DIESEL international

DIESEL SUPPLEMENT
N.11 November 2016
Vado e Torno Edizioni srl,
Via Brembo 27, 20139 Milan.
Phone: +39 02 55230950
Authorized by the tribunal of Milan
n. 786 of 17 december 1990
Managing director:
Maurizio Cervetto.
Print: Industrie Grafiche Rgm srl,
Rozzano (Mi), Italy.

PERKINS SYNCRO

BABY, COME BACK!

COMPARISONS:
single cylinder, 2.2 litre and 3 - 4 litre, Stage V and Tier 4F

AND...
Man D3876, Power Generation Shanghai, Cummins, the engines of THs, under the bonnets of Tractor of the year

DIESEL international

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COMPARISONS

DIESEL OFFROAD

FISH-EYE

Vado e Torno publishing group at a glance

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.

2016 DIESEL OF THE YEAR

Left: Jürgen Haberland, Head of Off-Road Man Engines. Here and bottom: the D3876 depicted at Bauma, in Man Engines and Man Bus & Truck booths.

JÜRGEN HABERLAND AND MAN OFFROAD

Purely German

Technological strategies adapt to specific applications. The German 15.2 liters primarily targets heavy duty area, as declared by MAN Offroad Engines manager. Mining equipment and combines are on the D38 sight

The D3876 between present and future. We spoke with Jürgen Haberland, head of MAN Off-Road engines branch.

Why did you choose double EGR for trucks and single EGR for off-road applications?

Our design philosophy is always focused on target applications: we believe in particular that double stage turbocharger and double-EGR are the ideal solution for the truck industry, while the variety of technologies and configurations of the offroad segment makes solutions such as single EGR more suitable.

What about Man solutions for off-road market? After the D26, the D28 and the D36 can we expect more news?

Of course. Man is an engine manufacturer committed to innovation, attentive to market requirements and the most innovative technology trends. Currently we are evaluating the most suitable solutions to comply with the expected Euro V standard, while as regards possible product range extensions, in particular for power levels, it is difficult to make a forecast at this time, although obviously our goal is to provide a product portfolio that can meet every need and application.

Therefore are we going to see in the future higher power levels than the current 485 kW, the top of your range, or do you think that current density levels are adequate?

The launch of this engine - which is giving us a lot of positive replies from users - is relatively recent, then we do not expect further power leaps in the near future. Of course we continue our testing activities also to assess what future power levels are going to be, but for now we believe that the 485 kW can be considered a satisfactory threshold.

Is the Stage V landscape already set or should we expect alternative solutions to reduce CO_2 levels such as hybrid systems?

Much depends on what the final parameters of the new standard are going to be, but we believe that the final version will not differ from the already known draft drawn up by the European commission. As for hybrid systems, given the current trends in oil and fuel prices, we believe that a broader deployment of these technologies in the short term can only be stimulated by specific regulations pushing somehow the market in this direction. It should also be noted as well that, despite the hybrid technologies are some years now on the table, the real market volume of this segment continues to be very limited.

What you feel will be the best applications for the D3876?

It is a very versatile engine, which thanks to its robust design and the use of selected components is suitable for a broad range of Heavy Duty applications in off-road and construction, from cranes to construction and mining equipment.

Is the D38 built in Germany?

Yes, in our Nuremberg plant, a facility that also houses an engine research and development center where in fact the D38 was conceived.

Are we going to see soon the D38 in marine applications?

Hard to say, right now. As you know, however, Man activities are divided into four main areas, including marine.

KOHLER. KDI STRUCTURAL VERSIONS AND DEMO AREA

It feels like home

This is Kohler general understanding among agricultural applications, a reminiscence of Lombardini, a leader in the medium-low power market. Engines up to 100 kW on tractors thanks to the 3.4-liter, structural versions of the 1.9 and 2.5-liter introduced at EIMA

After the KDI 3.4, the structural sump version of the 2.5 and 1.9 liters will be hosted under the Arbos hoods at Eima. This completes the range of genuinely agricultural engines of a brand that inherited from Lombardini the leading role in the low and medium power range for agricultural applications.. Thanks to those last models, also the specialized tractors will be equipped with the load-bearing structural sump with central tunnel for transmission shaft.

The agricultural vocation of KDI is also testified by other engineering and design elements such as narrow profile, which allows for tighter turning radius while significantly improving tractor maneuvering.

Two auxiliary lateral PTO (Sae Sae A and B), designed to pick up from the engine the highest power, allows a perfect integration with the hydraulic system of the machine in order to effectively power the usual attachments, guarantees the interface with any kind of transmission and, finally, reduces the space needed for installation.

This versatility is enhanced by the arrangements on the engine, allowing the installation of compressors for air-conditioning and air operated brake system (optional). Also the positioning of some components has been optimized according to the needs of agricultural machinery manufacturers. The fan support, for example, was placed on the upper side of the engine by increasing the gap between the cooling fan and the engine shaft. This allows to take advantage of the front PTO and use low and high profile radiators, both optimizing cooling and facilitating installation following the typical geometry of tractor's engine compartment.

Coming to specific engine design, the latest generation 2,000 bar common rail and the electronic management of the engine, perfectly interfaced with the electronics of the machine, allows specific calibrations for each application. Agricultural versions, in particular, privilege responsiveness and delivery speed along the entire torque curve, providing for a quick response of the tractor in any working condition, especially during peaks of power demand. Last but not least, the common-rail system adopted also reduces engine noise for a better comfort of use. Specific conversion kits allows the remapping of the electronic control unit to downgrade the engine of used machines sold in countries where emissions limits are not adopted.

In conclusion, a demo test is available for OEM to test Kohler powered machines. Photos depict the tests which were attended by BCS and Kohler technical staff. **Effebi**

CONSTRUCTION MACHINES

Starting over (from bottom)

A global trend of slow but steady growth, that should bring sales from 654,000 to more than 795,000 units per year, with an increase in value of 17.1 billion dollars, is expected by 2020. In India the forecasts are betting on an increase up to 80,100 engines in 2020

A timid optimism in the construction machinery sector is finally blossoming. The recent Global Volume & Value Service report released by Off-Highway Research shows positive figures for the first time after so many years. **"In 2017 there will be an ove**rall worldwide increase in sales by 5 percent. In absolute terms it means going from 654,750 units in 2016 to 690,500 and then 795,150 in 2020 ". In value, it means expanding the market from the current 72.2 billion dollars to 89.3 over the next four years.

This recovery (starting already this year, with a nice 21 percent leap forward) and the focus of the majority of investments in terms of percentage growth will have an Asian giant as protagonist. Not China, though, but India.

The Chinese market will get back in 2016 to the levels of 14 years ago, with the same number of machines (less than 105 000 units) that were sold in 2011 in just three months (the maximum peak of 435,000 machines sold was reached that year).

Europe, Japan, North America will follow, consolidating a reboot on a global scale without any particularly important area going against this trend.

India is planning to invest 465 billion dollars in the next five years in the construction of new infrastructures, essential to ensure the current economic growth trend. 70 percent of these resources will be invested in power area (energy sector), new roads construction and urban infrastructure.

Meanwhile, the recovery started 12-18 months ahead the rest of the world. The current year should close with a total sales volume of just under 58,500 units, an increase of 20 percent compared to 2015. This forecast, however, could even be considered prudent given that the first half of 2016 recorded a 37 percentage points increase over the same period of 2015. After the maximum negative peak in 2014 (less than 48,000 units sold) this expansion is expected to continue at least until 2020, with a total expected sales volume of 73,600 units.

Experts tell us that this market generated a direct demand for diesel engines of almost 54,000 units in 2015, and the forecasts are betting on an increase up to 80,100 engines in 2020.

Davide Canevari

DEUTZ HAS OPENED THE POWER CENTRE IN USA

The Deutz Corporation, based in Georgia (USA), has opened its first Power Center in the United States. In North Kansas City, customers can now access development services that are specific to their individual applications. The US subsidiary of Deutz AG will be using the Power Center to help equipment manufacturers and end customers to integrate its engines into their particular machines. The new concept complements the existing Deutz Service Centers and offers not only parts, aftersales and maintenance services but also bespoke planning, development and assembly. This means that the company is now able to fulfil all customer requirements with regard to individual machines and configurations. Customers can also buy new diesel and gas engines or refurbished Deutz Xchange engines in a dedicated sales area in the Power Center.

LATEST FROM BONFIGLIOLI

Bonfiglioli just introduced in its product range three new solutions. The first one is the iBMD, an integrated drive featuring a wide torque range extending from 2.7 to 30 Nm. This new device has all the characteristics of a servo motor as well as those of a modern drive. The new ANG is an inverter feauring a power range from 0.25 to 400 Kw, meeting the requirements of special machinery employed in a wide range of applications. Lastly, the new SQT series of flanged planetary gear units features high torsional rigidity, providing along with the BMD a compact solution suitable for extremely compact machines.

ET

The world scenario of agricultural mechanization

'ALMOST' NO FREE ZONES

In a more and more globalized world the agricultural mechanization pays its toll, suffering a widespread weakness that has just a few exceptions. China and Europe are showing poor figures, Russia, Brazil and Japan even worse. The States "pretend" to perform well; India and Turkey are the only exceptions

Damned globalization! The same that was glorified only a few years ago, by the way...
After experiencing a period of global growth - both for emerging, well established and raising economies - agricultural mechanization showed the same global dynamics in reversing its trend. Except for a bunch of solitary exceptions, all world markets have more or less made a U-turn, closing the 2016 with negative figures, and looking to 2017 with apprehension and few reasons to be optimistic.

CHINA

- If the Great Wall collapses, US market will fall
Market 2016 (forecast) - 1,460,000 / 1,550,000
Trend: The fall of the first quarter 2016 is increasing.
In the first half of 2016 sales in China stopped at 808,600 units (also considering machines below 30 HP). That's a huge volume for any other country which however, within the Great Wall, is a symptom of crisis, equal to a decline of 12 percent compared to January-June 2015. This decline in sales was much more severe in the range over 30 HP (minus 23 percent, raising up to minus 40 percent in the second half of the year), which makes the situation even more difficult. Being the market bounces unpredictable, extrapolating these data on an annual basis would be definitely arbitrary. A decline in sales seems however very plausible, bringing sales back to 1,460,000/1,550,000 units by the end of the year. This would mean losing something like 200,000 machines compared to 2015, the equivalent of the entire US market. Medium to long term forecast remain however largely positive.

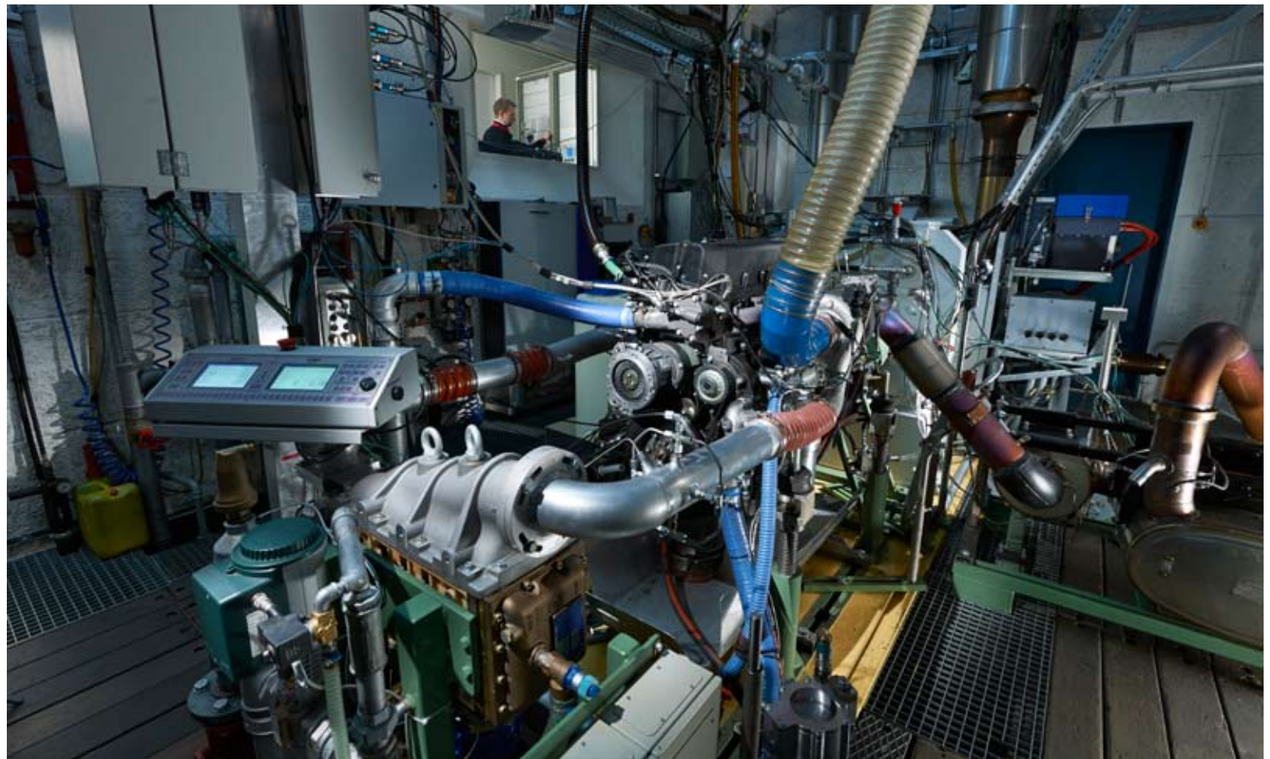
INDIA

- Export speaks USA slang
Market 2016 (forecast) - 670,000/690,000
Trend: Current growth and strong potential growth in the medium to long term.
Indian market recorded 134,000 deliveries in the range over 30 HP in the first four months of the year compared with 122,590 in the same period of the last year, corresponding to plus 9 percent. This may seem a misprint, but it's not. India is the only region of the world that is growing, more or less at the same pace as in previous years. This trend, if confirmed until the end of the year, could lead 2016 deliveries up to 670-690 thousand units. It must be also stated that today in India only 12 percent of the global tractors sales comes from models above 50 HP, while 78 percent is under 40 HP. For 2016-2017 period a GDP growth is expected that could even get to 7.8 percentage points, driven by the potential of tertiary sector (plus 9.3), industry (7.3) and only marginally agriculture (plus 2.9). However, the latest forecast confirms a growth trend of the mechanization market of 10 percent on an annual basis in the 2013-2018 period.
Export shows a peculiarity: according to a recent FederUnacoma survey, USA absorbed about 18,000 made in India tractors last year, being India top customer. The global expense was estimated at a quarter billion dollars. We're therefore speaking of entry level machines that do not reach the average value of 14 thousand dollars. On the contrary, USA tractors export to India is almost absent.

USA

- Home market is weak, but the real crisis is abroad
Market 2016 (forecast) - 205,000/210,000
Trend - Possible strong decline in the coming months.
In late August tractors sales in the US reached 145,000 units, confirming last year figures (142,500 in the first eight months). Keeping this trend, the market is expected to reach 205-210 thousand units in late December.
In fact, it all adds up only thanks to the range under 40 HP, where hobby and garden markets overlap professional agriculture. The range between 40 and 100 HP is suffering instead (minus 5 percent in January-August sales) and the one above 100 HP is clearly declining (minus 24 percent). Out of a hundred tractors sold in the United States only 12 are now above 100 HP, while in 2013 they were 17. Figures speaks for itself.
Short-term prospects do not seem different. According to the Food and Agricultural Policy Research Institute at the University of Missouri, the net income of farmers will fall by 10 billion dollars this year down to 69.6 billion, then only slightly bouncing back to 73.7 billion in 2018.
Exports also is in trouble. In the first half of 2016, Made in USA agricultural machinery exports stopped at 3.54 billion dollars (minus 12 percent compared to 2015 midyear data). In 2013, the States exceeded 3 billion revenues in world markets in a single quarter. Another figure that speaks for itself.

India leads the global market, that's 'depressed' in the rest of the world, except Turkey.
The market is weak in USA and in Europe.
The decline in China is rated at 12 per cent.



EUROPE

Market decline is no longer news in the Old Continent
Market 2016 (forecast) - 163,000 / 165,000
Trend: Short-term forecast still negative.
97,600 tractors sold in the first half of 2014; 86,000 in the first half of 2015; 81,300 in the same 2016 period. If we focus only on models above 50 HP, figures are similar: 79,400 (1st half 2014); 71,500 (2015); 67,500 (this year). The downward slide of Europe does not seem to stop, thus testifying a crisis that can be now considered structural.
The stagnation in the first six months (minus 5 percent) now could bring sales below 165,000 units on an annual basis. This would not be that surprising; the overall business climate stays quite lazy indeed.
In September, the CEMA survey on industry expectations was still on the pessimistic side. Germany, Austria and Poland were included in the black list of the most risky countries for business trends. UK showed a slight recovery after the Brexit, as Italy did; France, on the other side, shows no sign of a strong restart. "We are emerging from a crisis that lasted two years and adverse weather conditions that were never seen since the first postwar period" is the laconic comment of the French Minister of Agriculture Stephane Le Foll. Spain in the only and sole exception.
In summary, for the next six months 48 out of 100 European industries expect a declining business and only 18 are betting on a market recovery. A weak recovery would anyway be possible only after Spring 2017.

TURKEY

- Surprise ... envied by the world!
Market 2016 (forecast) - 70,000/73,000
Trend - general stability and robust growth for smaller power ranges.
In the end, the more solid and also dynamic market of the world seems to be Turkey, the same that in previous years showed instead ups and downs even within a few months. Last year production was 66,600 units with a fairly balanced export (17,000 units)/import (20,700 units) ratio. First-half sales of tractors above 30 HP went down to 26,500 units compared to 29,250 in the same 2015 period (minus 9 percent). However, if we include the range below 30 HP the trend is reversed sharply, and sales in January-June 2016 reach 34,900 units versus 30,800 in 2015 (plus 13 percent). The market can therefore be considered in reasonably good health and could now exceed 70,000 units, always including in the final count also the range under 30 HP.

BRAZIL

- "real" tractors try to (re) charge the market
Market 2016 (forecast) - 34,000/36,000
Trend: Possible slow recovery






after the steep decline in the last two years.
It is known that the economic crisis in Brazil has strongly plagued the agricultural sector. However, we can find some small and timid signs of recovery there. In the first seven months of 2016 tractors sales stopped under 21,100 units (28,650 in 2015). The decrease is thrilling (minus 26 percent) and has inevitably eroded the domestic production (decreased by 28 percent), taking into account a sluggish export (minus 16 percent). Obviously also other Latin America countries are no exception. According to forecasts, 2016 may close at 34-36 thousand units, compared to 45,000 last year and 68,600 in 2014. Where could we found a little of optimism? Sales of above 130 HP range are in line with 2015 figures; "real" tractor, then, are holding their position, while those under 80 HP are sinking. During the summer, then, a slowdown in the rate of decline in registrations (that largely exceeded 30 percent in the worst months) began to become evident. A little hope on the horizon...

RUSSIA

- Big dreams, still 2016 seems l*ike a nightmare!*
Market 2016 (forecast) - 14,600/15,200
Trend - waiting for a strong sales rebound.
Numbers and words tell deeply different facts. Between January and August tractors sales kept diving: barely 10,900 deliveries compared to over 14,200 in the same 2015 period (minus 28 percentage points). Reliable projections of 14,600/15,200 units on an annual basis would be quite a meltdown compared to 2015 (20,290) and 2014 (36,200). The tractors decline was only partly balanced by the combines (from 2,900 to over 4,400 - plus 51 percent - in the first eight months of 2016 vs. 2015). Yet the government flaunts optimism: "The local production is growing at double-digit rates"; "We have allocated resources that will allow Russian farmers to buy 17,000 new machines at favorable conditions". Even FAO forecasts on crops are flying high: at least 105 million tons of cereals this year and 111 million in 2017, while the Ministry of Agriculture is cautious about a further increase of 25 per cent by 2030!

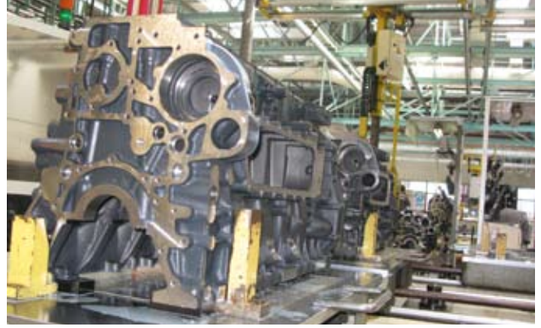
And the rest of the world

Japan remains by far one of the world landmarks in terms of production (151,000 machines last year, of which only 48,200 - less than 32 percent - mounted at least a 50 HP engine). The domestic market, however, seems to be experiencing a period of deep crisis, with a decline in sales which seems to have reached 27 percentage points in the first half.
Canada is about to close 2016 as the worst in the last five years (the decline in sales was about 16 percent at the end of July).
In South Africa, the sentiment of the companies stays 'moderately positive', while sales marked a minus 15 percent at the end of August. Sales volumes are anyway comparable to those of Austria. Definitely not enough to affect the global equilibrium... **Davide Canevari**

Sfh. Saic Fiat Powertrain Hongyan

YOU WANT CHINA? I'LL GIVE YOU CHINA!

Born from the agreement between SAIC and majority shareholder CNH comes SFH. About 30 thousand units per year, an entire family of Cursors, including almost all the 9-liters in the world, the F1 and the potentially implementable Nef line



Set foot in a Chinese factory and find the one you would never expect. FPT Industrial in the Celestial Empire has changed acronym and is now called SFH, SAIC Fiat Powertrain Hongyan, named after the two parties of this joint venture. And what is it that you would not expect, at least compared to a cliché on working environments at these latitudes? The Western-style layouts, generous spaces, semi-automated processes. With a production capacity of 30 thousand engines, this plant is the only one in Fpt territory to produce units for all emission levels: Euro, GB, Stage and Tier and the Apac area. Regarding the subjects participating in SFH's capital, in a nutshell, the majority is firmly in the hands of CNH Industrial. To be precise, the Chinese automotive manufacturer SAIC (Shanghai Automotive Industry Corporation) together with FPT holds shares equal to 60 percent, 30 percent is in the hands of FPT and the remaining 10 per cent in municipalities (CME).

Cursor City

Welcome to the home of all Cursors, where 95 percent of the Cursor 9 are matriculated. 200 thousand square meters, of which 65 thousand covered and 23 thousand dedicated to the assembly of the 9-liters. With the presentation in Beijing of a gas version, the Cursor 11 and 13, the F1 and Nef, in numerical terms still at modest levels, the incentives are all possible given that there's no lack of space for potential new lines. To deal with all this, there are 503 employees; 358 on the lines and 145 white-collar workers, of which 44 Chinese engineers involved in the design and testing phases and the entire design process, with three test areas available for the trial phases, lasting about half an hour. All with the Italian, Loiacono, at the summit. Even the General Manager comes from Italy (as far as citizenship, the latest professional experiences were in Chicago); we're talking about Federico Bullo. The latest arrivals of the Cursor family on Chinese soil are gas versions of the 9-liter, presented at the Truck & Bus Show in Beijing (article in the box) and the 11-liters. Matching the same level as other Cursor production facilities (at Bourbon Lanchy in France and Cordoba in Argentina) the system used here is the WCM (World class maintenence). It is the only production plant capable of processing the entire Cursor test cycle. The work flow requires the assembly of the engine block, as well as, the cylinders. The 9-liter engine is moved on conveyor belts, the C11 and C13 are carried by hooks, thus differentiating the timing of assembly steps, logistics and packaging. A series of colored, horizontal lines and signage identifies the different work activities. **FB**

ASSEMBLING CAPACITY

Activity	Product	Figures
Assembly	Cursor	43,000
Assembly	F1	16,000
Assembly	Nef	8,000
Manufacturing	C9 cylinder block	35,000
Manufacturing	C9 cylinder head	32,000
Manufacturing	C11-13 cyl. block	11,000
Manufacturing	C11-13 cyl. head	11,000

THE CURSOR AT BEIJING BUS & TRUCK

Basking in the spotlight at Bus & Truck, Cursor 9, the 8.7 liter 6-cylinder (BxS 117x135 mm) showed off its muscle, aka 294 kW at 2,000 rpm and 1,700 Nm at 1,200, considerably closer to every motor designer's goal line: extinguishing the performance gap between diesel engines and their gas equivalent. Can biomethane eliminate carbon dioxide or, in any case, reduce particulate and nitrogen oxide production to a minimum and avoid power dips and stroke weaknesses? The answer, in the more aggressive models, is in the handful of additional kilowatts against a reduction of 150 Nm. Despite the inevitable flexing of the torque curve, a 300 rpm drop, it's still an improvement on the past. The ideal is that of stoichiometric combustion, without any concessions to lean mixtures, lambda 1:1, providing for the same amount of air and gas in the cylinder. Cylinders which, like turbo, piston and O-ring seals that hold down oil consumption, have been redesigned with modified input ports to enhance turbulence angulations. A three-way catalyst is integrated into the end of the gas flow structure, impregnated with platinum and palladium for the catalytic conversion of nitrogen oxides, unburned hydrocarbons and carbon monoxide, as well as, facilitating gas flows. The end result is Euro 6 approval without EGR and SCR, thus skipping all the issues related to temperature, congestion, as well as the monetary implications on the final cost and consumption. The Cursor 9 CNG is geared to communicate with automatic transmissions.
The FPT team also displayed the F1C 3-liters from 107 kW and 350 Nm, in the waste gate version, to 125 kW and 400 Nm in those with VGT, the Cursor 11 and Cursor 13.

Here, a detail of Cursor 9 Cng.

In Chiongqing plant is manufactured the most part of Cursor 9. Up, on the right, the Cursor 11, on the left, the F1C.

Cummins. A conversation with Clewlow, Knust and Nandick

ENGINES WITHOUT FRONTIERS

A Cummins QSB6.7 is today under the hood of the Napier Raiton.

The company scored 10.4 billion dollar revenues last year, mostly from automotive. But a quarter of the turnover came from off-road applications. Cummins announced at Bauma the intention to leave the EGR out of their Stage V engines

We took stock on Cummins together with an exceptional trio: Clewlow Bryden, Director Off Highway sales, Shelley A. Knust, Hmld Off-Highway Engineering, and Steven Nandick, Communications Director EMEA / Cis.

What was Cummins total turnover in 2015, how many engines you sold and which are the main markets for each application?

The total turnover of the engines segment was 10.4 billion dollars in 2015, with over one million engines produced, 12 percent came from high power range (19 to 91 liters), 63 percent from heavy duty and mid range (from 2.8 to 15 liters) and 25 percent from spare parts. Coming to target applications, 29 percent of the production was absorbed by the heavy duty truck segment, followed by medium power vehicles, both trucks and buses (24 percent); light vehicles were worth 14 percent, while construction and agriculture 11 percent; mining, marine and oil & gas segments closed the ranking with 13 percent, followed by stationary applications (11 percent)

What changes have been introduced in the new engine? I noticed that you have also changed the acronym...

Correct. We decided to eliminate the EGR looking for a global simplification of the engine, so we thought that a simpler name was more appropriate. We left behind the Qs (Quantum system) initials when we migrated from mechanical to electronic injection and chose, as I mentioned before, to simplify the engine architecture. The new engine is very similar to our Stage III models, given the absence of EGR, and we have also eliminated the variable geometry turbine. Also the overall dimensions are very similar: the engine in fact makes use of the same monobloc of Stage III models, consequently, besides the changes involving internal components, is very similar to the engines of the previous generation. The decision not to use EGR has easily understandable implications in terms of architecture simplification, since it allows to eliminate all the circuitry and the cooling components needed by this solution; it goes without saying that this simplification also reduced the overall size of the engine, making it easier to install even in very limited space.

Cummins is also working with small OEMs providing them with the needed engineering support for the implementation of the engines?

Sure, and this is one of the reasons why our design philosophy is moving towards a simplification of the global architecture of our engines, which are not only easier to install, but also offer a greater number of mounting options, simpler cooling systems and smaller monoblocks.

Did you also introduced changes in SCR solutions?

The overall efficiency of these solutions have been surely improved, and this also affected the overall size both of the system and the engine. We also had a gradual improvement in engine thermal management designed to allow continuous operation at optimum temperature regardless of the application, which consequently also affected positively the dosage and consumption of additive and, ultimately, the SCR efficiency.

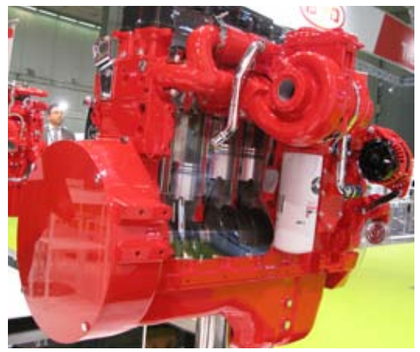
The EGR is therefore destined to disappear, both in low and high pressure version?

As I already mentioned, our choice was to eliminate the EGR to simplify engine architecture, but this was not the only reason. In fact our global strategy pushed us to develop an equally global product, able to meet any emission standard. That strategy, however, collides with a technical limitation of the EGR, ie the need of low sulfur fuels that are not available in all markets; hence the need for a global player like Cummins to redirect our technological strategies towards different solutions.

Any ideas about hybrid applications in the offroad market?

Many of our customers are already developing hybrid solutions (such as Komatsu and Mecalac, among others); in this type of applications the specifications required fot thermal engines are slightly different than the traditional ones, thus requiring ad hoc study in the engineering phase, even if this is not a constraint from our point of view. Each application has of course different needs and requires different utilization profiles of the engine, but whatever the request is this is not in fact a technical constraint in the engine design; also in this case, in other words, the focal point is the engineering of the engine within each specific application.

Here, Clewlow Bryden and Shelley A. Knust; down, on the four pics, the automotive Isl and three industrial engines: B4.5, X12 and X15.



A map of your manufacturing facilities. Let's talk about China, where you manufacture among others the QSF series. Foton is the only Chinese partner?

Foton is our only partner in the off highway market; we have a joint venture with Foton in China, but we work with other brands, such as Liugong for the wheel loaders addressed to the Chinese market.

Do you cooperate with other engine manufacturers for the western market?

We have a joint venture with Scania for Xpi injection systems, and a joint venture with Komatsu, a cooperation that lasted for decades on the global arena through joint initiatives in Australia, South Africa, the United States, Peru.

What is Cummins point of view about automotive technology beyond Euro VI? Will the diesel engine survive?

We just recently launched a campaign entitled "Beyond Euro VI". In general we believe that the trend is using existing technologies and optimize their combined operation within a technological framework that in our opinion will see the diesel engine playing a main role also in the coming years: today, in fact, we don't have a more efficient technology in terms of performance. In some segments, such as Bus, there are in fact electric alternatives which are however currently convenient only for specific utilization profiles.

Will Cummins acquire in the next future a genset manufacturer as Kohler with Sdmo and Yanmar with Himoinsa did?

Talking about the genset range we are currently dismissing our factory located in Manston, Kent, to transfer the generators assembly lines in Daventry (where we manufacture the 90 percent of engines used in these applications), in order to optimize our manufacturing facilities.

Cummins will invest in natural gas and biogas? What about biomethane?

Cummins manufactures Isl9 and Isx12 engines even in CNG version for bus and truck markets, which can use biomethane meeting specific requirements. Cummins engines may use B20 biodiesel; we are currently testing other biofuels, and other new features are planned.

Shanghai International Power and generating sets

THE USUAL 'SUSPECTS'

The first lady was FPT Industrial with its Cursor 16 G-Drive unveiled at Mee in Dubai. Perkins also thinks big with an 'European' stand. Steyr plays at home, John Deere, Man and Briggs&Stratton were in. Among the myriad of local players the most famous Yuchai and Weichai stand out

We left it on home combines and we found it in Dubai: we're talking about the Cursor 16 awarded in the G-Drive version. This version was on display also in Shanghai with all the features that earned him the Diesel of the Year 2014 prize, first of all power density with 567 electric kilowatts worth 600 kVA fully available. In an exhibition that represents the triumph of Made in China (not only Yuchai and Weichai) **FPT Industrial** raised together with Perkins the flag of Western engine technology. The 16-liter was the absolute protagonist of FPT booth, as anticipated, sealing the evolution of the Cursor range in power generation version. The strongpoints of the offroad monoblock were confirmed, such as 2,200 bar common-rail, the cylinder head made of compacted graphite and double recess steel pistons (see box), also featuring in this specific version a 1:1 fan speed/engine speed ratio.
Benefits are easily measured, thanks to the undersized fan, in terms of reduced absorption, releasing a dozen kVA for supplying electric power, and lower mechanic noise. The Cursor 16 G-Drive is available in six versions configured to release energy vertically, optimizing combustion and avoiding dispersions in the cylinder liner, withstanding temperatures up to 56 °C and maintenance intervals at 600 hours.
FPT Industrial booth also hosted the Cursor 9 in the usual diesel version, providing up to 275 and 299 mechanic kW depending on usage.
The NEF45 is another workhorse that enters the Chinese market with 1,500 rpm calibration and 100 mechanic kW, featuring the same trademark of his older brother Cursor 16: power density.

The Western 'guys'

Among the multitude of local actors, FPT Industrial was not the only proponent of the Western engine school: another one is **Perkins**. The Chinese branch of Perkins has revived the layout of European fairs with its vast booth that boasted the 4008-30 Tag. This engine was introduced earlier this year in three versions (Tag1, Tag2 and Tag3) and followed the path of 'virtuous' downsizing, ie increasing the specific power/displacement ratio. Intakes, electronic regulator, filters positioning and cooling circuit have been updated. The capacity of this 8-cylinder engine is 1,000 electric kW and 1,250 kVA, better than the European standard. The 1.1-liters cylinder of the 1100 series (105x127 mm) was available in 3 and 6-cylinder versions, while the 400 series had two 3 and 4-cylinder versions, the base model 11G-403A and the 404A-22SG. The range is completed by the 1506A-E88Tag, a 6-cylinders 8.8-liters engine providing 333 mechanic kW equal to 300 electric kW and 330 kVA, suitable for heavy duty applications, at high altitude and in tropical climates.
Even **Steyr** made it big: research and development located in Austria, Chinese ownership, relying on local foundries and a couple of component suppliers. The M12 Cr, 1 liter cylinder, 40 to 3,000 rpm, 136 Nm at 2,250 rpm, the SE and the V8 were on display.
Heng Guang International Trade represented **Man**, showing the six-cylinders D26 and the 12-cylinders D28.
Among other brands, a lone **John Deere** 4-cylinders 4045HfC04 showed by Jebsen Industrial, a dealer headquartered in Shanghai.
Another Chinese dealer showed the **Volvo Penta** Twd1653Ge, on top of the range thanks to its 16.2 liters (144 mm bore, 165 mm stroke), delivering 564 kW and 603 kW maximum power in stand-by.
There's room also for **Briggs & Stratton** petrol engines, the Vanguard 35 (1 liter, 25,7 kW), the Vanguard 21 (627 cc, 15.4 kW) and the Ic 13.5 (420 cc, 10 kW).
Local brands have several ties with Europe, the US and Japan, a reminiscence, albeit slowly fading, of the colonization that took place before the local expansion through partnership with Western partners such as Bosch, Ricardo and AVL and technologies derived from Japanese engines such as Nissan and Mitsubishi.
Let's start from **Sme**, acronym of the joint venture between Shanghai diesel engine and Mitsubishi heavy industries. The Sr series covers the range from 500 to 2,000 kW and set a goal of 5 thousand units per year starting from 2020. We've seen on display the S16R-PTA-C, a 16 - cylinders, 65,37 liters cooled turbo Mitsubishi, (170 mm bore, 180 mm stroke) delivering up to 1,684 kW in prime mode and 1895 kW in stand-by.

Sanchai Power

Chongqing Sanchai power group comes from one of the main Chinese engine manufacturers, as evidenced by the joint ventures with Cummins and FPT Industrial. The focus is on power generation sided by other stationary applications such as motor pumps and marine, delivering 30 thousand units ranging from 58 to 3,000 kW. Cummins inspiration is evident in K50 and K19 models, the eponymous of the American series (159 mm bore, 159 mm stroke) available in 1,227 kW and 373 kW versions.
Shandong Huayuan Laidong engine is focused on medium-low power range. His product range is highly segmented, splitting displacements from 1 to 3.4 liters.
VMan Power, which widely uses technologies from the homebase of Nuremberg (as the name in its extension, Sino-Foreign-Shanghai Youngfor Power, clearly suggests), is focused instead on big shots. The D15 series makes use of its 1.8-liters cylinder in 6, 8 and 12-cylinders engines (128 mm bore, 142 mm stroke, which in Europe is called Man V8), delivering in standby 190, 255 and 390 kW. The overall range of VMan starts at 84 kW and ends at 1,150 kW.
His name is **Weifang Ydaneng** Power and hides the inspiration of Lovol that provides its gas units for genset in cng, lng and biogas versions. The Made in Europe matrix is strong. Lovol still exploits the agreement with Perkins (Tianjin Perkins), but the foreign inspiration of Ydaneng (Weifang is the city in the Shandong region where production facilities are based) is reflected also in the Steyr series,

PERKINS

Fpt Industrial has shown in Shanghai the Cursor 16 powergen version for Asian market. Weichai and Yuchai are the most complete engine manufacturers in China with some solutions also for high emissioned markets. Here a panorama of the chinese players. On the top and bottom two of the European ones, Perkins and Fpt.

YUCHAI

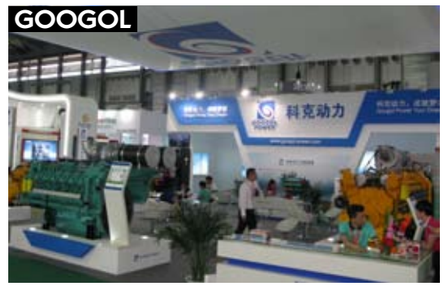
WEICHAI

FPT INDUSTRIAL

CURSOR 16: DIESEL OF THE YEAR 2014

We can say we have seen its birth. At the end of 2013 Diesel editorial staff has witnessed the first steps of the Cursor 16, that was later introduced and awarded the 2014 Diesel of the Year prize at Samoter in Verona. Having surpassed the 13 - liters version, it stands at the top of the Cursor range. This 15.9 liters engine (141 mm bore, 170 mm stroke) enters the market equipped with Bosch 2,200 bar common-rail, fixed turbine and waste gate valve, providing 570 kW at 1,900 rpm and 3,320 Nm available at 1,500 rpm, waiting for the scheduled ultra-high performance evolution with dual turbine, 630 kW and 3,500 Nm. The key to the Italo-Swiss engineering (the research and development center is located in Arbon on Constance Lake) is power density, with overall dimensions close to the Cursor 13 that is just 13 mm lower. Engine stroke is then relatively short to favor housing and diameter, featuring a 327.6 kW/m3 ratio and a relative density (dm3/m3) of 9.15. Tier 4 Final/Stage IV compliance is based on Hi-ESCR, excluding the too 'demanding' EGR and its complexity in terms of chamber complications and difficult thermal management that may require larger radiators. Among the peculiarities of the Cursor 16 we found the ball bearings taking the place of the oil bearings to reduce friction and thereby improve response time. The cylinder head is made of compacted graphite iron and double re-entrant pistons were used to generate a dual vortex turbulence in the chamber.

in the one dedicated to Deutz, a pioneer of the European avant-garde in China with air-cooled engines, and Cummins.
Dongfeng light engine couples its brand with that of an illustrious Japanese automotive brand, Nissan, in a co-operation that has also generated cars and commercial vehicles. The components come from Japan, as stated by the marketing branch, and are derived from automotive: common rail is by Bosch and blowers by Honeywell, but made in China. **North General** power group shows its gas units, a 15,87 liters, 300 kW and a 31.7 liters, 1,000 kW. Googol Power brings in the CNG acronym, showing its top-of-the-range 53.1 liters (170 mm bore, 195 mm stroke), 1.832 kW in stand-by, which sports the common rail.
Beijing BEINEI diesel engine comes from the capital city and manufactures 15 thousand units per year, mainly for power generators, but also for boating. BEINEI is still one of the last Deutz licensee on the basis of a 20 years old agreement. The brand showed a 2.7-liters, 28 kW, a 2.8, 24 and 36 kW, a 4.3, 56 kW and a 6, 4, 87 and 112 kW, available in aspirated, supercharged, 2 and 6 cylinders version.
Zichai shows its German roots with the 500 kW G9512 Liebherr.
Lovol, which is well known in the Italian agricultural world for having revived brands such as Arbos and Goldoni, boasts an assorted range which relies on various versions of only three engine sizes, 3, 4 and 6 liters.
The parade closes with three big shots: Sinotruk, Yuchai and Weichai.



Sinotruk, Weichai, Yuchai

Coming from Hangzhou, a city that was ruled by Marco Polo, **Sinotruk** sells in China long distance trucks and 400 thousand engines through its production facility located in Jinan. Sinotruk shows its German imprinting, having exploited the licenses of Steyr then Man, which holds a quarter of the shares. Even today the engine range for genset are signed by Austria and Bavaria.
Coming to **Yuchai**, among its eclectic 27 series range we chose the Raynwin brand, which is the entry level engine family. On the other side of the product range we find the 79.1 liters Yc12Vc, turbocharged with intercooler, available from 1,120 to 1,805 kW in prime mode and from 1.230 to 1,985 kW in standby.
Finally **Weichai**, focused on marine and generation applications, the latter available in almost all platforms, both diesel and gas. The brand is a perfect example of the new hierarchy in the global arena: Weichai, the new owner of Ferretti shipyard, brought in two Bauodouin units on behalf of the European colonies: the first is the 12M33, delivering 1,100 and 1,210 kW, the second is the 6M33D620E310, 19.6 liters, 565 and 620 kW.
The other series are genuinely made in China: their initials indicate the cubic capacity: WP2.1, WP4.1, WP 6, WP10 and WP13.

Fabio Butturi

Man E2848 and waste – silage mixture

HEAT FROM COWS

In the North Western Italy a typical textbook case study of cattle waste transformation. Livestock waste mixed with corn shreds is processed through a plant that features a 14.6 liter engine very familiar to these applications, the 250-electric kilowatt Man E28: the result is 2,000,000 kWh/year

At the peak of a long period of expansion, biomasses are showing the problem of the opportunity of long-term investments which involves basic topics such as supply, service and maintenance. Lured by the prospect of easy money guaranteed by public incentives, up to now many farmers have invested in biomass power stations, even larger than the capacity of their companies to self-supply those plants. In the long run, however, once the incentives ended, those forced to buy raw materials to feed their plant have seen profit margins shrinking and even risking losses.

Talking about sustainability

An example of sustainability of biomasses (from both environmental and economic points of view) for energy purposes is the cogeneration station of the livestock cereal company owned by Giletta brothers in Revello (Cuneo), in the North Western Italy (the second nation in Europe for biogas production, after the unattainable Germany), designed and built by Avs and active since February 2011.

The plant, which has an electrical output of 250 kilowatts, is completely self-sufficient being fed by the waste of the company's herd, mixed with 20 percent of corn shreds to stabilize the fermentation process. The ''daily ration" consists of 20 cubic meters of sewage, 5 tons of manure and 5 of corn shreds. Besides economic benefits, using only in - house products gives more control over what is used into the digester, providing the bacteria with a more homogeneous substrate, an indispensable condition for a proper and efficient processing.

The plant consists of a 180 cubic meters primary fermenter where the biomass is kept six days, and a 1,500 cubic meters main fermenter where the product is stored for about 45 days.

The biogas produced (130 cubic meters/hour with a 53 percent methane content) is burned by a Man 8 cylinders engine, the E2848, and converted into electrical energy and heat (1/3 - 2/3 ratio) with a total efficiency of about 85 percent.

The electric power produced by the alternator, 2 million kWh per year, except for a small portion that is used for operating the system itself, is then transformed into medium voltage (15,000 volts) and transferred to the provider, while heat is recovered both from engine cooling circuits and exhaust gases and is used to operate the dryer and feed a local heating network that serves nine houses and a farm nearby.

The virtuous cycle ends with the use of digestate as a valuable fertilizer nitrogen, a practice that has reduced almost completely the use of chemical fertilizers.

Technical assistance to the cogeneration unit is supplied by Ets, Man dealer for Italy and Austria, which has its own after-sales service. Via a remote control system with dedicated software Ets technicians are able to carry out the complete management of the generator from a remote station through the monitoring and online diagnostics of the operating parameters 24 hours a day.

The most critical part is the inspection of the engine and its most important components, which is generally scheduled every 60 thousand hours. The system must then be stopped, and the engine is brought to a workshop for adjustment, a rather expensive solution not only in terms of costs but also because plant downtime results in a loss of income, and any mechanical problems means waiting several days before resuming production. That's why is more convenient and secure, as done in the specific case of Giletta, replacing the engine with a new unit, an operation that resulted in just two days plant shutdown.

Sergio Bolis

THE ENGINE: MAN E2848

Man E2848 is one of the most popular engines for biogas cogeneration applications. This 8-cylinder V delivers 265 mechanical kW and an electric output of 250 kWe, is supercharged and features an aftercooler with double-stage cooling: the temperature of the mixture is cooled down to 50 °C. Efficiency rates are 40.5 (mechanical) and 49.6 (electric).

Brand- Model I.D.	Man E2848
B x S mm - S/B	128x142 - 1,11
N.cil.- dm³	8 - 14,6
Max Power kW/rpm	250/1.500
Mpe bar	13,96
Piston speed m/s	7,1
Rules and balance	
Dry Weight kg	1.200
L * W * H mm	1.210*1.172*1.340
Volume m³	1,9
Power density kW/m³	131,56

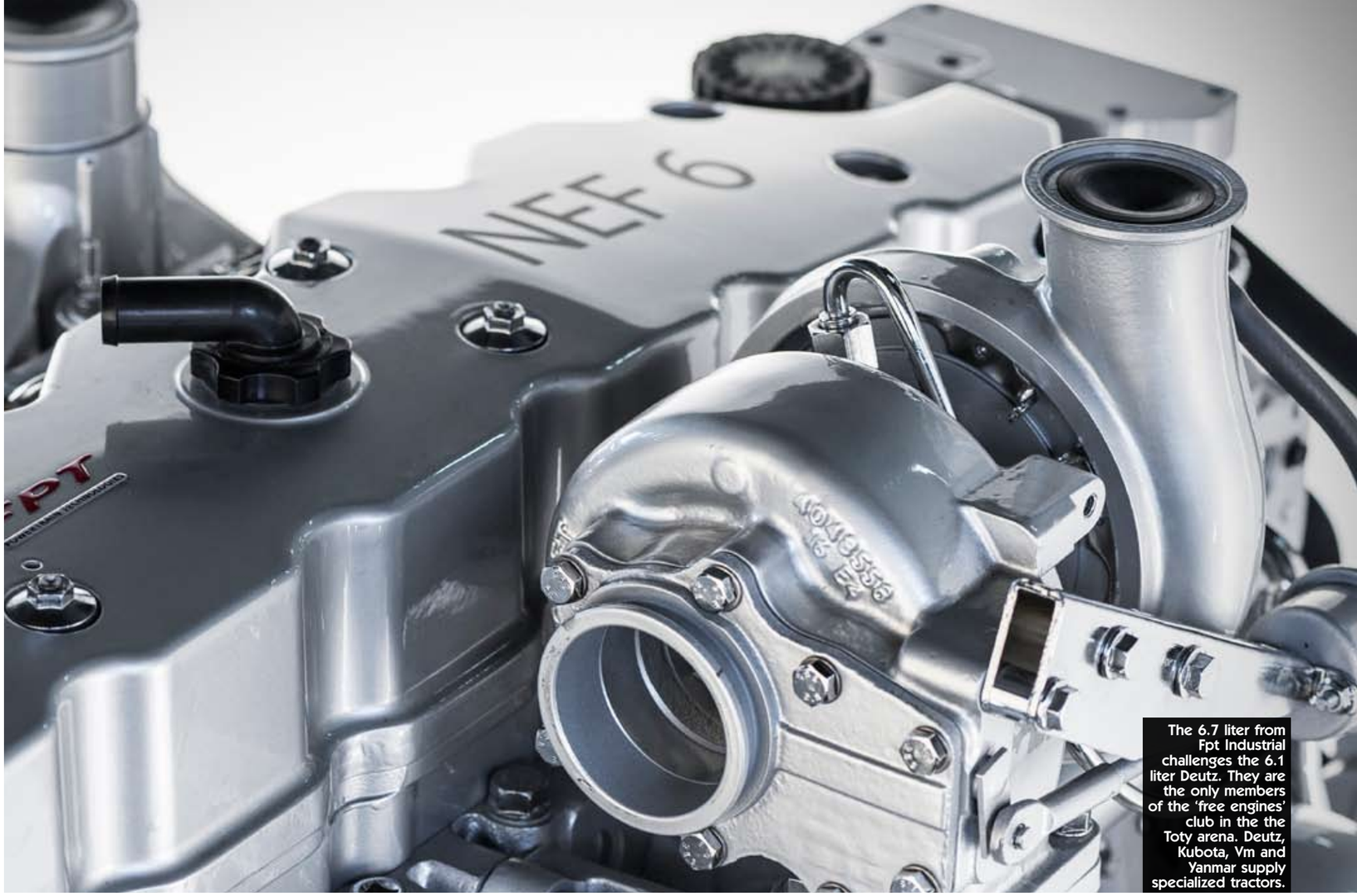
CAPTIVE AND FREE

Among 'Toty' finalists 4 to 7 tractors are powered by 4 cylinder engines. Deutz is now a free supplier of Same Deutz-Fahr. Fpt Industrial Nef 6.7 is on both captive and free: Cnh Industrial and Argo Tractors. Deutz, Kubota, VM and Yanmar equip specialized tractors

There is a fact that is immediately evident reading the list of finalists for the Tractor of the year in open field class: four on seven tractors are driven by 4-cylinder engines, and this speaks volumes about the irreversible direction taken by the agriculture market about engines. Once won the traditional inclination of farmers not only for 6-cylinders but also for large displacements, manufacturers are now betting on downsizing and lower segmentation. Thus, thanks also to the increasingly massive presence of electronics, the reference market of 4-cylinders is steadily widening up to 147 kW. The first to get there is Massey Ferguson 6718S, which thanks to the 4.9-liters Agco Power rely on a extra boost that brings maximum horsepower from 128,6 to 147 kW (in transport and PTO use), and Steyr 4145 ProfiCvt that features the 4.5 liters Fpt Nef Ent wich provides 114 kW @2,000 rpm, plus further 14,7 kW to deal with sudden load peaks. Deutz Tcd4.1 still shows the best power density. Fitted on the Fendt 516 Vario, this engine reaches with only 4,038 cc reaches 121,3 kW without boost.

From Brno with love

The Zetor 1617, built by the Czechoslovak brand and fitted on the the ForterraHd 140 is far more traditional, with its 100,7 kW and a fuel injection system featuring an electronically controlled mechanical pump. Among the 6-cylinders the Fpt Nef 67 Ent (under the hoods of Case Ih Optum 300 Cvt e McCormick X8.680 Vt-Drive with its 220,6 kW) and Deutz Tcd 6.1 fitted on Deutz-Fahr 6215 RcShift, which reaches 166,2 kW at 1,900 rpm, are taking the scene. A closer look at the different philosophies adopted by the manufacturers to manage Tier 4 Final emissions standard may be of some interest. On one hand Deutz and Zetors choose the couple Scr - Dpf, while FPT and Agco use SCR - Doc solutions.The same protagonists (with the exception of Zetor) also compete in the new 'Best utility' range, where FPT provides its F5C to Case Ih Luxxum 120 and New Holland T5.120, Deutz drives the Deutz-Fahr 5120C with its Tcd 3.6, and the Finnish engine in 4.4 liters version equips Massey Ferguson 5711. Here the competition narrows to the power range between 80,9 and 88,2 kW, with only Agco Power stuck to its 1.1 liters cylinder due to a lack of alternatives, while FPT and Deutz already use 850 and 900 cc cylinders.To reach Tier 4 Final stage FPT developed on its F5C a compact Scr with Low rate Egr, while Deutz and Agco settled the matter with Scr and Doc. The peculiarity of the Finnish engine is that the complex of Scr and Doc filters is not located under the hood but in a special space under the cabin, so as not to affect visibility and maneuverability of the tractor. Among the specialized tractors, still stuck at Tier 4i, Yanmar and Kubota enter the competition, Vm is holding on, and the only captive solution comes from New Holland - FPT.
4TNV98T Yanmar, 4-cylinders, 16 valves, 3.3-liter with mechanical pump and cooled Egr controlled by the electronic control unit is the real exception. Other manufacturers chose common rail and after-treatment solutions based on Doc and Dpf filters. **S.B.**

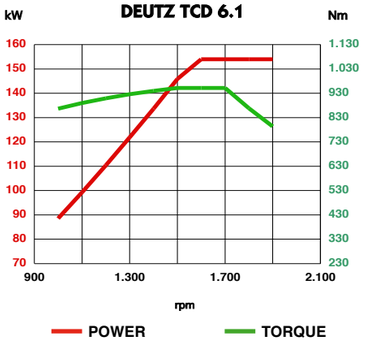


The 6.7 liter from Fpt Industrial challenges the 6.1 liter Deutz. They are the only members of the 'free engines' club in the the Toty arena. Deutz, Kubota, Vm and Yanmar supply specialized tractors.

Deutz & Deutz

STYLE OF POWER

New look, new transmissions, new cab. These are some of the features packed in the new 6 Series by Deutz - Fahr. Twelve models ranging from 114,7 to 155,9 kW available in two platform variants, three transmission types, two cabin configurations with different comfort levels, and various other feature options



6 German liters	
Brand	DEUTZ
Model	TCD6.1
I. D.	
B x S mm - S/B	101 x 126 - 1,25
N. cil. - dm³	6 - 6,05
Maximum power kW - rpm	156 - 1.900
Mep at max power bar	16,6
Piston speed m/s	8
Maximum torque Nm - rpm	940 - 1.500
Torque at max power Nm	784
% power at max torque (kW)	94,7 (148)
Work range rpm	400
DETAILS	
Specific power kW/dm³	25,7
Specific torque Nm/dm³	155,1
Areal spec. power kW/dm²	32,43
RULES AND BALANCE	
Dry weight kg	676
L x W x H mm	767x621x1.205
Volume m³	0,57
Weight/power kg/kW	4,3
Weight/displacement kg/dm³	111,6
Power density kW/m³	273,7
Total density t/m³	1,19
SPECIFICATION	
Injection system	common rail
Techno	turbo waste gate

CAPTIVE OR NOT CAPTIVE?

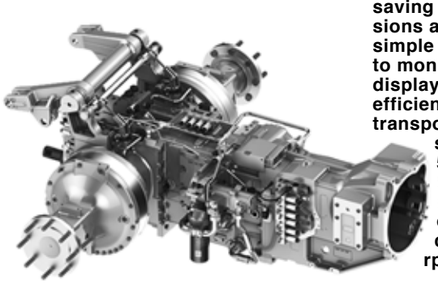
"This is NOT the question..."
Deutz calls Deutz. Despite being Same not anymore one of the shareholders of the brand based in Cologne, the partnership remains strong. A transaction that takes place within the free market and rewards the 6.1-liter, the Deutz flagship in a power segment ranging from 4 cylinders engines with 1.2/1.3 liters cylinder and 6 cylinders engines with 1.3-liter cylinder. Deutz itself brought to Bauma the Stage V ready 5 liters engine. The Tier 4 Final/Stage IV of this segment is still taken over by 4 and 6 cylinders engines with 1 liter cylinder. The 6-cylinder mounted on Agrotron 6 Series (Tractor of the year 2017 finalist) includes six highly segmented power rates, from 114.7 to 155.9 kilowatts, and fits the all-inclusive package for omologation. Recirculation stays in place working together with after-treatment, particulate filter and Scr system. Common rail is driven by EMR4 control unit.

ZF

Transmission at their best

The most distinctive feature of the new 6 Series is the transmission concept, which has at its core the solutions provided by ZF (which also supplies the rear axle) with TPT16, TPT18 and TPT20 Terrapower transmissions. There are three levels: Powershift, RCshift and Ttv. The new 6 Series Powershift models feature a manual transmission with 5 mechanical gear speeds plus 6 Powershift steps forward and 3 reverse (total number of speeds 30 + 15, with creeper: 54 + 27). The RCshift models feature a fully automatic transmission with 5 robotised gear speeds plus 6 Powershift steps forward and 3 reverse (total number of speeds 30 + 15, with creeper: 54 + 27).

Four driving modes can be selected: Manual (user selects range and Powershift speeds), Semi-auto (user selects range and the system selects Powershift speeds automatically in field operations) and Full-auto Field / Road (system selects range and Powershift speeds automatically in Field / Road operations). The highest level of shifting comfort is offered by the reliable and proven stepless transmission in the TTV models. Their speed range extends from 0.2 Km/h to 40Km/h or 50 Km/h, and they now feature new software for more efficient driving. All transmission types will reach 40 or 50 Km/h maximum speed at reduced engine speeds, thus saving on fuel. All transmissions are easy to operate, simple to program and easy to monitor via the on-board displays. To ensure fuel-efficient driving during transport work, maximum speeds of 50 Km/h, 50ECO Km/h and 50 SuperECO Km/h, are available with an overdrive performance of 50 km/h at 1447 rpm.



Soft landing on every ground

TThe new front axle suspension and braking system both developed by SDF are one of the trademarks of the new 6 Series. The front axle - provided by CARRARO for 6155, 6165 and 6175 models, and by DANA for 6185, 6205 and 6215 models - is now fitted with double-acting hydraulic cylinders and a longer stroke, significantly increasing the damping effect, which is also electronically controlled. The electronic system and the software are developed by SDF: depending on the brake intensity and driving speed, two suspension levels are activated – the Anti-Dive and Anti-Rise system, or the complete suspension system for the field and on road; the suspension system can also be locked. The 6 Series TTV is equipped with high performance dry disc brakes on the front axle, with the additional Booster brake system ensuring maximum braking performance with the lightest pedal pressure. Talking about brakes, TTV models are also equipped with the EPB (Electronic Parking Brake), the automatic parking brake system developed by SDF which acts on the rear brake discs. The EPB with many Smart functions automatically disengages when the shuttle direction is activated and automatically engages when the driver leaves the seat.

The attachment points of the new 6 Series offer a wide range of features, up to five hydraulic valves in the rear and two in the front, and a rear lifting capacity up to 10000 kg.

Madium and high power tractors are probably the most competitive ranges on the market. Therefore, when a global player such as Deutz - Fahr announced the new Agrotron 6 Series expectations were very high: 12 models ranging from 156 to 226 HP, two wheelbases, three transmission variants, powered by the new Deutz 6.1 L06 Stage 4 - Tier4 Final engine, packed in a brand new tractor concept designed by Italdesign Giugiaro actually make the 6 Series a potential winner even for the most demanding farmers.
The new Agroton was designed to perfectly match any application, mainly thanks to its wide choice of transmissions. Customers can pick between a manual powershift transmission with 5 mechanical gear speeds plus 6 Powershift steps forward and 3 reverse (total number of speeds 30 + 15, 54 + 27 with creeper), a fully automatic RCshift transmission with 5 robotised speeds plus 6 Powershift steps forward and 3 reverse (total number of speeds 30 + 15, 54 + 27 with creeper) or a TTV transmission, which is capable of varying speed continuously, optimising engine power without unnecessary loading or fuel wastage and ensuring a smooth drive and advantages in terms of comfort and safety, particularly when driving on the road.
Another exclusive feature of the new 6 Series is the new front axle, which features an intelligent, adaptive suspension system to provide maximum stability during heavy draft operations. The advanced Anti-dive system ensures stability and safety during transport; on the safety side we also find the high performance dry disc brakes on the front axle (6205 and 6215 TTV models), which guarantee maximum braking performance with the lightest pedal pressure in combination with the Booster brake system. Coming to hydraulics, co-designed with Bosch Rexroth, it is possible to choose between mechanical and electro-hydraulic controls, up to five hydraulic valves in the rear and two in the front, and a hydraulic pump output of up to 170 L/min, with a rear lifting capacity up to 10,000 kg. The models equipped with the MaxiVision 2 cab offer proportionally controlled hyd valves for a broader scope of operation and control. A separate oil tank ensures an ample supply for the TTV models. The main hydraulics are available with a load sensing system or an open center constant flow pump. The new front support with new integrated front lift (made by Sauer) is designed to match the front suspension, providing a compact layout for maximum steering capability, offering up to 5,480 kg lift with up to two dedicated front valves. This new front linkage system is also equipped with a position control function, and can be fitted with an integrated ISOBUS terminal. All operations can be carried out very efficiently at reduced engine speeds and fuel consumption thanks to the four PTO speeds 540/540ECO/1000/1000ECO at

The cab provides all round visibility thanks to its design, use of cab glass and optimised hood dimensions, and a quieter environment with reduced vibration and heat thanks to the separation between cab and bonnet.

All at your fingertips

The newly designed armrest makes the 6 Series particularly relaxing and intuitive to operate. All routine functions can be automated. The new, highly ergonomic MaxCom joystick on the armrest controls everything from driving speed, direction of travel and cruise control selection to the ComfortTip system, rear and front lift controls, providing an intuitive system that requires no change of hand position and is very quick to operate. The MaxiVision 2 cab is offered on TTV models with electro-hydraulic spool valves, and the MaxiVision cab for RCshift or Power-shift models is fitted with mechanical spools and electro-hydraulic spool valves as an option. For all models, the front lift and front loader controls can be mechanical or electro-hydraulic depending on the configurations. Each model is equipped with the new InfoCenter, a digital dashboard with 5" LCD display, integrated within the tiltable steering column in the central console. All of the controls are clearly marked with colours and are logically arranged according to their frequency of use. The driver has complete control over the new 6 Series at all times and can work for very long periods at maximum productivity.

the rear and 1000 or 1000ECO at the front. All hydraulic and PTO functions can be easily set and controlled from the right console or armrest in the cab. Plus, the 6 Series models are available factory-fitted with a 'Ready Kit' for the front loader.

The new 6 Series features MaxiVision and MaxiVision 2 cabs, which offer different operating comfort levels depending on the technological features included and three roof types – a simple green sliding roof, a glass roof with UV absorption or the FOPS safety version. The InfoCentre on the dashboard features a 5" colour display, providing the driver with a stream of data about the tractor's operating conditions and offering maximum convenience in terms of settings and information. On TTV models there is an additional WorkDisplay fitted on the right pillar, performing real time working information. The comfortable armrest control with the MaxCom joystick is also a new addition. Overall, the cab interior benefits from reduced noise, vibrations and heat due to the fact that the cab and the engine hood are separated at the bulkead.

All models of the 6 Series can be factory equipped with precision farming technology, with features such as the central monitoring and control units coupled with the iMonitor2 that offers a screen size of 8" or a 12" version. Everything runs on a single user interface, from tractor functions to ISOBUS applications, automatic steering, control systems and data management. Two independent cameras can be fitted as an option. The new 6 Series can also be TIM ready (Tractor Implement Management), making the tractor and the implement an intelligent, closed combination - technology. Another option is the VT4 system, which makes possible to control implements using the tractor's own systems, avoiding too many control boxes in the cab. The section control and variable rate control systems for sprayers and seeders are included as standard, allowing the driver to activate or deactivate sections in order to avoid overlap and to conserve crop protection agents and seed. Thanks to an optional remote control system, product specialists can support the operator remotely via the IMonitor screen. There are also automatic control systems as well as solutions for wireless data transmission and data management.

6 Series tractors can be factory fitted with precision farming technologies coupled with the iMonitor2. The VT4 system (available as optional) allows to control implements using the tractor's own systems, while thanks to the ISOXML standard tasks can be planned, documented and evaluated with a number of agricultural field records.

The Tl470 Agri by Bobcat. Bottom, from the right, the Deutz Tcd3.6 Deutz and the Doosan Infracore D34.

Doosan D34 versus Deutz Tcd3.6 and Kubota V3800-Cr

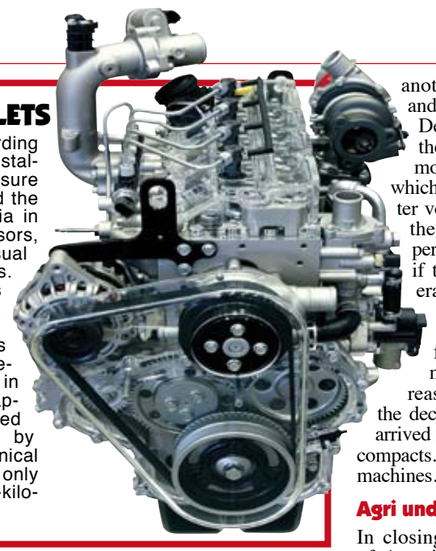
THE TRIO IN LIFTING

Tl470 Agri Series embraced the Tcd 3.6 Deutz, quite similar to the D34 Doosan, which now takes its revenge on five Bobcat models. Koreans show their first 97 kilowatts. In this division, compact Kubota has also carved out a space

Now also the D34, the top of the Doosan Infracore range, is fitted on Bobcat, that had so far used under the hoods other players. The revenge takes place in agricultural versions carrying the Agri brand as can be read in the side box.
But let's start from scratch. Starting at the turn of 2012 and 2013, Doosan Infracore used its initial to open 'D season' with a crackling announcement that hinted at an eternal spring for the three and four-cylinders made in Incheon, Korea. The monogram represented a brand that had matriculated over 1.5 million vehicles at the time, first Doosan Industrial forklifts and second the telescopic handlers and excavators from the Bobcat subsidiary. A precise in-house strategy planned on doubling production capacity by 2015. A critical enough mass to make one think the Korean compact would be competitive even in this tightly-guarded market, ranging between 3 and 3.8 liters. Well, 2015 is long gone and little or nothing has leaked concerning the production cycle, in part because of the proverbial parsimony of Asians sharing information, but Doosan Infracore is also very jealous of its commercial details. Indeed it's difficult to compute the supply contracts for the D18, D24 and D34, the three musketeers with Tier 4 Final certified engines that could be of interested to North American or European oems. But penetration in the agricultural Old World appears to have gone missing and even the saturated earth-moving sector has limited room to maneuver.
In the farm world, Bobcat has for first applied the Agri sticker to the 7-meter telescopics, Tl470 and Tl470Hf, developing the machines for operations in farm-working conditions. Travel speeds reach 40 km/h and Bobcat has upgraded some series accessories arriving at a usable multifunctional status: some examples include reversible ventilation, brake distributors for trailer, hooks for drawbars, front towing and, now, confirmed European approval for use as farm tractors. Other strategic cards still to play on the agricultural operator's table include the Shs mode (Smart handling system) for adjusting the arm (lifting, extension, orientation) depending on the type of work to be performed. For example, the high speed setting is suited to the treatment of manure and similar materials, the slow for more precision work. Other examples concern the dual-action, rear auxiliary hydraulics and the tool-holder with its locking hydraulic attachment. The Eco prefix touches a different nerve center, revealing the secrets under the hood: a simple button optimizes hydraulic performance without driving the engine to full power, instead adjusting the machine operating parameters according to the load. In the Incheon attack trio (1.8, 2.3 and 3.4 liters), this performance should have been the purview of the top of the line but, as we said, the favorite turned out to be the Deutz Tcd3.6 L4, IIIB-approved (in the IIIA price list, there's another illustrious name, the Kubota V3800), calibrated on the Tl360 and Tl470 to produce 74.4 kW at 2,300 rpm, and 89.5 kW at 2,200 rpm on the Tl470Hf. In analyzing the low entry models, their performance would seem to mirror one another, the same power and 100 rpm less for the Deutz, 200 less for the the 90 kW and 20 Nm more for the D34 Doosan which, however, unveils better volumetric data and, on the weight scale, is 30 percent lighter. Of course, if the German 3.6 is literally sweeping through the telescopics (in this case, take a look at the following article) there must be more than one reason. The fact is that the decisive hour has not yet arrived for the brilliant Korean compacts. At least for the Bobcat machines.

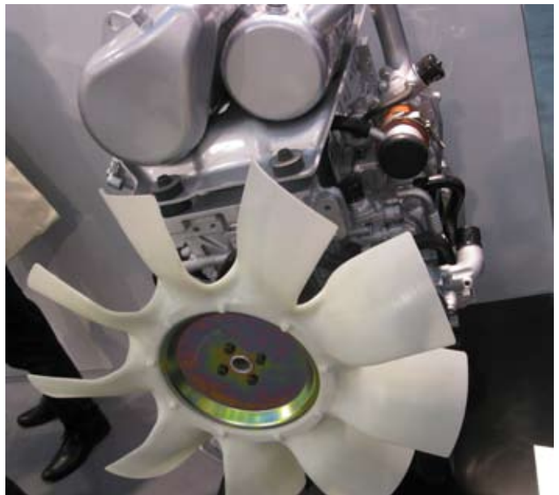
DOOSAN INFRACORE: KOREAN TRIPLETS

Things start with a three-cylinder 600cc cylinder displacement, sharing four-cylinder segmentation. The last of the triplets, dominating the 1.8 and 2.4 liter markets, are the D34s, amending the aforementioned head by pumping 8 and 9 millimeter in their bore and stroke and diving into the lively 3.4-liter super-compact division. From a volumetric and thermodynamic point of view, the Doosan strategy circumvents the complicated embrace of the particulate filter trap. Simplifying after-treatment is intended to lighten the block of trappings inherited from IIIB onwards, promoting modularity and flexibility regarding the emissions capsule installation and avoiding pressure signal complications and the plethora of paraphernalia in tow: see pressure sensors, wiring, LED or other visual and audible indicators. For the Stage V, it seems clear, even Doosan will have to scale back, but there are still three years until January 2019. Regarding after-treatment, in the aforementioned capsule there is the expected catalyst, accompanied by provisions for the technical urea on the D34, the only model to break the 56-kilowatt taboo.



IT'S TIME FOR D34!

Only the top-of-the-range D34 could fight the excessive power of Deutz. This 3.4 liters is in great shape thanks to its 97 kilowatts and 500 Nm, unknown before the transplant on Tl3870 and close to the leaders of this range, Deutz, Kohler, Same and, one step back, Cummins. 55.2 and 74.5 kW are also available on the five new models of Agri series, with load capacities ranging from 2.6 to 3.8 tonnes and lifting heights from 6 to 7 meters. Perkins 1104D-44TA or 1104D-E44TA are available for Tier 3 markets.
Among the main characteristics of these machines we find the power lift, which optimizes the use of hydraulic flow to increase lifting capacity, the fan with automatic inversion, the dampened boom extension, the Speed management system that controls the drive speed independently from the engine speed.



Agri under the lens

In closing, let's take an x-ray of American telescopics. The Tl360 has a maximum lifting capacity of 3 tons, while that of the Tl470, Tl470Hf, Agri Tl470 and Agri Tl470Hf checks in at 3.5 tons. All the models claim a lift capacity of 3 tons at full height. The maximum reach for the Tl360 is 3,365 mm, while that of the other models is 4,002 mm; the lifting capacity at maximum reach for the Tl360 is 1,300 kg and 1,500 kg for all other models. The arm is characterized by the integrated head, a larger cross section and a longer overlap, which, together with the type of the main frame and the chassis with its protected profile allows for heavy duty uses. Closing with designer details, the asymmetric cab situated in the back right corner, free of all structural components with its rounded windscreen, low point of articulation for the arm and all-glass door, guarantees visibility in all areas and dominates the left side of the machine.

Dante Ferrari


CLAAS

DEUTZ-FAHR


MERLO


DIECI


FARESIN

JCB


MANITOU


MASSEY FERGUSON


NEW HOLLAND

Telescopic overviews

THE FIEF OF PORZ

Only JCB and New Holland hold their 'captive' own. For everyone else, a duopoly made up of Deutz and Kubota dominates the engine room. The star is the Tcd3.6, the crumbs to John Deere and FPT Industrial. It's the heritage of Hanover for 2016, waiting for some news

In the telehandler market, who do you compare the Bobcat with? And which are the most popular engines? The superpower is Deutz, followed by Kubota.

MERLO

Merlo spreads the Turbofarmer medium to heavy duty family to opposite ends of the spectrum, from the super-compact P to the Multifarmer handyman.
Conceptually designed for modular production, Turbofarmers share some common characteristics, differentiating with customized equipment. The mid-size family 38.7, 38.10 and 42.7 adopts Deutz's Stage IIIB Tcd 3.6 at 90 kW and their Tcd 4.1 at 115, models between 7 and 10 meters in height with carrying capacities of 3.8 and 4.2 tons. The series is equipped with electronically controlled EPD (Eco power drive) hydrostatic transmissions, while the Cs models (i.e., with electronic joysticks), and, generally, all the 115 kW models come with the Plus version, adding the Speed mode control to record and maintain consistent machine handling speed, and the Eco function that reduces engine speed to avoid unnecessary fuel consumption.
Merlo also offers some models with CVTronic, continuous variable transmission, which consists of two hydrostatic axial piston motors powered by an electronically controlled hydraulic pump. Compared to conventional hydrostatic transmissions, CVTronic increases torque at low engine speeds and lowers transport fuel consumption, smoothing acceleration without torque interruption from zero to 40 kilometers per hour.

MANITOU

Manitou has also chosen Kubota V 3307 for models up to 55 kW and Deutz Tcd 3.6 for models from 74 to 90 kW. But to offer 141 horsepower, the new Mlt 960 with CVT (continuously variable transmission) comes with a Stage IIIB-approved 4.5-liter John Deere. Here we find an electronically-controlled cooling system automatically adjusting fan speed as a function of engine temperature. Automatic ventilation reversal also ensures optimum cleaning of the radiators.
The compact Mvt 730 Varioshift (2 meters high and 2.11 wide) and 940H Mlt are characterized by their hydrostatic transmission and Deutz engines, respectively 74 and 90 kW.

JCB

In Tier 4 Final, the Brits have motorized ECOMAX. These are the 531-70 and 536-60 models, the 536-70 in standard and low profile (Lp) set ups, the 541-70 and 535-95 HT and, lastly, the high-capacity 550-80 and 560-80 models. Output for 4.4- or 4.8-liter 4-cylinders reach 80, 92 and 107 kilowatts.
Smart Hydraulics defines regenerative hydraulic system adopted to ensure faster boom operations at lower rpms. The Powershift 4-speed gearbox and selectable 2- or 4-wheel drive traction are right at home on the 526-56 Agri-Plus. Furthermore, the new transmission disengagement function activated with the brake pedal makes it easy to balance propulsion and hydraulic power to obtain the best performance when tugging and lifting.

DIECI

Two debutantes, Agri Tech 35.7 VS Evo2 and Agri Star 40.7 Evo2.
The first, at 7 meters with 3.5 tons of carrying capacity, is equipped with the VS Evo2 hydrostatic transmission developed by Dana, and composed of a hydrostatic pump coupled to two hydraulic piston motors.
Traction is handled with 104 kilowatts from the 4.5-liter Nef.
The Agri Star 40.7 Evo2, designed to be housed in containers without requiring disassembly, hosts the Kubota Stage IIIB with dpf.

FARESIN

The debut for this range of heavy-duty agricultural lifters consists of two 9-meter models with maximum capacities of 5.5 and 7 tons, and a 10-meter model with a maximum capacity of 6.5 tons.
All share Deutz Tcd 3.6 IIIB 90 kilowatt engines and a 152-liter per minute hydraulic system, with a variable displacement pump to control load sensing, enhanced by a regenerative valve that allows full-speed arm lifting even at minimal engine rpms, reducing fuel consumption.
Instead for Faresin's bestseller, the small 6.25, a new hydrostatic transmission was introduced to increase traction force from 25,000 to 40,000 Newtons.

CLAAS

The entire Skorpion range reached Stage IV thanks, of course, to Deutz: the top of the range 9055 and 7055 rely on the 4.1-liter, 115 kW, the six smaller cousins get by with the 3.6-liter, 100 kW.
The largest two use Smart roading, to automatically reduce on-road engine speed by 15 percent; all models come with Smart handling, that in all modes, proportionally adjusts load stress according to the weight and angle of the load.

MASSEY FERGUSON

Agco has expanded its range: the 9305 Xtra fits between the 9205 and 9306 models, with a lifting capacity of 3,000 pounds and a lifting height of 5.8 meters.
Compact in size (with 20-inch tires measuring 2.1 meters high by 2.1 wide), the 9305 Xtra (just for for a change) hosts a Tcd 3.6 Stage IIIB with 73.5 kW, and uses twin-flow hydrostatic transmission to reach a maximum speed of 40 kilometers per hour.
The auxiliary open-center 100 l/min hydraulic system handles load sensing with 4 electro-hydraulic spool valves, which allow the operator to perform three functions simultaneously with great precision.

NEW HOLLAND

New Holland, like JCB, produces its engines at home, and thus represents another exception to German domination. The 4-cylinder FPT Nef 4.5 mans the 5 models of the Lm series, with three in the standard version offering 89 kW powershift transmissions with four forward gears and three in reverse, and two 105 kW Elite versions with six forward gears, including automatic transmission in fourth, fifth and sixth gear, and three in reverse. In the Elite models, respectively the 6.35 and the 7.42, lifting capacities are 3.5 and 4.2 tons, with the maximum height reaching 6.1 and 7 meters.
The hydraulic system, operated with a joystick mounted on the armrest, uses a variable displacement piston pump with a flow rate of 140 liters per minute.

DEUTZ FAHR

The compact Agrovector 25.5 is the newest entry, completing the range composed of five other models: the 29.6, 29.6LP, 35.7, 37.6 and 37.7. As evident in the monogram, the 25.5 has an extension arm up to 5.6 meters has a capacity of 2.5 tons, while the 55 kWs of power is provided by a 4-cylinder Deutz Tcd 2.9 of 2.9 liters. The dimensions are really compact, 1.8 meters wide, 1.9 in height, and 3.3 in length, which allows 4.3-meter diameter turns (further becoming 3.2m if operating all 4 wheels).

Sergio Bolis

Comparison amongst 'singles'

WAITING FOR THE SHOCK

Naturally conservative, single cylinder engines are waiting for the jump to Stage V. Meanwhile the market request keeps steady, albeit without frenzy. In the meantime Yanmar mounted DOC, Kohler improved filtration, Hatz believes in segmentation

What has changed in the evolution from IIIA to date among the mono cylinders of Hatz, Kohler and Yanmar triad? In summary, the key points of the updates are two: air filtration and the epiphany of doc. The long shadow of Stage V stands in the background.

Yanmar and DOC

Let's start with the most innovative, primarily **Yanmar**, that shows the courage to dare since the times of Lv. Egr is the trademark of the technological character of Lv series. To meet the fourth step of US legislation the exhaust gas after-treatment rules through the catalyst. Doc becomes a standard on Lw series, which enters the grid with L70 and L100 models. It would be interesting to see which would be the impact of a DPF, but the price delta and the impact on dimensions strongly discourage this solution.

Kohler and the filters

Since the end of 2012 **Kohler** update its range with Kd brand, celebrating Kohler new course, with the following displacements: 224, 348, 441 and 505 cc. The air filter acquires a separator pre-filter and a valve for the expulsion of dust residues, which improve filtering efficiency in cooperation with a cartridge of grater size than in Ld versions and using the same type of material. The other functional lever is located in the tank, where the primary fuel filter is associated with a security filter, which prevents the intrusion of impurities during maintenance. Hatz retain the imprint that has made the B series the favorite choiche for small applications in the building industry. The SCS (Single Cam System), as stated in the acronym, relies on a single eccentric to drive the two valves and the injection pump. The gear of the distribution is fully part of the oil pump. The iron rod is removable and oil cooled.

Hatz and the five babies

Compared to other competitors, **Hatz** kept the original segmentation: the vertical shaft versions are an alternative to petrol engines for heavy duty applications and are still available in five displacements (243, 280, 347, 462 and 517 cc). As Kohler did, Hatz opted to keep the 500 cc, which would compete in applications such as rotary cultivators and gensets around 7 kVA.

Let's jump back to the past to better understand the present. In the middle of the last decade injectors made a significant leap ahead thanks to variable geometry systems, whose predecessor was the Stanadyne Rate shape nozzle belonging to the large family of direct injection. Further evolutions of variable geometry injectors include the bottleneck in the sprayer and the needle, which has a larger diameter. The dynamic effect of this architecture provides for better homogenization of the spraying in the chamber. A low-loads pre-injection allows to decrease the acoustic impact both at stable engine speed and in the acceleration phase (Yanmar has developed in house a system of this kind). Detonation is weaker, temperatures drop, 'ears' and oems are pleased.

Ten years ago, the decree of 24 July 2006 published in the Official Gazette number 182 included in our regulations the Directive 2005/88, which extends to lawn mowers the regulations on noise levels of equipment for outdoor use. Meanwhile, 2019 is coming close. It is early to draw conclusions, but the fate of engines under 19 kilowatts still appears to be written in detail and the impression is that Yanmar may have traced the right path. Waiting for the shake-up…

A final conclusion on the state of the segment.

Focus on markets

Regarding garden machinery equipped with single-cylinder engines, despite the lack of a petrol/diesel disaggregated data, 2015 have seen in Italy a slight decrease of Ride On Mmv (from 3,154 to 3,143 units), consumer riding lawn tractors (from 23,445 to 22,371) and mowers (from 301 135 to 286 660, equipped for the most part with petrol engines). Motor hoes showed positive trends, raising from 30,194 to 31,432 units.

HATZ

Brand / Model	HATZ 1B20	HATZ 1B27	HATZ 1B30	HATZ 1B40	HATZ 1B50
I. D.					
B x S mm - S/B	69 x 65 - 0.94	74 x 65 - 0.88	80 x 69 - 0.86	88 x 76 - 0.86	93 x 76 - 0.82
N. cil. - dm³	1 - 0.24	1 - 0.28	1 - 0.34	1 - 0.46	1 - 0.51
Maximum power kW - rpm	3.4 - 3,600	4 - 3,600	5.4 - 3,600	7.5 - 3,600	8.5 - 3,600
Mep at max power bar	4.8	4.9	5.3	5.5	5.6
Piston speed m/s	7.8	7.8	8.3	9.1	9.1
Maximum torque Nm - rpm	10 - 2,450	12 - 2,450	16.5 - 2,000	25 - 2,000	26 - 2,400
Mep at max torque bar	5.5	5.5	6.1	6.9	6.5
Torque rise %	21	20.2	20.7	23.3	20.5
Torque at max power Nm	8	10.8	14.7	19.6	22
% power at max torque (kW)	79.3 (3)	77 (3)	64 (3)	69.90 (5)	76.90 (7)
Work range rpm	1,150	1,150	1,600	1,600	1,200
DETAILS					
Specific power kW/dm³	13.9	14.1	15.4	16.2	16.5
Specific torque Nm/dm³	43.2	42.8	47.5	54.1	50.3
Areal spec. power kW/dm²	9.19	9.30	10.80	12.30	12.50
RULES AND BALANCE					
Dry weight kg	28	29	35	48	35
L x W x H mm	361x286x401	361x117x401	370x298x431	392x335x480	392x392x480
Volume m³	0.04	0.02	0.05	0.06	0.07
Weight/power kg/kW	8.2	7.3	6.5	6.4	4.1
Weight/displacement kg/dm³	115.2	103.6	100.9	103.9	67.8
Power density kW/m³	85	200	108	125	121.4
Total density t/m³	0.70	1.45	0.70	0.80	0.50
Displacement/volume dm³/m³	6.08	14	6.94	7.70	7.37

YANMAR

Brand / Model	YANMAR L48N	YANMAR L70W	YANMAR L100W
I. D.			
B x S mm - S/B	70 x 57 - 0.81	78 x 67 - 0.86	86 x 75 - 0.87
N. cil. - dm³	1 - 0.21	1 - 0.32	1 - 0.43
Maximum power kW - rpm	3.5 - 3,600	4.8 - 3,600	6.8 - 3,600
Mep at max power bar	5.4	5.1	5.3
Piston speed m/s	6.8	8	9
Maximum torque Nm - rpm	11 - 2,200	18 - 2,400	24 - 2,000
Mep at max torque bar	6.8	7.2	7.2
Torque rise %	22.9	27.7	26.2
Torque at max power Nm	9	12.7	17
% power at max torque (kW)	76.4 (3)	94.30 (5)	75.50 (5)
Work range rpm	1,400	1,200	1,600
DETAILS			
Specific power kW/dm³	**16.1**	14.9	15.5
Specific torque Nm/dm³	52.9	**56.2**	56.1
Areal spec. power kW/dm²	9.21	10	**11.72**
RULES AND BALANCE			
Dry weight kg	27	38	48
L x W x H mm	332x384x417	395x448x472	429x472x484
Volume m³	0.05	0.08	0.10
Weight/power kg/kW	7.7	7.9	7.1
Weight/displacement kg/dm³	123.3	118.8	110.1
Power density kW/m³	70	60	68
Total density t/m³	0.54	0.48	0.48
Displacement/volume dm³/m³	4.38	4.00	4.36

KOHLER

Brand / Model	KOHLER KD15-225	KOHLER KD15-350	KOHLER KD 15-440	KOHLER KD 500
I. D.				
B x S mm - S/B	69 x 60 - 0.87	82 x 66 - 0.80	76 x 86 - 1.13	87 x 85 - 0.98
N. cil. - dm³	1 - 0.22	1 - 0.34	1 - 0.39	1 - 0.50
Maximum power kW - rpm	3.5 - 3,600	5.5 - 3,600	5.9 - 3,600	8.8 - 3,600
Mep at max power bar	5.3	5.4	5.1	5.9
Piston speed m/s	7.2	7.9	10.3	10.2
Maximum torque Nm - rpm	10 - 2,400	16.6 - 2,200	24.5 - 2,200	30 - 2,200
Mep at max torque bar	6	6.1	8.1	7.6
Torque rise %	19.5	20.1	31.7	24
Torque at max power Nm	9	14.7	15.7	23
% power at max torque (kW)	74.7 (3)	69.60 (4)	95.70 (6)	78.60 (7)
Work range rpm	1,200	1,400	1,400	1,400
DETAILS				
Specific power kW/dm³	15.7	15.8	15	17.4
Specific torque Nm/dm³	46.4	47.5	62.8	59.4
Areal spec. power kW/dm²	9.46	10.38	13.11	14.92
RULES AND BALANCE				
Dry weight kg	28	33	45	48
L x W x H mm	415x358x265	444x386x301	413x340x512	504x415x355
Volume m³	0.04	0.05	0.07	0.07
Weight/power kg/kW	8	6	7.6	5.5
Weight/displacement kg/dm³	125	94.6	115.4	95
Power density kW/m³	87.5	110	84.3	125.7
Total density t/m³	0.70	0.66	0.64	0.69
Displacement/volume dm³/m³	5.60	6.98	5.57	7.21

Ultra-compact 2.2 engines

COLOGNE PERFUME

DIESEL focuses on super-compact 2.2 liters engines. Among the five competitors Deutz is the latest to come, showing performances close to the low end of 2.5 to 2.9 liters range. FPT-Vm features a 3-cylinders, 4-cylinders from Perkins and Doosan Infracore

We have a baby! The latest edition of Bauma was announced as the one of small engines, and the expectations were fulfilled thanks to three spearheads in the range between 2 and 2.5 liters. The lineup of super-compact engines between 2 and 2.9 liters has indeed expanded in recent times, enabling us to focus on 2.2 liters engines. The high detail level of this comparison excludes one of the three competitors, Yanmar, which stops at 2.09 liters (see box below). Among the other two, the one that gained the attention of the insiders is definitely the Tcd2.2 by Deutz, which is substantially a 3-cylinders version of the 4-cylinders Tcd2.9. The 730 cc cylinder is therefore a modular one, which stands in a power range between 22.5 and 55.4 kW. Thanks to common rail and waste gate (there's also an aspirated version available) for air regulation in the intake pipe Deutz reaches the top of specific power curve. External EGR and DOC are used to meet Tier 4 Final, dpf will be added to meet Stage V.

Torque in pole position

The Tcd2.2 wins the second place for torque values and it's beaten only by Doosan Infracore D24, an entry level engine that was supposed to be used on Bobcat low-power skids and telescopic as a base for expansion into the world of standalone engines, even if we have no further news about this project. Still the thermodynamic parameters of this 2.29 liters are the spearhead of the Korean triad. Its 280 Nm leave behind the competitors that stop at 250 Nm, with the exception of Perkins. The British are updating their product range, pointing at a double presence in Stage V. The Syncro series will in fact feature a 4-cylinders, 2.8-liter delivering 55 kW who will continues the British tradition of reliability and low stresses, featuring technical solutions and overall dimensions suitable for offroad Oems. Peterborough also updated the performances of the 404, which gains a ten percent in power standing in line with other competitors, and shortens the distance in torque curves, while staying a step below.

Low stresses

Stresses, moreover, are kept down by software mapping despite the piston showing a textbook speed of 10 meters per second, the highest of the lot (although it must be said that the Vm curve, stable from 1,000 / 1,100 laps, as reported in the official data, should be better evaluated). MEP is the lowest of the lot, indicating that engineers may improve it. A slight change in specific curves or stretching rpm range would do the trick. The engine from Ferrara stays alive and kicking, despite the stagnation of Cento industrial area. The update of FPT Industrial branded R22, however, adds a taste unleashing at maximum torque 90 percent of the available power and reaffirming its primacy in the core of FPT engineering philosophy, power density and dimensions.

The resilience of EGR

In this power range egr is widely used, even for R22, contrary to the strategy outlined by FPT with its Hi-ESCR. The particulate filter is used on Vm and will be used in Stage V by Deutz, which chose the catalyst for Tier 4 Final. Our lineup lacks the 2.2-liters Mitsubishi 4Cj - 44 kW at 2,500 - because torque curve is not available at the moment.

From the left side, Fpt Industrial R22, Perkins 404D-22T, Doosan Infracore D24, VM R753. At the bottom, the newcoming Deutz Tcd2.2.

FOCUS ON 2.2

Brand Model	DEUTZ TCD2.2	DOOSAN D24	FPT INDUSTRIAL R22	PERKINS 404D-22T	VM R753
I.D					
B x S mm - S/B	92 x 110 - 1,20	90 x 90 - 1,00	94 x 107 - 1,14	84 x 100 - 1,19	94 x 107 - 1,14
N. cylinder - dm^3	3 - 2.19	4 - 2.29	3 - 2.22	4 - 2.21	3 - 2.22
Maximum power kW - rpm	**55.4** - 2,600	55 - 2,600	52 - 2,600	50 - 2,800	50 - 2,600
Mep at max power bar	11.9	11.3	11	**9.2**	10.6
Piston speed m/s	9.5	**7.8**	9.3	10	9.3
Maximum torque Nm - rpm	250 - 1,600	**280** - 1,600	250 - 1,800	208 - 1,800	250 - 1,100
Mep at max torque bar	14.6	15.7	14.4	**12**	14.4
Torque rise %	35.3	**40.8**	37.9	31.6	40
Torque at max power Nm	**206**	**206**	196	157	186
% Power at max torque (kW)	75.7 (42)	85.40 (47)	90.70 (**47**)	78.50 (39)	52.40 (26)
Work range rpm	1,000	1,000	800	1,200	**1,600**
DETAILS					
Specific power kW/dm^3	**25.1**	24	23.4	22.5	22.4
Specific torque Nm/dm^3	113.9	**122.2**	112.2	93.8	112.2
Areal specific powerkW/dm^2	**27.84**	21.65	25	22.52	24.04
RULES AND BALANCE					
Dry weight kg	215	204	210	228	225
L x W x H mm	754x576x708	673x556x690	519x524x723	727x635x772	614x557x723
Volume m^3	0.31	0.26	**0.20**	0.36	0.25
Weight/powerkg/kW	3.9	**3.7**	4	4.6	4.5
Weight/displacement kg/dm^3	98	**89.1**	94.3	102.8	101
Power density kW/m^3	178.7	211.5	**260**	138.9	200
Total density t/m^3	0.69	0.78	1.05	0.63	0.90
Displacement/volume dm^3/m^3	7.08	8.81	**11.14**	6.16	8.91
SPECIFICATION					
Emission level	tier 4 final	tier 4 final	tier 4 final	tier 4 final	tier 4 final
Injection system	common rail	common rail	common rail	common rail	common rail
Techno	wg egr doc	wg egr doc	wg egr doc Pm cat	wg egr doc	2V wg egr dpf doc
INDEX					
Torque	12	12.2	10.1	13.8	**17.7**
Performance	4.8	4.7	4.7	4.2	4.7
Sress	8	**7.8**	7.9	7.3	7.9
Lightness	11	9.7	10.8	11.8	11.7
Density	21.4	26.2	**32.4**	14.8	25.8
DIESEL Index	6.8	**7.1**	6.6	6.5	6.6

YANMAR 4TNV86CHT

Of all the natural competitors in the wide range between 2 and 2.9 liters, the most penalized by our choice to select only 2.2-liters is the Yanmar 4Tnv86Cht, which is 2,091 cc (86 mm bore, 90 mm stroke). This engine introduced at Bauma has what it takes to gain respect: common rail and DPF, 48.5 kW at 2,600 rpm and 216 Nm at 1,690 rpm improve performances by 10 and 20 percent compared to the previous Tnv86T model, and are candidates to have their say in the super compact range.

The Japanese 2.1 liters.

Compact engines from 3 to 3.8 liters. Stage V and Tier 4 Final-Stage IV

GOOD FIRST TAKE!

Stage V engines came in, already scoring better in the competition. Cummins pushes on maximum performance, Deutz stretch up to 5 KW, Perkins launches its in – house compact named Syncro. Among the Tier 4 Final, Yanmar updates its Tnv94

At Bauma 2016 manufacturers have finally moved from words to action, after a long year opened by the tags 'Stage V Ready' seen for the first time at Intermat. The prophecies of marketing offices became true thanks to the first monoblocks to be manufactured in 2019, such as **Cummins F3.8**, which is going to reach high performance curves, **Deutz Tcd3.6 L4 Hp**, which stands for High power, and the newborn **Perkins Syncro**, aka **904J-E36TA**. This is the dawn of Stage V, and it is a dawn that is not going to be forgotten. Three important profiles stood in the Bavarian arena, all different from each other. After a progressive settlement in the generation segment, Perkins pushes on propulsion through a brand new project that could join the Deutz - Kohler – Same trio in the 100 kilowatts range. The British engine runs low at 2,200 rpm, confirming the vocation of Peterborough towards stress containment. In the range above

Here, Perkins 904 Syncro. At the bottom, from the right side, Deutz Tcd3.6HP and Cummins F3.8.

STAGE V? HERE WE ARE!

Brand Model	CUMMINS F 3.8	DEUTZ TCD3.6 L4 HP	PERKINS 904J-E36TA
I.D.			
B x S mm - S/B	102 x 115 - 1.13	98 x 120 - 1.22	98 x 120 - 1.22
N. cylinder - dm^3	4 - 3.75	4 - 3.62	4 - 3.62
Maximum power kW - rpm	**116** - 2,600	105 - 2,300	100 - 2,200
Mep at max power bar	**14.5**	15.4	15.4
Piston speed m/s	10	9.2	**8.8**
Maximum torque Nm - rpm	**600** - 1,200	550 - 1,600	500 - 1,500
Mep at max torque bar	20.5	19.5	**17.7**
Torque rise %	41.7	**42.3**	40
Torque at max power Nm	431	**441**	431
% Power at max torque (kW)	65 (75)	87.80 (**92**)	78.60 (79)
Work range rpm	**1,400**	700	700
DETAILS			
Specific power kW/dm^3	**30.9**	29	27.6
Specific torque Nm/dm^3	**159.6**	151.8	138
Areal specific powerkW/dm^2	**35.47**	34.77	33.11
RULES AND BALANCE			
Dry weight kg	280	350	275
L x W x H mm	818x728x786	900x592x1,036	667x569x776
Volume m^3	0.47	0.55	**0.29**
Weight/powerkg/kW	**2.4**	3.3	2.8
Weight/displacement kg/dm^3	**74.5**	96.7	75.9
Power density kW/m^3	246.8	190.9	**344.8**
Total density t/m^3	0.60	0.64	0.95
Displacement/volume dm^3/m^3	8	6.58	**12.49**
SPECIFICATION			
Emission level	STAGE V	STAGE V	STAGE V
Injection system	common rail	common rail	common rail
Techno	wg scr dpf	wg egr dpf scr	wg egr doc dpf scr
INDEX			
Torque	**16.5**	9.6	9.4
Performance	6,1	5,8	5.4
Stress	10.2	9.6	**8.8**
Lightness	9	11,1	9.1
Density	20.1	16.2	**28.1**
DIESEL Index	**8**	7.2	7.3

56 kW the brand embraces the complete spectrum of emissions technologies (egr, scr, doc and dpf), claiming the efficiency of recirculation in lowering temperatures, urea consumption and therefore overall dimensions of Adblue tank. Torque is aligned with Tier 4 Final best in class. When the comparison focuses on the two futuristic antagonists we enter a different playfield. The first one is Deutz that reaches 105 kilowatts, doubling progression in the torque curve rising from 500 to 550 Nm. The engine shows an excellent elasticity and power at maximum torque delivering 92 kW, corresponding to 87.8 percent of the total power, which allows good reactivity to top performance request at best specific fuel consumption point. Here we can find the Dvert post-processing module, which eliminates Doc coupling urea catalyst and Dpf (optional until now). Last but not least, Cummins updates the entire range looking at the future. Curves swell in double figures, pushing power from 98 to 116 kW and torque from 488 to 600 Nm reaching the top of the rank.

Cummins eliminates egr

The strategy of the Columbus based brand was made explicit by the Ceo and Chairman Tom Linebarger, following the new wave inaugurated by FPT Industrial and followed by Scania: no more egr. Among the reasons and opportunities of this choice, in addition to the delicate aspects of combustion temperature and heat dispersion, we find the issue of fuel quality with a high sulfur tolerance (up to 5,000 ppm), required to be a global provider. Coming to power density, one of the propulsion engineering chimeras, Perkins beats the competition also widening his vision to Stage IV rankings.

From Stage V to IV

Let's come to the real comparison, that of Tier 4 Final/Stage IV. The group hails the return of Yanmar over 56 kW. The Japanese took their time but, as often happens to them, they did everything right, confirming the interim power rates while leaving behind a few Nm, thanks to a compact unit that tries to minimize the post-treatment impact while leaving its mark in terms of dimensions. Dpf (with 6,000 hours scheduled maintenance) and scr support egr allowing Yanmar to use the Stage V Ready tag. Same still shows

the best absolute rates, resized in definitely captive specific curves and displacement. Reaching 100 kW and 500 Nm they join Deutz and Kohler which differ on specific curves and have the KDI at the top. The 3.35 liters from Reggio Emilia stands out in specific performances (showing the best Nm/liter ratio), without taxing the engine block sealing with excessive stress. Deutz instead plays the card of power density, where dimension/weight/displacement ratio shows interesting figures. Just below, at 98 kW and 488 Nm, we find the first made-in-Foton Cummins, before the Egr sacrifice. Close to 90 threshold we find FPT Industrial and Perkins, offering the same block in Tier 4 that just slightly differ in figures and weight based on the data sheets. Even for those twins torque climbs up to the top of the comparison. The F5 series is the only Fpt that still uses gases recirculation. At 92 kW quota we also find Isuzu, which packed a 3-liter engine that could do better on the torque curve and will have to deal with the so far refused dpf. VM faded behind the Fca automotive shadow, but its industrial engines still show brilliance, pure lines and a favorable power/mass ratio. The Diesel Index is pleased. Kubota plays its wild card, the 3.8, which is the flagship of the Japanese product range. It's not a lightning war, but it's brilliant in terms of density and available power at maximum torque. The last oriental engines in the grid, Mitsubishi and Doosan, are virtually unknown. We don't know much about the first one, even if the overall project could be competitive with a couple of modifications, maybe increasing rpms. Doosan Infracore chose non to use dpf. We'll see if Koreans will send a signal in Stage V.

DOOSAN

ISUZU

KUBOTA

PERKINS

CUMMINS

DEUTZ

FPT INDUSTRIAL

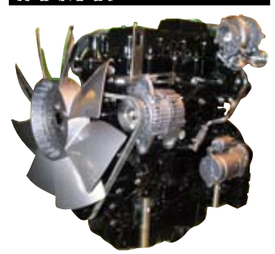
KOHLER

MITSUBISHI

SAME

VM

YANMAR



THE TIER 4 FINAL FULL LIST

Brand Model	CUMMINS QSF3.8	DEUTZ TCD3.6	DOOSAN INFRACORE D34	FPT INDUSTRIAL F34	ISUZU 4JJ1X	KOHLER KDI 3404TCR SCR	KUBOTA V3800-CR	MITSUBISHI D04EG	PERKINS 854F-E34TA	SAME KE4	VM D754IE3	YANMAR TNV94HT-CR
I.D.												
B x S mm - S/B	102 x 115 - 1.13	98 x 120 - 122	98 x 113 - 1.15	99 x 110 - 1.11	95 x 105 - 1.11	96 x 116 - 1.21	100 x 120 - 1.20	94 x 120 - 1.28	99 x 110 - 1.11	103 x 115 - 1.12	94 x 107 - 1.14	94 x 110 - 1.17
N. cylinder - dm^3	4 - 3.75	4 - 3.62	4 - 3.40	4 - 3.38	4 - 2.97	4 - 3.35	4 - 3.77	4 - 3.33	4 - 3.38	4 - 3.83	4 - 2.97	4 - 3.05
Maximum power kW - rpm	98 - 2,600	**100** - 2,300	74 - 2,400	92 - 1,900	92 - 2,200	**100** - 2,200	74.5 - 2,600	74 - 2,000	90 - 2,200	**100** - 2,000	85 - 2,300	88.4 - 2,500
Mep at max power bar	12.3	14.7	11.1	17.5	17.2	16.6	**9.3**	13.6	14.8	16	15.2	14.2
Piston speed m/s	10	9.2	9	7	**7.7**	8.5	10.4	8	8.1	**7.7**	8.2	9.2
Maximum torque Nm - rpm	488 - 1,200	500 - 1,600	430 - 1,400	500 - 1,500	375 - 1,800	500 - 1,400	400 - 1,600	375 - 1,500	490 - 1,600	**540** - 1,600	420 - 1,300	420 - 1,400
Mep at max torque bar	16.7	17.7	16.2	18.9	16.2	19.1	**13.6**	14.4	18.6	18.1	18.1	17.6
Torque rise %	39.9	40	**47.9**	44.4	30.8	40	43.9	40.5	44.6	44	39.2	37.6
Torque at max power Nm	363	412	294	461	402	431	274	353	392	**480**	353	333
% Power at max torque (kW)	62.6 (61)	83.80 (84)	85.20 (63)	85.4	76.90 (71)	73.40 (73)	90 (67)	79.70 (59)	91.30 (82)	90.50 (**91**)	67.30 (57)	69.70 (62)
Work range rpm	**1,400**	700	1,000	400	400	800	1,000	500	600	400	1,000	1,100
DETAILS												
Specific power kW/dm^3	26	27.6	21.7	27.1	**30.8**	29.7	19.7	22.2	26.4	26	28.7	28.8
Specific torque Nm/dm^3	129.8	138	126.1	147.6	125.9	**148.8**	106.1	112.5	144.6	140.8	141.4	137.5
Areal specific powerkW/dm^2	29.97	33.11	24.5	29.87	32.39	**34.48**	23.73	26.62	29.22	30.03	30.58	31.8
RULES AND BALANCE												
Dry weight kg	280	350	265	360	320	394	345	360	270	496	257	235
L x W x H mm	818x728x786	592x947x989	701x580x769	678*586*896	928x823x888	718x580x816	843x581x834	715x625x750	739x623x805	751x611x679	702x557x736	719x496x717
Volume m^3	0.47	0.55	0.31	0.36	0.68	0.34	0.41	0.34	0.37	0.31	0.29	0.26
Weight/powerkg/kW	2.9	3.5	3.6	3.9	3.5	3.9	4.6	4.9	3	5	3	**2.7**
Weight/displacement kg/dm^3	**74.5**	96.7	77.7	106.3	107.5	117.3	91.5	108.1	79.7	128.8	86.5	76.9
Power density kW/m^3	208.5	181.8	238.7	255.5	135.3	294.1	181.7	217.7	243.2	322.5	293.1	**340**
Total density t/m^3	0.60	0.64	0.85	1	0.47	1.16	0.84	1.06	0.73	1.6	0.89	0.9
Displacement/volume dm^3/m^3	8	6.58	11	9.4	4.38	9.88	9.20	9.80	9.15	**12.4**	10.24	11.75
SPECIFICATION												
Emission level	tier 4 f/stage IV	tier 4 f/stage IV	tier 4 f/stage IV	tier 4 f/stage IV	tier 4 f/stage IV	tier 4 f/stage IV	tier 4 f/stage IV	tier 4 f/stage IV	tier 4 f/stage IV	tier 4 f/stage IV	tier 4 f/stage IV	tier 4 f/stage IV
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	common rail	common rail
Techno	wg doc scr	afterc. doc scr	wg doc scr	wg egr doc scr	afterc. doc scr	wg scr egr doc	egr doc dpf scr	egr doc dpf scr	wg egr doc scr	wg egr doc scr	wg egr dpf scr	wg egr dpf scr
INDEX												
Torque	**16.1**	9.4	12.2	4.9	6.2	10.4	12.1	7	8.5	6.5	12.2	13.2
Performance	5.3	5.5	4.9	5.43	5.1	5.7	4.6	4.6	5.4	5.3	5.4	5.4
Stress	8.9	9	8.4	8.6	8	9.2	**8**	7.5	8.9	8.6	8.8	8.9
Lightness	9.1	11.6	9	12.2	12.4	13.4	10.4	13.1	9.3	16.6	10.2	8.9
Density	16.4	14.8	23.3	23.7	11	25.6	15.2	19.3	22.6	**34.6**	28.1	30.7
DIESEL Index	7.4	7	7.1	6.6	6.5	7.1	6.5	6.1	7.2	6.1	7.4	**7.6**

2016 DIESEL OF THE YEAR

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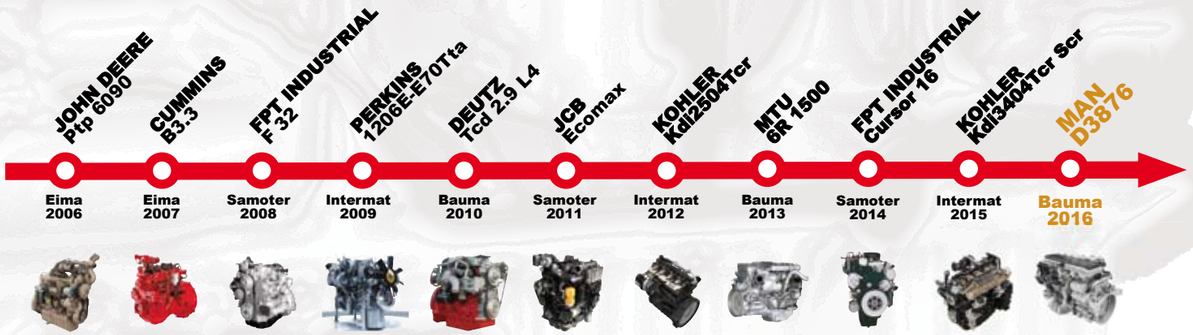

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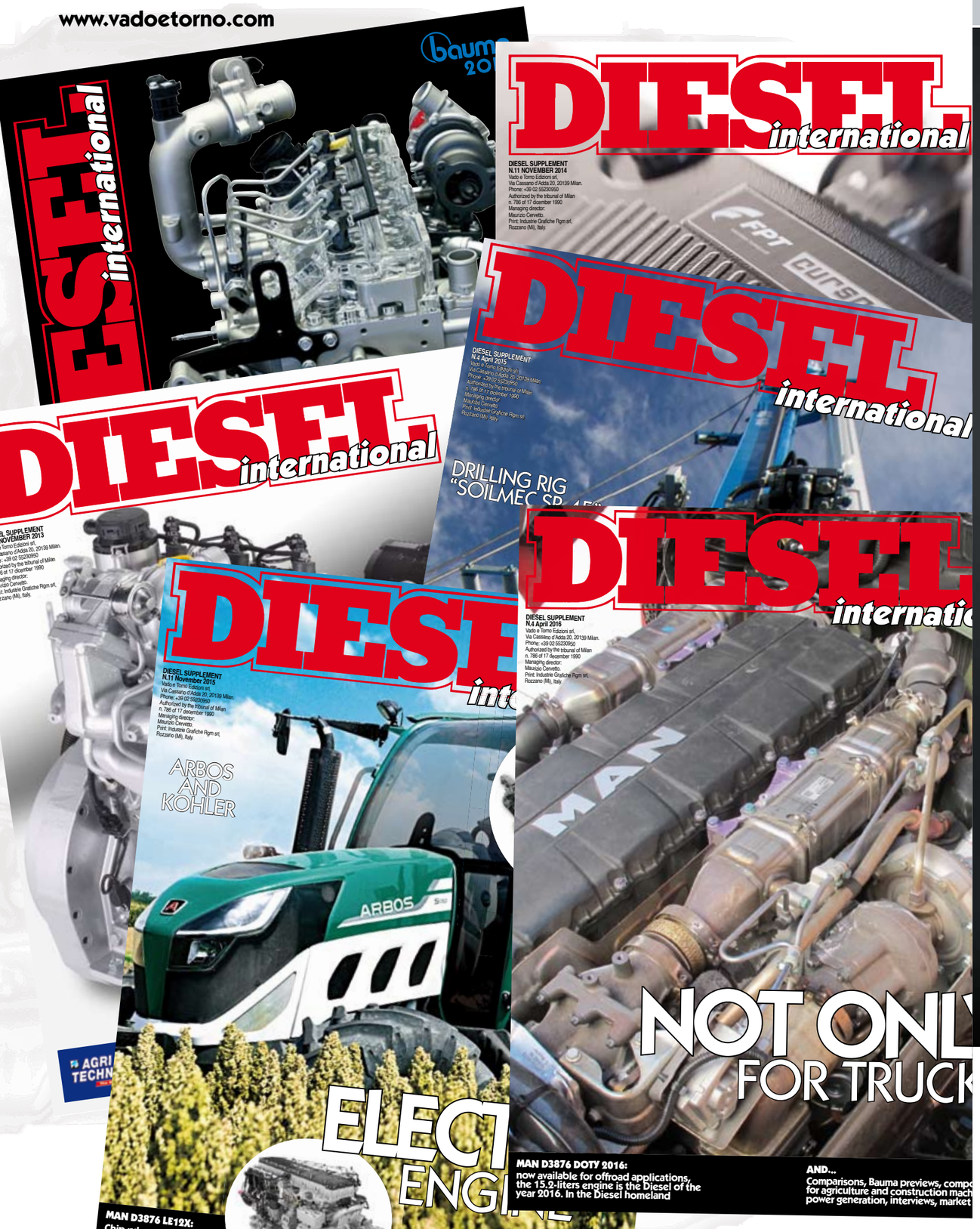

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E-mail: abbonamenti@vadoetorno.com

CITAZIONI

DIESEL

Engines and components for OEM
Culture, technology, purposes
And market of Diesel engines
Established in 1986

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Printing
Industrie Grafiche RGM srl, Rozzano (Mi)

Offset
Fram, Milano

Milano City Court Authorization n. 860 – December 18th 1987 National Press Register n. 4596 – April 20th 1994 Poste Italiane Inc. – Mail subscription D.L. 353/2003 (mod. in L. 27/02/2004 n° 46) Art. 1, subsection 1, LO/MI

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VADO E TORNO EDIZIONI

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Annual subscription
Italy 35 euro, International 55 euro
Air Mail Annual subscription
65 euro
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