except for Ftp Industrial and Perkins) and the use of the twin turbo, a real gem of the industrial sector, is really strong. With the exception of Jcb and Man all other engines published on the grid are Tier 4 Final Stage IV certified.
These are the leading actors.
Cummins introduces the Qsb 4.5 that originated from the historical partnership (in 1996) with Iveco and New Holland, a joint venture that ended a while ago. The American manufacturer has changed the bore and stroke values preserving, nevertheless, the swept volume. The 4.4 litre Cummings dispenses 128 kW for a maximum torque of 705 Nm.
Deutz's response is the Tcd 4.1 L4, with its 4 litre engine has the smallest volume in the range. A difference that is appreciable in terms of torque, here at 609 Nm (100 Nm less than the mean value by comparison).
Fpt Industrial stands out of the crowd by seizing the Tier 4 Final with the Scr system alone. A choice that rewards the reduction in radiators and the thermodynamic efficiency. In line with its tradition, Ftp Industrial does not excessively challenge the performance (27.8 kW/litre), favouring instead reliability and duration.
Jcb offers a higher engine volume, and plays the 4.8 litre 4-cylinder card, dispensing 129 kW at 2,200 revs with a torque value of 750 Nm. The English manufacturer has not yet presented the Final version, with the addition of the Scr system.
From the UK to Germany, Man, an exceptional Teutonic that approaches the industrial sector with the D08, a purely automotive engine with truly excellent performances. Its power reaches 162 kW with a torque value of 850 Nm. All thanks to a well organised and refined twin-turbo system.
No less is Mtu, that offers the novel R4 1,000, a Mercedes engine (934 series) that is the best in class of the sector. It reaches as many as 170 kW and the Nm are 950. No other engine at the moment on the market is able to reach these values (its performances are those of a 6-cylinder).

Bigger cylinder

To conclude, Perkins, Sisu and Volvo. The first presents the legendary 105 per 127 swept volume, here in the twin-turbo version. Meanwhile, the Finnish answer is an increased swept volume 49 Cwa. Volvo Penta, in contrast, presents a complete novelty. The Tad572V is a 5.1 litre 4-cylinder manufactured in India that substitutes the engines of Deutz origin that have monopolised until now the line of attack of the Volvo industrial catalogue.

ONLY FEW OVER 130

Brand Model	CUMMINS QSB4.5	DEUTZ TCD 4.1 L4	FPT INDUSTRIAL N45 ENT SCR	JCB ECOMAX 4.8L	JOHN DEERE 4045HFC93	MAN D0834	MERCEDES OM 924	PERKINS 1204E-ETTA	SISU 49 CWA	Volvo Tad572Ve
I.D.										
Bore x Stroke mm - S/B	107x124 - 1.16	101x126 - 1,25	104x132 - 1.27	106x135 - 2.06	106x127 - 1,2	108x125 - 1.16	110x135 - 1.23	105x 127 - 1.21	108*134 - 1.24	-
Cylindes n.- displacement cc	4 - 4,458	4 - 4,036	4 - 4,483	4 - 4,763	4 - 4,481	4 - 4,578	4 - 5,129	4 - 4,397	4 - 4,908	4 - 5,1
Performance										
Maximum rating kW/rpm	129/2,500	115/2,400	125/2,200	129/2,200	129 - 2,200	162 - 2,100	170 - 2,200	129 - 2,200	147 - 2,200	160 - 2,200
Mep at max power bar	14,17	14,53	15.51	15.07	16.02	20.62	18.44	16.32	16.66	17.36
Piston speed m/s	10.33	10.08	9.68	9.9	9.31	8.75	9.9	9.31	9.83	9.9
Maximum torque Nm/rpm	705/1,500	609/1,600	700/1,600	750/1,500	713/1.600	850/1,750	950/1,400	750/1,400	835/1,500	900 - 1,200
Mep at max torque bar	20.28	19.35	20.03	20.20	20.41	23.81	23.76	21.88	21.82	22.51
Torque rise %	43	33	29	34	27	15	29	34	31	30
Torque at max power Nm	492.41	457.26	542.21	559.56	559.56	736.16	737.4	559.56	637.64	694
Power at max torque % - kW	85.9 - 110.8	88.79 - 102,09	93.89 - 117.35	91.39 - 117.87	92.67 - 119.53	96.22 - 155.85	81.98 - 139.35	85.29 - 110.01	89.29 - 131.23	70,7 - 113
Work range rpm	1.000	800	600	700	600	350	800	800	700	1,000
DETAILS										
Specific power kW/l	28.94	28.49	27.88	27.08	28.79	35.39	33.14	29.34	29.95	31,2
Specific torque Nm/l	158.15	150.89	156.14	157.47	159.13	185.67	185.21	170.59	170.14	175,5
Areal specific power kW/dm2	35.88	35,9	36.81	36.56	36.56	44.23	44.74	37.26	40.14	42
Areal specific torque Nm/dm2	196.11	190,13	206.11	212.58	202.09	232.08	250.04	216.65	227.99	236,88
RULER AND BALANCE										
Dry weight kg	360	400	410	591	540	490	540	420	600	560
L * W * H mm	818*713*820	783*629*812	810*678*901	841*697*911	867*680*1,211	937*882*926	818*755*1,033	845*741*867	902*620*887	772*859*995
Volume m3	0.478	0.4	0.495	0.534	0,714	0,765	0,638	0,543	0,496	0.66
Mass/displacement kg/l	80.76	99.11	91.46	124.08	120.52	107.03	105.28	95.53	122.26	109.18
Weight/power kg/kW	2.79	3.48	3.28	4.58	4.19	3.02	3.18	3.26	4.08	3.5
Power density kW/m3	269.73	287.56	252.62	241.57	180.68	211.69	266.47	237.63	296.34	242.49
Power density kW/m3	9.32	10.09	9.06	8.92	6.28	5.98	8.04	8.1	9.89	7.77
SPECIFICATIONS										
Emissions	Tier 4 Final	Tier 4 Final	Tier 4 Final	Tier 4 Interim	Tier 4 Final	Tier 4 Interim	Tier 4 Final	Tier 4 Final	Tier 4 Interim	Tier 4 Final
Injection system	Common rail	Common rail	Common rail	Common rail	Common rail	Common rail	Common rail	Common rail	Common rail	Common rail
Specifications	Vgt - Scr - Doc - Dpf	T - Egr - Scr - Doc - Dpf	T - Scr	Vgt -Egr	TT (Fixed-Vgt) - Scr	TT - Egr - Dpf	T - Egr - Scr	T - Doc - Scr	T - Scr	T - Scr
INDEXES										
Torque	3.58	3.01	3.61	3.7	3.65	4.1	5	3.7	4	4.9
Performance	3.26	2.89	3	3.2	3.2	5.19	5.44	3.3	4	5
Stress	27.1	27.63	26.07	26.9	24.46	32.04	30.04	27.26	26.64	26.1
Lightness	1.32	1.24	1.25	1.11	1.15	1.21	1.19	1.22	1.13	1.2
Density	2.99	3.25	2.99	3.13	2.55	2.52	2.96	2.84	3.38	3.12
Diesel Index	2	1.77	2.1	2.06	2	2.52	2.92	2.09	2.8	2.1

The 1.1-litre swept volume is applicable to several sectors: from agricultural to construction, and even light-duty trucks.

Around the 3 litres

A COMPLETE FAMILY PICTURE

Cummins with two models, but the B3.3 will never pass the Tier 4. Deutz and Kubota offer engines with consistent volume. A different approach for Vm and Yanmar, who focus on specific performances. Mitsubishi is stuck on the previous step, while Doosan and Kohler compete without Dpf

With Kohler coming on stage, the 'family' portrait will be complete. The 3.4-litre from Reggio Emilia is the nth tile of a particularly busy segment, where the big guns seem to have played their best cards. Not in all cases though. A typical case is that of Mitsubishi (now Perkins) which despite having the right engine volume and everything it takes to stand out, has preferred to stay out of the competition

that spans 80-90 kW, with the exception of the 100 kW Kohler (an engine that will be released in 2014).

Qsb3.3 is the pioneer

The 3.3 Qsb Cummins, a 3.3 litre 4-cylinder of Japanese origin, was the first to show to the world the true potential of this model of engines. In fact, Cummings had already displayed the same calibration in IIIA, when its direct competitors, aside from being half as many as the ones on the grid today, had stopped between 70 and 74 kW. Compared to previous versions, the Vgt and Dpf are making their first appearance. Besides this, 4 valves and common rail remain stable.

Deutz responds with the Tcd 3.6, one of the few engines with 2 valves. Not bad if you consider the German performances. The maximum power is 90 kW with a torque value reaching 480 Nm.

Another story is the 3-litre by Isuzu, that appeared for the first time at the Bauma 2010. The Japanese firm relies on specific performances and writes 92 kW on its ID. A power value that brings the mean effective pressure to 11.07 bar for a linear speed of 7.7 m/s, the lowest in comparison.

A different case again is Kubota, that did not need to revolutionise its offer. The 3.8 litre in this confront has already been available for the past few years. The technical innovations for the IIIB are the external Egr, the intercooler and the common rail, which substitutes the legendary inline pump.

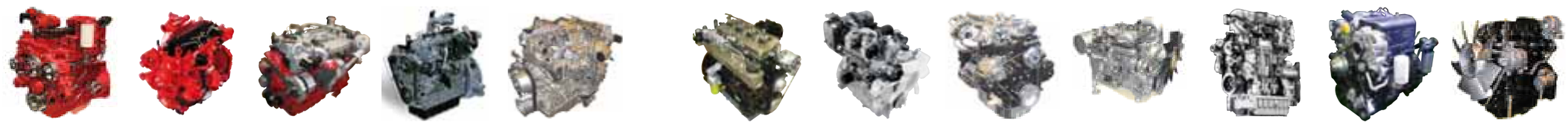
Another Japanese on the list is Mitsubishi that, up until the IIIA, was available on the market with the brand Perkins/Cat, with the name series 800. A range that has never met with great approval on the market because of its inability to match its direct competitors and because incapable of stealing market shares to engines with a litre swept volume.

Perkins made in Turin

By signing an agreement with Fpt, Perkins finds itself with a top category young product. Compact and well-performing, the 3.4 Perking displays 4 valves per cylinder, common rail and Dpf. An engine that is destined to become a star in the industrial sector.

To close the Vm, one of the few in the Final version thanks to the Scr and Yanmar that uses a 3-litre with high performances and a refined design. So much that it was awarded the highest Diesel Index. ■

THE TWELVE APOSTOLES



Brand - Model	Cummins Qsb 3.3	Cummins Qsf 3.8	Deutz Tcd 3.6	Doosan D34	Isuzu 4Jj1X	Kohler Kdi 3404T Cr	Kubota V3800-Cr-Ti	Mitsubishi K42	Perkins 854E	Same Kd4	Vm D754Te3	Yanmar Tnv94Ht-Cr
I.D.												
B x S mm - S/B	95x115 - 1.21	102x115 - 1.13	98x120 - 1.22	98 x 113 - 1.15	95.4x104.9 - 1.1	96x116 - 1.21	100x120 - 1.15	94x120 - 1.28	99x110 - 1.11	103 x 115.5 - 1.12	94x107 - 1.14	94x 110 - 1.17
N.cil.- dm3	4 - 3.26	4 - 3.75	4 - 3.62	4 - 3.4	4 - 2.99	4 - 3.36	4 - 3.7	4 - 3.3	4 - 3.4	4 - 3.84	4 - 2.969	4 - 3.05
Maximum power kW/rpm	82/2,600	98 - 2,600	90/2,300	74 - 2,400	92/2,200	100/2,600	85/2,600	74/2,600	85/2,600	95/2,200	85/2,300	88,4/2,500
Mep at max power bar	11.85	12.28	13.24	11.07	11.07	10.62	10.62	12.37	13.52	15.59	15.24	14.18
Piston speed m/s	9.97	9.97	9.2	9.04	7.69	10.4	10.4	8.8	8.43	7.7	8.2	9.17
Maximum torque Nm/rpm	420/1,400	488 - 1,200	480/1,600	430 - 1,400	420/1,800	480/1,500	400/1,600	372/1,600	420/1,400	516/1,600	420/1,300	420/1,400
Mep at maxtorquer bar	16,53	16,6	17,01	16,18	17,97	18,34	13,62	14,33	15,91	17,2	18,15	17,65
Torque at max power Nm	300.97	359	373.42	294.24	399.06	367:03:00	311.98	320.99	356.82	467	352.67	337.44
%pot. a max torque (kW)	75.14 (61.61)	61.3 (62.6)	89.42 (80.47)	63.08 (85.2)	86.11 (79.21)	75.45 (75.44)	78.9 (67.06)	84.29 (62.36)	71.65 (61.61)	88.3 (86.5)	67.31 (57.21)	69.7 (61.61)
Work range rpm	1,200	1,400	700	1000	400	1,100	1,000	1,000	1,200	1,600	1,000	1,100
DETAILS												
Specific power kW/dm3	25.16	20.63	24.87	21.7	30.69	29.79	22.56	22.23	25.4	25.47	28.63	28.97
Specific torque Nm/dm3	128.88	177	132.64	122	140.1	142.99	106.16	111.73	124.07	134.11	141.48	137.62
Areal spec. power kW/dm2	28.94	30	29.84	24.54	32.19	34.56	27.07	26.67	27.94	29.42	30.64	31.86
Areal spec. torque Nm/dm2	148.21	149	159.17	150	146.97	165.87	127.39	134.08	136.47	154.9	151.38	151.38
RULES AND BALACE												
Dry weight kg	265	280	270	265	320	-	300	250	270	540	257	235
L * W * H mm	713*495*703	818x728x786	713*580*792	-	928*760*888	-	745*562*816	715*625*750	570*595*680	602*578*679	702x557x736	719*496*717
Mass/power kg/kW	3.23	2.86	3	3.5	3.48	-	3.53	3.38	3.14	5.51	3.34	2.66
Mass/displacement kg/dm3	81.32	20.63	74.61	-	106.75	-	79.62	75.09	79.76	140	86.5	77
Power density kW/m3	330.49	209.37	274.79	-	146.9	-	248.79	220.79	239	414	267.5	345.72
Density t/m3	1.07	0.6	0.82	-	0.21	-	0.88	0.75	2.36	2.29	0.89	0.92
Displacement/volume dm3/m3	13.13	8.03	11.05	-	4.79	-	11.03	9.93	29.61	16.3	10.24	11.94
SPECIFICATION												
Emission level	Tier 4i	Tier 4 F	Tier 4	Tier 4 f	Tier 4i	Tier 4 f	Tier 4i	Tier 4i	Tier 4	Tier 4i	Tier 4 f	Tier 4i
Injection system	Common rail	Common rail	Common rail	Common rail	Common rail	Common rail 2,000 bar	Common rail	Common rail	Common rail	Common rail Delphi	Common rail	Common rail
Valves-Air Intake-Emission techno.	4V Turbo aft, Egr Dpf Vgt	Egr - Scr	2V Turbo aft, Egr Dpf Doc	Doc - Scr	4V Turbo aft, Egr Dpf	4V Turbo aft, Scr	4V Turbo aft, Egr Dpf Doc	4V Turbo aft, Egr Dpf	4V Turbo aft, Egr Dpf	2V/Turbo aft, Egr Doc	2V Turbo aft, Egr Dpf Scr	4V Turbo aft, Egr Dpf
Index												
Torque	3.2	4.8	4.1	3.4	3.6	3.9	3.1	2.7	3.5	3.3	3.6	3.5
Performance	4.5	6	5.3	4	5.2	5.7	4.5	3.9	4.6	4.2	5	5.5
Stress	6.4	7.4	7	7.3	8	7.2	7.2	7.7	7.9	7	7.9	7
Lightness	3.3	3.2	2.9	3.4	3.3	-	3.4	3.4	3	3.2	3.3	4
Density	3.3	3.9	2.8	-	1.4	-	2.5	2.2	2.4	2.3	2.7	3.5
DIESEL INDEX	20.7	25.3	22.1	18.1	21.5	16.8	20.7	19.9	21.4	20	22.5	23.5

300 cc single-cylinder

THE ULTIMATE CC CHALLENGE

Farymann disrupts the absolute monopoly of the the Hatz, Kohler and Yanmar triad by introducing a different injection system. The competition is between two small German-based and two small Italian-based companies, as the Japanese product is assembled in Lombardy, Italy

Within this range, Kohler presents the 350 cc of the 15 Ld class. The new Kdi will in fact start being manufactured by the end of this year, but only the dimensional values will be altered. The Kohler is slightly higher in cc, however the 15 Ld 315 with 287 cc, could not be used in the current segmentation of the single-cylinders in Reggio Emilia, despite it being more appropriate. Farymann, which stably rotates around the Indian Greaves Cotton, is a disruptive element for the usual triad, Hatz, Kohler and Yanmar, competing on the European markets. Remarkably, this model is also available in its water-cooled sister version (its three competitors, however, are air-cooled), from 15-18W, with higher performance both in terms of power (with the 18W increased by 9.6% compared to the 18D) and of torque value.

A close challenge

Nevertheless, with this kind of cubic capacity the usual equilibrium is repeated, with the four singles spanning only one kilowatt interval .
Hatz appears to be at a disadvantage as far as power is concerned, but it wins on Diesel index. With 4 kW, Hatz fails to match its neighbour Farymann (4.7 kW), however Lombardini excels compared to all its competitors, including Yanmar (although by just a fraction of a kW), which wins in terms of having the highest torque value. Hatz holds the most well-regulated mean effective pressure (in line with the 1B30, which follows in the Ruhstorf catalogue), and this emphasises Lombardini's 5.93 bar, which accounts for the increase in power. Hatz marvels for its weight, as it weighs in at 10 kilos less than its neighbour and ends at a double digit percentage compared to the other two. ■

MORE THAN 3 OUT OF 4 ARE EUROPEAN




Brand- Model	Farymann 18 D	Hatz 1B30	Kohler15 Ld 350	Yanmar L70N
I.D.				
Bore x Stroke mm - S/B	82x55 - 0.67	74x65 - 0.88	82x66 - 0.8	78x67 - 0.86
Cylindes n.- displacement cc	1 - 290	1 - 279	1 - 348	1 - 320
Performance				
Maximum rating kW/speed	4.7/3,600	4/3,600	5/3,600	4.9/3.600
Mep at max power bar	5.5	4.87	4.88	5.21
Piston speed m/s	6.6	7.8	7.92	8.04
Maximum torque Nm/rpm	13.5/2,500	12/2.400	14.7/2.200	18/2,400
Torque at max power Nm	12.46	10.6	13.25	13
Specific power kW/l	16.19	14.1	14.35	15.31
Specific torque Nm/l	46.85	44.6	42.2	56.25
RULER AND BALANCE				
Dry weight kg	41	29	33	36
L * W * H mm	401x220x422	361*272*401	373.5*328.25*444.5	290*422*543
Volume m3	0.037	0.04	0.054	0.055
Power density kW/m3	126.25	101.59	91.75	88.39
SPECIFICATIONS				
Emissions	Tier 3B	Tier 3B	Tier 3B	Tier 3B
Injection system	Unit pump	Rsn Stanadyne	Rsn Stanadyne	Rsn Stanadyne

Over 400 cc

ONLY THREE AT THE STARTLINE

Kohler sacrifices the 0,5 litre and hands over the key for the top challenge to the 450 cc. For the leading actors in gardening, threatened by the low cost, and in construction, the power ranges between 7.3 and 8 kW and the injection system is Stanadyne Rsn

The top picture shows the 1B40 by Hatz. Below, the Japanese Yanmar manufactured in Italy. To close, the new Kohler. hey all have the Stanadyne Rsn in common, which cushions the detonation thanks to a pre-injection and to the several holes for atomisation.

For this range of cubic capacity it is once again a matter of a few cubic centimetres, however, the launch of the Kohler Kd15 series has returned an important verdict: the designated heir of the innovative Lombardini family has dropped the top of the series from the unrealistic attempts to hold it with the half a litre. Only Hatz remains to advocate the cause of these units, with which Lombardini has confronted the Germans. A dispute which has brought about more pain than glory for everyone, forcing them to fight their way with the two-cylinder regarding power density and specific curves. The challenge at the top is once more between the same three players revolving around 450 cc, from the 435 by Yanmar to the 462 by Hatz, also available in the vertical version, considering that Faryman is bailing out, as it is set on 290 cc.

Kohler, American leader

Halfway down we find Lombardini with the black maquillage on the lid, a homage to its American leader, which divides the same type of cylinderin two, silenced and non-silenced, separated by a fraction of a kW. A choice that has been bypassed by Yanmar, which mantains in its catalogue the Ln version entrusting the Lv version to the North American market. Aside from nominal differences, all three players are equipped to face the challenge regarding emissions.
In fact, they all have the Stanadyne Rsn in common, which cushions the detonation thanks to a pre-injection and to the several holes for atomisation. The campaign in favour of 'silence' stems from the 2005/08 European legislation and the subsequent legislative incentives to muffle the decibels deriving from open-air operating machines (i.e. both machinery from construction sites and power generators). The aim has been tackled with hoods on the manufacturer's side, and contributed to by motorists with the optimization of the injection system, the combustion chamber, the valves, the areation and the coverage of muffler and recoil. Speaking of recoil, in Reggio Emilia the rubber pulley has been covered to reduce the friction and, consequently, noise. This operation is part of the adjustments on the Kd15, together with the air filter cartridge, bigger in size and filtration capacity. The tank is now equipped with a second filter and has a more efficient exhaust. These adjustments to the injection have provided a competitive advantage to the Kohler, that can show off its muscles with 8 kW. Even in terms of specific values, the torque is ahead of the competitors, although Yanmar is in the wake with the highest absolute value, closely followed by Hatz.

For the future

At the moment, no major revolution is expected for the future, and the structure of the three singles still remains anchored to the mechanical avocation and to the two valves. Something may happen in the next few years: there is rumor that in Bruxelles the Epa limits could be extended to under 19 kW. On this front, Yanmar has the competitive advantage of an internal Egr, redesigned for Lv. Lombardini has taken the first, important step and Hatz will begin the revolution of its offer at Bauma. Bets can be made on how to increase the pressure and 'mock' the poles. For sure Hatz, Kohler and Yanmar possess the competences and the economy of scale to succede without having to fear the aggressiveness of the Chinese, who in fact still focus on the petrol equivalents. ■

BETWEEN 7.3 AND 8.3



Brand- Model	Hatz 1B40	Kohler Kdi15-350	Yanmar L100N
I.D.			
Bore x Stroke mm - S/B	88x76 - 0.86	86x76 - 1.1	86x75 - 0.87
Cylindes n.- displacement cc	1 - 462	1 - 411	1 - 435
Maximum rating kW/speed	7.3/3,600	8/3,600	7.4/3,600
Mep at max power bar	5.37	6.62	5.78
Piston speed m/s	9.12	10.32	9
Maximum torque Nm/rpm	25/2,000	24.5/2,000	27/2,600
Torque at max power Nm	19.35	21.21	19.62
Power at max torque % - kW	71.77 - 5.24	64.18 - 5.13	99.41 - 7.36
Work range rpm	1,6	1,6	1
RULER AND BALANCE			
Dry weight kg	48	45	48.5
L * W * H mm	392*335*480	412.8*340*512	412*471*494
Volume m3	0.063	0.072	0.096
Mass/displacement kg/l	103.89	109.56	111.38
Weight/power kg/kW	6.58	5.63	6.55
Power density kW/m3	115.81	111.33	77.19
SPECIFICATIONS			
Emissions	Eu/Tier IIIB	Eu/Tier IIIB	Eu/Tier IIIB
Injection system	Rsn Stanadyne	Rsn Stanadyne	Rsn Stanadyne

WITH DOUBLE OVERHEAD CAMSHAFT

Euro 6

Delphi common rail at 2,500 bar and variable-geometry turbocharger. Egr and Scr take care of emissions. Ever present, the particulate filter, here in the active version. Here is the 10.8 engine in its Euro 6 version, that substitutes the 9.2

The 9.2-litre is being made to retire, making way for the 10.8-litre with a strong personality. This is Daf's choice for the Euro 6, focusing on specific performance through its technology. The new entry, the Mx-11, is an inline 6-cylinder available in five different calibres that are able to cover a power range spanning from 210 to 310 kW, all dispensed at 1,900 revs. These power values enable the Dutch 10.8-litre to motorise up to 44-Ton machinery, reaching the Xf catalogue, now covered by the 12.4-litre engines.
The main features of this new entry are the four valves per cylinder, governed by the double overhead camshaft (a first timer for Daf engines), the Delphi common rail that ensures maximum injection pressures of 2,500 bar and the variable-geometry turbocharger by Cummins.

There're all aftertreatment

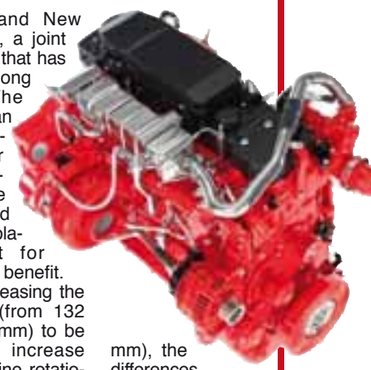
The same manufacturer is also used for the exhaustion gas post-treatment system, which uses Scr, active-regeneration particulate filter (Dpf) and Doc. All is completed/everything is brought together with the exhaust gas recirculation (Egr), which is responsible for the reduction of combustion temperature and, consequently, of NOx (nitrogen oxides). As the manufacturer himself points out, he embarked on this project from scratch, with the sole aim of providing the market with a compact engine that well integrated all of its components. Some fusions in the monoblock (in iron graphite manufactured in Brazil) that enclose part of the pipework and the two pumps that dispense the pressure for the common rail system, are to be considered in light of this.
The true Daf Mx-11 signature is nevertheless the double overhead camshaft that allows for better adjustment of the aspiration and exhaust and a significant reduction in weight (the camshafts are hollow for a total reduction in weight of 15 kg). Furthermore, this technology guarantees an optimization of the Mx engine brake and appears to be necessary for the reduction in emissions and consumption. The new Daf is a truly well-designed automotive engine that does not seem to be willing to give in to its competitors regarding pushed technology and performance. This is why, as the manufacturer stated, the choice was in favour of a Vgt and not of a complex biturbo. A choice that, on paper, outclassees the Iveco 11-litre (Euro 6 without Egr) and the 12.7-litre by Scania, both remaining, with 353 kW, the two leaders in the truck sector.

Look the competitors

The other competitors are Volvo-Renault, with the 10.8-litre in the Euro 5 version reaching 338 kW (a great deal more than Daf) and Man, which is still set on 323 kW. Finally, we have the Mercedes Om 470 with 10.6 litres, which at its maximum calibration dispenses 10 horsepower less than Daf, but, despite having a smaller engine size, it levels equal when considering torque values (2,100 Nm for both).
The only flaw, if one has to point it out, would be the limited bravery regarding anti-emission technologies. Also because Avl, Daf's partner, has been known for its innovative solutions. Considering the industrial projects with Doosan and Kohler.

Sam Chu Lin

FOR LIGHT DUTY



For the Euro 6, the agreement with Cummins for the supply of engines with 1.1 litre displacement in the 4 and 6 cylinder versions is once more renewed. The first, Px 5, covers the power range between 112 and 157 kW. For higher power values the 6.7-litre Px-7 is able, thanks to four different calibres, to erogate powers between 164 and 231 kW with torque values starting at 850 Nm and reaching 1,100. The 4 and 6-cylinder engines by Cummins are the result of the memorable partnership (1996) with Iveco and New Holland, a joint venture that has ended long ago. The American manufacturer has therefore created this displacement for its own benefit. By decreasing the stroke (from 132 to 127 mm) to be able to increase the engine rotational speed (2,500 revs) and by broadening the bore (for 104 to 107) to avoid losing extra important ccs especially for the torque. Compared to the original version (104x132 mm), the differences concern not only cylinder measures but the entire combustion cycle. Unlike the N series from Iveco, here we find Vgt and Egr. Instead, they have in common filter and Scr.

EURO SIX BY PACCAR

Brand Model	DAF MX-11 320	DAF MX-11 291	DAF MX 11 210	DAF MX 11 240	DAF MX-11 271
D.I.					
Bore x Stroke mm - S/B			123 x 152 - 1,24		
N. cilynders - dm³	6 - 10.837	6 - 10.837	6 - 10.837	6 - 10.837	6 - 10.837
Maximum power kW - rpm	320 - 1,900	291 - 1,900	210 - 1,900	240 - 1,900	271 - 1,900
Mep at mx power bar	19,0	17,3	12,5	14,3	16,1
Piston speed m/s	9,6	9,6	9,6	9,6	9,6
Maximum torque Nm	2,100 - 1.000	1,900 - 1.000	1,200 - 1.000	1,400 - 1.000	1,600 - 1.000
Mep at max torque bar	24.90	22.50	14.20	16.60	18.90
Torque rise %	3.1	3	1,.3	1.6	1.7
Torque at max power Nm	1,607.0	1,460	1,058	1,205	1,362
Power at max torque % (kW)	68.8 (220)	68.50 (199)	59.70 (125)	61.20 (147)	61.80 (167)
Work range rpm			900		
DETAILS					
Specific power kW/l.	29.5	26.8	19.4	22.1	25
Specific torque Nm/l.	193.7	175.4	110.3	129.2	147.3
Areal specific power kW/dm²	44.88	40.81	29.45	33.66	38.01
Areal specific torque Nm/dm²	294.6	266.6	167.8	196.5	224.0
SPECIFICATIONS					
Emission Level			Euro 6		
Compression ratio :1			17		
Injection system			Common rail		
Emission technologies			Scr- Vgt - Doc - Dpf 4V		

In these pages, the Daf MX11. It's an inline 10.8-litre 6 cylinder in Euro 6 version. Compared to the 12.4 and the 9.2 that it is subsituting, it has an double overhead camshaft. A novelty for the engines of the Paccar group. The MX11 is a very important project, developed with the collaboration of the Austrian Avl, a company that in the last few years has signed several important projects, the last being, temporally, that with Doosan for the D series.

On the right, the Hi way by Iveco. Below, on the right, a detail of the 6 cylinder Cursor 11, launched a few months ago, that became immediately the protagonist of an entire truck series: the most important for European markets.

Euro 6

Euro 6 at Fpt Industrial

AN ELEVEN THAT LOOKS LIKE A 13

The protagonist of the new Iveco Hi way series is the 11-litre 6 cylinder that, thanks to its 338 kW, becomes the reference engine: a true best in class. Now Man has to keep up. With the 'Scr-only' system the Fpt Industrial technicians have had to rethink the truck cabins

Fpt Industrial faces the Euro 6 with a fully renovated Cursor family. The range contemplates the 9-litre, the novel 11-litre and the profoundly revised 13-litre. Aside from the 'Only Scr' system, these share the basic geometry: common rail and variable pitch turbo. Not much is left of the Euro 5 engine block. Also for the Cursor 13, the only one to preserve the same values of bore and stroke, the transition from pump injectors to common rail has required the remaking of the cylinder block and head, to face working pressures up to 25 bar and injection pressures up to 2,200 bar.

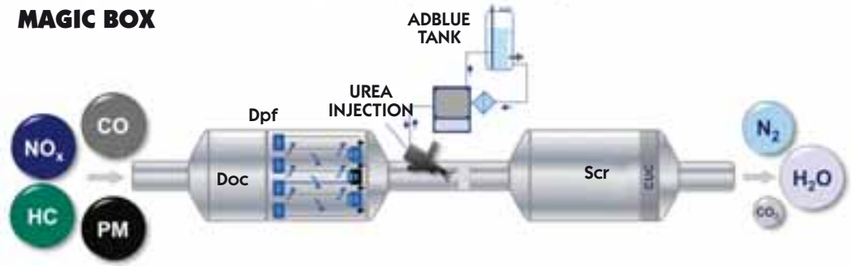
The magic rail

The common rail placed under the cylinder head cover is powered by a two-piston pump (rotary pump only on the Cursor 9) on the left (the cold side). This system, mapped out by Fpt Industrial and patented with the acronym Hi-escr, allows to remain within the limits of the Euro 6 without having to resort to the Egr. NOx and Pm are contrasted on two opposite fronts. The particulate becomes lower as the temperature in the combustion chamber increases; on the other hand, cutting down on nitrogen oxides requires to act on the propeller cooling. This is why it is not necessary to increase the radiation cores and, consequently, to modify the cabin. This is one of the many advantages offered by the 'Only Scr', but not the most important. It lies within the laws of combustion. Once the problem of nitrogen oxides has been transferred elsewhere, the motorist is free to plan out the combustion with the only intention to obtain the highest performance. All the operating parameters leap ahead. Power and torque, maintained until now in line with the calibrations of the correspondent Euro 5, increase to record-breaking specific values: a 600 horsepower version of the Cursor 13 is now undergoing testing and for the Cursor 16 one (expected in 2014) that will reach 800 horsepower.
The entire range will be completely revised for the engine equipment. The Cursor 9, which measures more or less exactly as the current Cursor 8 soon to be exiting the scene, will cover values of power to 338 kW, which are now covered by the Cursor 10, another engine on its way to retirement. The Cursor 11 will play a key role in the 338/368 kW range, a new meeting point for the European branching, and Cursor 13 will be dedicated to superpowers. All three have limited size to improve their unleaden weight and the space available inside the cabin.

The 'Scr only' as dogma

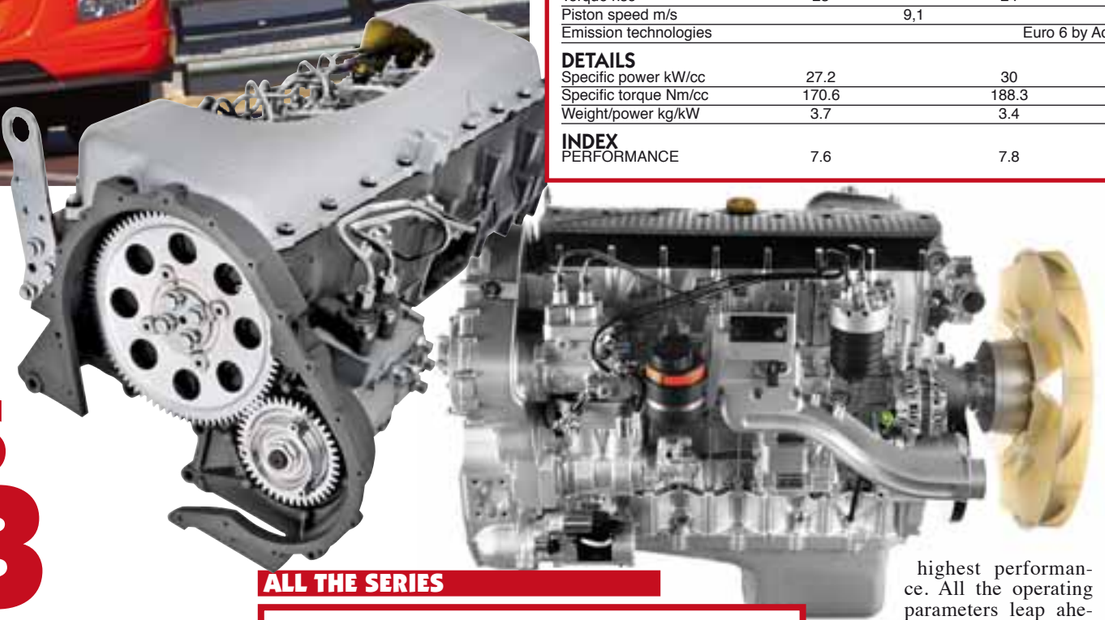
To achieve these results, Fpt Industrial has focused extensively on the Scr group. In a box with restrained dimensions compared to those of other manufacturers, 5 elements reside in series. The oxidation catalyst (Doc) enriches the exhaustion gas with oxygen. The residual particulate is captured with the particulate filter (Dpf). Being of a passive nature, it does not require periodical regeneration through oil combustion, due to the limited amount of Pm dismissed by the combustion chambers. **Pieter van der Does**

MAGIC BOX



CURSOR 11 AND 13 MADE IN FPT INDUSTRIAL

Brand and model	Fpt Industrial Cursor 11		Fpt Industrial Cursor 13	
I.D.				
Cylinder n.	6 in line			
BorexStroke mm - S/B	128 x 144 - 1.13		135 x 150 - 1.11	
Displacement cc	11,118		12,882	
Injection system	common rail			
Air intake	turbo geom. variabile			
Compression ratio	17.5			
Peso	1,160		1,230	
PERFORMANCE				
Maximum rating kW - rpm	308 - 1,900	338 - 1,900	367 - 1,900	411 - 1,900
Maximum torque Nm	1,900	2,100	2,300	2,500
Rpm Torque	1,000/1,500		1,000/1,600	
Work range rpm	900			
% Power at max torque (kW)	64.5 (199)	65 (219)	65.6 (241)	63.6 (261)
Torque at max power Nm	1,550	1,700	1,844	2,070
Mep at max torque bar	21.9	24.2	22.9	24.9
Torque rise	23	24	25	21
Piston speed m/s	9,1		9,5	
Emission technologies	Euro 6 by Adblue			
DETAILS				
Specific power kW/cc	27.2	30	28.5	31.9
Specific torque Nm/cc	170.6	188.3	178.5	194.2
Weight/power kg/kW	3.7	3.4	3.3	2.9
INDEX				
PERFORMANCE	7.6	7.8	7.7	7.7



ALL THE SERIES

Serie	Cylinders N°	Displ. Liters	Air intake type	Power kW- rpm	Torque Nm - rpm
Tector	4	4,5	waste-gate	118 – 2,500	580 – 1,250
	4	4,5	waste-gate	137 – 2,500	680 – 1,250
	4	4,5	waste-gate	152 – 2,500	750 – 1,400
Tector	6	6,7	waste-gate	162 – 2,500	800 - 1,250
	6	6,7	waste-gate	184 – 2,500	850 – 1,250
	6	6,7	waste-gate	206 – 2,500	1,000 – 1,250
	6	6,7	waste-gate	235 – 2,500	1,100 – 1,250
Cursor 9	6	8,7	waste-gate	228 – 2,200	1,300 - 1,200
	6	8,7	waste-gate	243 – 2,200	1,400 - 1,200
	6	8,7	waste-gate	265 – 2,200	1,650 – 1,200
	6	8,7	Vgt	294 – 2,200	1,700 – 1,200

Euro 6

THE LION KING ON ITS THRONE

All the Man Euro 6 engines share the ticket Scr-Egr, completed with the particulate filter. The twin-turbo becomes a must while the common rail dispenses the same injection pressures as in the Euro 5. The 10.5 litre is overtaken by the 11 litre by Ftp Industrial

This is the Euro 6 version of Man. Along with a general image restyling, the Euro 6 brings along some technological innovations, for example in its engines. By 2014 the Nuremberg engines will make use of Scr, Egr, Dpf, common rail and biturbo.

At Man the Euro 6 has been made possible thanks to the combination of the best technologies available today on the market, all incorporated to minimise the overall size. This is why the engineers in Nuremberg have united the particulate filter, Doc and Scr module in one compact, easily placeable unit. In addition to these technologies, Man has reluctantly had to make use of the exhaustion gas recirculation (Egr), a technology well known to the German manufacturer and one that was already experimented when launching the Euro 3 versions. A lot of thought was put into the supercharge system with the twin-stage turbo that is common in models with a higher power. This particular system, a must for the Man engines, has the advantage of increasing the values of power and torque, of optimising the specific consumption rate and of reducing emissions.

The Man truck catalogue in its Euro 6 version begins with the 4 and 6-cylinders of the D08 range. The former are available also in the 11 and 162 kW versions, while the 6.8-litre can go further, covering the range of power between 184 and 250 kW at 2,300 rev.

The central point of the Man sale is the D26 series, a 6-cylinder line with 10.5 litres that, up until the Euro 5, was able to threaten those market sectors covered by competitors with the 13-litres. Now the maximum powers have reduced to a point that the top of the range has to revert from 324 kW to the current 294. In this case too, the top powers display a twin-stage turbo and the emissions are kept under control by the Scr-Egr combination, helped in this task by the filter and the Doc.

MAN AT A GLANCE

Brand and model	Man D 20		Man D 26	
Cylinders n.	6 in line			
Bore x Stroke mm - S/B	120 x 155 - 1.29		126 x 166 - 1.32	
Displacement cc	10,518		12,419	
Injection/Air intake	common rail/ turbo 2 stadi			
Compression ratio :1	17.5			
Dry Weight	960		1.058	
PERFORMANCE				
Maximum power kW - rpm	265 - 1,900	294 - 1,900	324 - 1,900	353 - 1,900
Maximum torque Nm	1,800	1,900	2,100	2,300
Torque rpm	1,000/1,400		1,100/1,400	
Work range rpm	900			
% Power at maximum torque	71.2	67.7	74.7	75.1
Torque at max power Nm	1.334	1.481	1.628	1.776
Mep at max torque bar	22	23.2	21.7	23.8
Torque rise	35	28	29	30
Piston speed m/s	9.8		10.5	
Emission technologies	Euro 6 con Egr e Adblue			
DETAILS				
Specific power kW/cc	25.1	28	26	28.3
Specific torque Nm/cc	171	180.9	169.3	185.4
Weight/power kg/kW	3.6	3.2	3.2	2.9
INDEX DIESEL	5.2	5.7	5.22	5.4

12,4 litre at the top

Man close their offer with the 12.4-litre D28, in this case too the power and the maximum torque are set back. To date, the D28 range covers the interval between 324 and 353 kW (for the Euro 5 the range was between 353 and 397 kW), for a maximum torque that shifts from 2,500 Nm to 2,300.

A different story is that of the D28, the 8-cylinder V engine, implemented side by side with the Swiss Liebherr. The above mentioned 16-litre, apparently, will not be available for the Euro 6 and will be substituted by an in-line 6-cylinder with a similar volume that is right now undergoing tests. **Lisa Ling**

In these pages, the Mercedes Arocs 3245 equipped with Om 473. An inline 15.6-litre 6 cylinder engine. The most powerful model at the moment is the 460 kW. Mercedes has already declared that in the near future the 520 kW version will be launched.

Euro 6

16 litre by Mercedes Euro 6

THE DISCOVERY OF A NEW STAR

Here is the long anticipated inline 6 cylinder engine that will substitute the V8 by surpassing in terms of power and torque. At the top, the 460 kW for 3,000 Nm. But the 520 is already on its way. For the Euro 6, Scr, Egr and particulate filter become the main actors. The injection is managed by the X-pulse

Here we have the missing link from Mercedes. The inline 15.6 6-cylinder, Om 473, that will replace the V8 Om 502 and that will focus on reliability and low consumption. There are currently three different calibrations are available, covering power values ranging between 380 and 460 kW. But the German firm has already announced their intention to increase horsepower to the legendary 700.

Over 750 horsepower

A value that partially reduces the gap with Volvo and Scania, that with similar volumes can reach 750 and 730 horsepower respectively (still anticipating Ftp Industrial's move, with the intention of relegating its 16-litre to the off-road). In line with the Euro 6 legislation, the new entry is the development of the Dd15 Detroit Diesel which is to be assembled in Mannheim. Amongst its features, of note is the turbocompound, which, after Volvo's launch, regains an active role to tackle emissions and power. Scr and a particulate filter are called into action to work downstream and support recirculation. All in all, the same 'package' is seen for the launch of the 470 and 471 series. The same goes for the X-pulse injection that works between 900 and 2,100 bar and has six-hole injectors. As expected, also four valves per cylinder, here governed by a dual overhead camshaft.

A lot of effort has been put into the layout of the combustion chamber, built in the piston crown, which has had to take into account the peculiar injection system and the close-by turbocompound. Both the design and realisation of the pedestal fulfil some purely truck-oriented requirements: high life-span and rigidity during torsions. For this reason the engine block is made of special alloy cast-iron (Mercedes patent) and displays reinforced horizontal and vertical ribs.

Minimum blow-by

The steel pistons ensure minimal warp in a way that, as claimed by the producer, oil consumption and blow-by are minimised.

To conclude, there is a monolithic steel head with vermicular graphite, able to resist to ignition pressures of more than 200 bar.

Connie Chung

16 LITERS, SIX IN LINE FROM MERCEDES

Brand Model	MERCEDES OM 473 - 517	MERCEDES OM 473 - 578	MERCEDES OM 473 - 625
I.D			
B x S mm - S/B	139 x 171 - 1.23	139 x 171 - 1.23	139 x 171 - 1.23
Cylinders n. - Displacement l.	6 - 15.6	6 - 15.6	6 - 15.6
Maximum rating kW - rpm	380 - 1,700	425 - 1,700	460 - 1,700
Mep at max power bar	17.6	19.7	21.3
Piston speed m/s	9.7	9.7	9.7
Maximum torque Nm - rpm	2,600 - 1,000	2,800 - 1,000	3,000 - 1,000
Mep at maximum torque bar	21.4	23	24.6
Torque rise %	2.2	1.7	1.6
Torque at max power max Nm	2,136	2,391	2,577
Power at max torque % (kW)	71.6 (272)	68.90 (293)	68.10 (313)
Work range rpm	700	700	700
DETAILS			
Specific power kW/l.	24.4	27.3	29.5
Specific torque Nm/l.	166.8	179.3	191.9
Areal specific power kW/dm²	41.76	46.7	50.55
Areal specific torque Nm/dm²	285.2	306.8	328.3
Dry weight kg	1,284	1,284	1,284
SPECIFICATIONS			
Emission level	Euro 6	Euro 6	Euro 6
Emission technologies		Egr	
Aftertreatment		Doc-Dpf-Scr	
Compression ratio :1	17	17	17
Injection system	X pulse	X pulse	X-pulse
Air intake	Turbo compound	Turbo compound	Turbo compound
Consumption spec. min g/kWh - rpm	185 - 1,000	185 - 1,000	185 - 1,000
Consumption spec. at max power g/kWh	203	203	203

OM 936 - 7.7 LITERS Power	Torque
175/2,200	990/1,200-1,600
200/2,200	1,100/1,200-1,600
219/2,200	1,200/1,200-1,600
235/2,200	1,300/1,200-1,600
260/2,200	1,400/1,200-1,600

OM 470 - 10.7 LITERS Power	Torque
240/1,800	1,700/1,100
265/1,800	1,800/1,800
290/1,800	1,900/1,800
314/1,800	2,100/1,800

OM 471 - 12.8 LITERS Power	Torque
310/1,800	2,100/1,100
330/1,800	2,200/1,100
350/1,800	2,300/1,100
375/1,800	2,500/1,100

Pump injector or common rail?

TWO WAYS TO SPELL EURO 6

Euro 6

Six cylinders and two versions. It's the syntesis of the duplication of the D13 for the Euro 6. These are not two different ratings of the same engine, but two completely different injection systems: turbocompound and common rail for the I-torque version, pump injection for the other

Volvo introduces two versions of its inline 13-litre 6-cylinder in Euro 6 (338 kW). The first will be available immediately, the second, named I-Torque, will instead enter production at the end of the year and will be on the road by 2014.

Pump injector and Scr

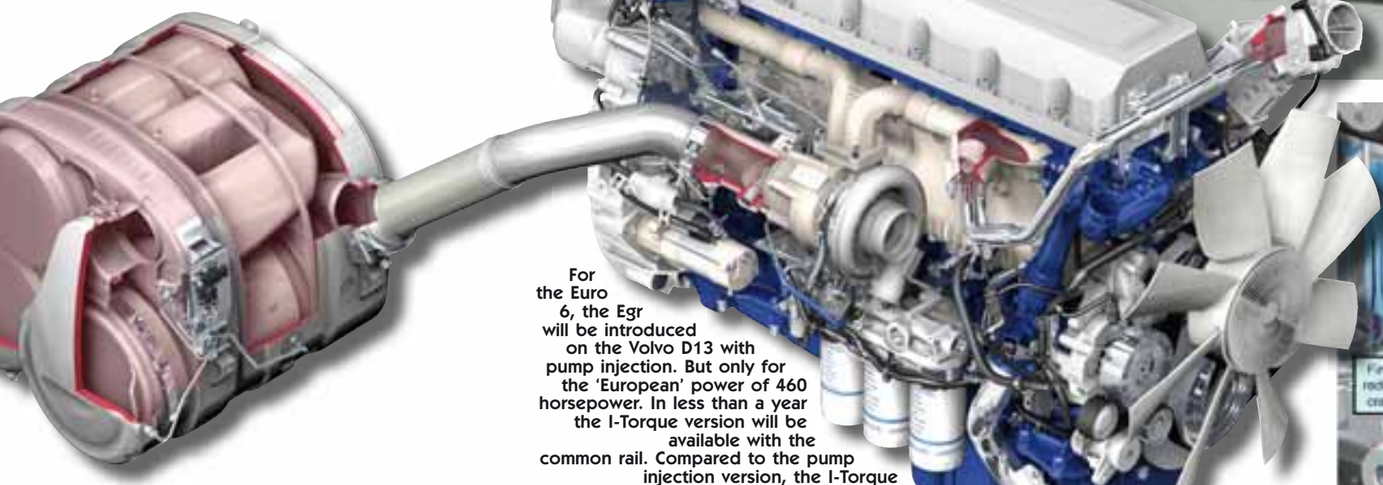
The first Euro 6, the D13 Ke 6-460, is the classic Swedish 13-litre with pump injector and post-treatment for exhaust gas (Scr), to which recirculation of exhaust gases (Egr) and particulate filter (Dpf) are added. It is essentially an upgrade of the Euro 5 engine with the compelled choice of the Egr. All is going according to plan, or so it seems. Except for the fact that the Volvo Euro 6 is the only one in the whole European motoring field with a pump-line-injection system. While all other manufacturers have adopted the common rail, some even a while ago (Man) and some with the shift to Euro 6 (all the others). Pump injectors have been abandoned due to their inability to sustain pressures over 2 thousand bar, a peak that Volvo itself reached with its products, labelled Delphi.

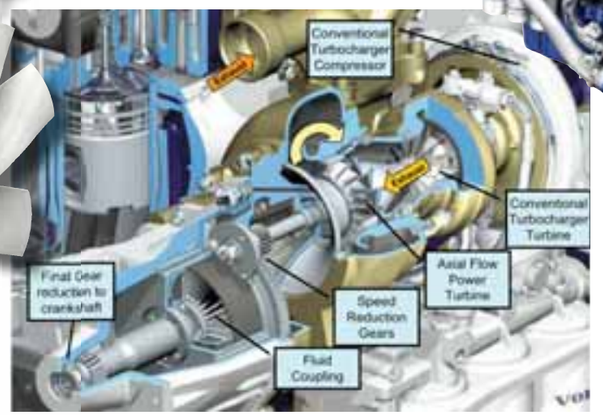
In the near future, however, the second Euro 6 will be launched; the I-Torque, designed in Göteborg. It is the evolution of the 13-litre Swedish common rail, achieved with a dedicated project, again by Delphi. Basically, without changing anything of the engine cylinder head, the pump-line-injectors have been removed and the third-generation common rail that works at pressures between 2700 and 300 bar has been inserted. Another feature is the use of the turbocompound, here back on the scene. By maximising both systems' abilities, using the common rail to burn fuel and the turbocompound to minimise the energy loss, the Swedish engineers have plotted an engine torque graph which is very different from that of the previous versions, but still unusual, to the point that it reminds us of the legendary Renault 'maxi couple' from the 70s: immediate high Nm, in fact an enormity considering that they reach a peak which is only attainable with the 16-litre calibrated at 441 kW (600 horsepower), to then decrease as soon as the engine starts delivering its maximum power.

Robert Cunningam

VOLVO D13

	460 I-Torque	460 Ke 6-460
Injector system	Common rail	Unit pump
Air intake	Turbocompound	Intercooler
Maximum power kW/rpm	338/1,200-1,900	338/1,400-1,900
Maximum torque Nm/rpm	2,800/900-1,200	2,300/1,000-1,400
Torque Index	**6.5**	**3.6**
Stress Index	**7.2**	**6**
Diesel Index	**9.1**	**7.3**





For the Euro 6, the Egr will be introduced on the Volvo D13 with pump injection. But only for the 'European' power of 460 horsepower. In less than a year the I-Torque version will be available with the common rail. Compared to the pump injection version, the I-Torque will have a higher torque.

Scania Egr e Scr

Euro 6

THE GRIFFIN'S WAY

Scania introduces the 12.7-litre 6 cylinder in the Euro 6 version. Scr, Egr and Vgt, completed by particulate filter and Doc. For now the calibrations are 324 and 353 kW. Surely the range will be expanded to lower values in the future. And the Hcci? Lost somewhere

At Scania, everything is set for the Euro 6. Starting with the 8-cylinder with a 16 litre V engine, offered in the 382, 426 and 537 kW calibrations. The key player in the offer by the Swedish manufacturer is in any case the 12.7 litre 6-cylinder inline engine, that remains set to rotation at 1,900 revolutions per minute with a piston speed of 10.1 metres per second (the fastest in its category). For the DC 13 in Euro 6 version, the powers range from 301 to 353 kW. The injection is performed by the common rail Xpi, capable of maximum pressures of 2,400 revolutions, with typical values of 1,800 bar. In this case, the injectors have eight holes and ensure for three injection pulses, a solution that guarantees the optimisation of the combustion cycle. From the Euro 5 it inherits the variable-geometry turbocharger that is key to support performance, especially at low speeds.

The long history of Egr

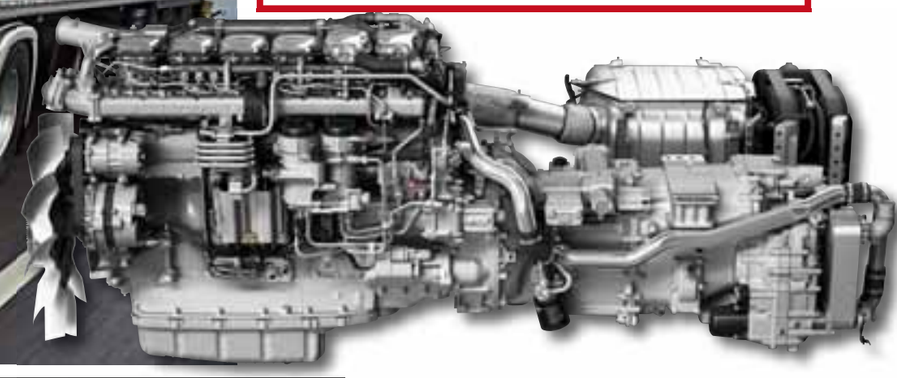
The Egr clings firmly to the Swedish engine, although the values are slightly lower than the Euro 5 (25% compared to 30%) due to the downstream Scr with which it works closely, thanks to an electronic system allowing this complex architecture to run more smoothly. The after-treatment is an actual chemical plant in which the oxidation catalyst, the particulate filter, two parallel Scr catalysts and another catalyst to eliminate any trace of residual ammonia, coexist in the same 'box'.
For this particular series, Scania has announced the development of an innovative Adblue dosing module with electronic activation, which ensures higher precision and is very reliable also in the absence of air.

Technologies for Scania

The Adblue is injected into a mixer, patented by Scania, and subsequently evaporates into urea before entering the two parallel Scr catalysts. At this stage another catalyst removes the residual ammonia from the exhaust emissions. According to the manufacturer, with this system the evaporation path is particularly short and allows to maintain the required temperature. To complete the series, the 9-litre 5-cylinder Swedish 'oddball', will be available in four different calibrations by January 1st 2014. At the top of the range we have the 253 and 264 kW, which utilise the post-treatment for exhaust emissions, followed by the 183 and 205 kW at the other end of the spectrum, that add recirculation to the Scr.

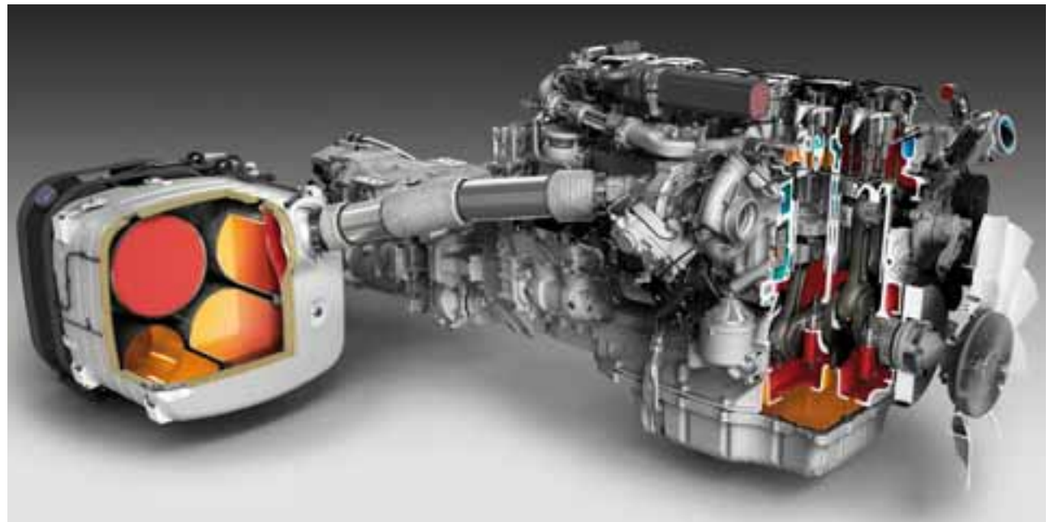
The gas versions

With the same engine volume, Scania offers a series of gas-operated versions at 205 kW and 250 kW, with a torque value of 1,350 and 1,600 Nm respectively. Both models have Egr (5-20%), turbo with waste gate and multiple injection with 3-way catalyst. **Akash Agrawal**



SCANIA AT THE POWER

Brand - Model	Scania DC13	
I.D.		
Bore x Stroke mm - S/B	130 x 160 - 1,23	
Cylinder n. cc	6 - 12,7	
Maximum power kW - rpm	324 - 1,900	353 - 1,900
Mep at max pawer bar	16,4	17,8
Piston speed m/s	10,1	
Maximum torque Nm - rpm	2,300 - 1,000	2,500 - 1,000
Mep at max torque bar	23,20	25,20
Torque rise %	4,1	4,1
Torque at max power Nm	1,627	1,774
% Power at max torque (kW)	74,4 (241)	74,20 (262)
Work range rpm	900	
DETAILS		
Specific power kW/l.	25.4	27.7
Specific torque Nm/l.	180.5	196.2
Areal specific power kW/dm²	40.70	44.35
Areal specific torque Nm/dm²	288.8	313.9
RULER AND BALANCE		
Weight kg	1.100	
L x W x H mm	1,710x780x1,430	
Volume m³	1.91	
Weight/power kg/kW	3.4	3.1
Mass/displacement kg/l	86.3	
Power/volume kW/m³	169.6184.8	
Mass/volume t/m³	0.580.58	
Displacement/volume l/m³	6.67	
SPECIFICATION		
Emission level	Euro 6	
Compression ratio :1	17,3	
Injection system	Xpi	
Technologies	Scr-Egr-4v	



In these pages, the images of the 12.7 litre by Scania in its Euro 6 version, The Swedish manufacturer was one of the first to disclose its technologies for the Euro 6. Following the increase in engine volume that came about with the passage to Euro 5, Scania has enriched its engines with technologies that have ensured the Euro 6 certification and the increase in the efficiency.

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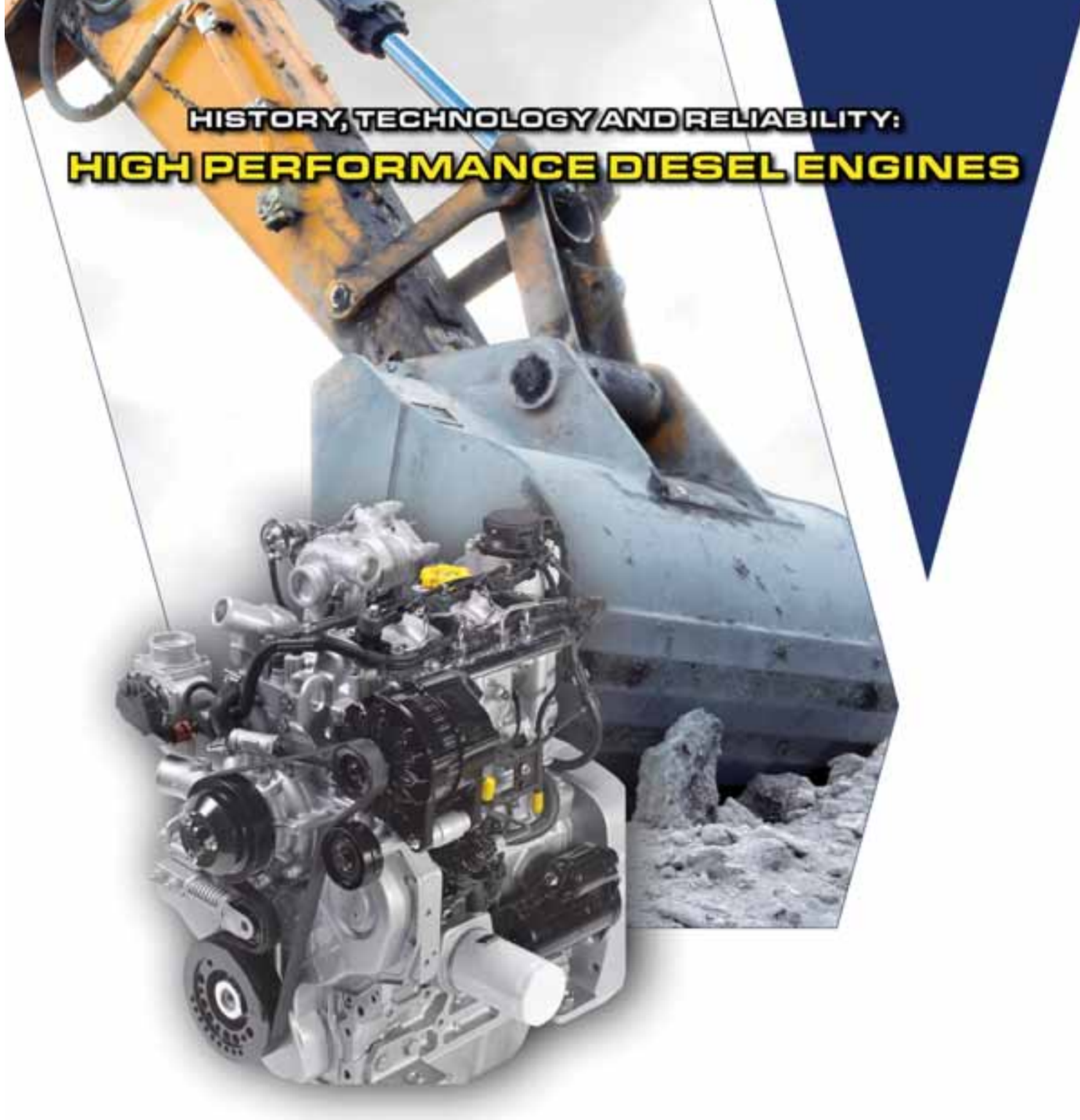

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