DIESEL international

DIESEL SUPPLEMENT
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NOT ONLY FOR TRUCKS

MAN D3876 DOTY 2016:
now available for offroad applications, the 15.2-liters engine is the Diesel of the year 2016. In the Diesel homeland

AND...
Comparisons, Bauma previews, components for agriculture and construction machinery, power generation, interviews, market report

MAN

2016
DIESEL
OF THE YEAR

DIESEL international

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DIESEL OF THE YEAR

25
MAN D3876

It's finally back to its roots, where it was created by Rudolf Diesel. Doty 2016 awards the 15.2 liter, 2-stages turbo and Egr on truck, Vtg and Egr and Scr on offroad applications

Mobility revolution: truck, bus, tractors

GREEN INDEX

The collaboration between Trattori, Autobus, Vado e Torno Publishing and LifeGate has spawned Mobility Revolution Truck, Bus and Tractor, the only rating that measures the impact and sustainability of all vehicles for transporting goods, people or for farm work. And the revolution has only just begun ...

On one side, the magazines Vado e Torno, Autobus and Trattori, and on the other, LifeGate, a reference point for sustainable development for people and businesses, a community (LifeGate.it has about 5 million users) and a channel for disseminating awareness and new ways of living, even in the world of transportation.

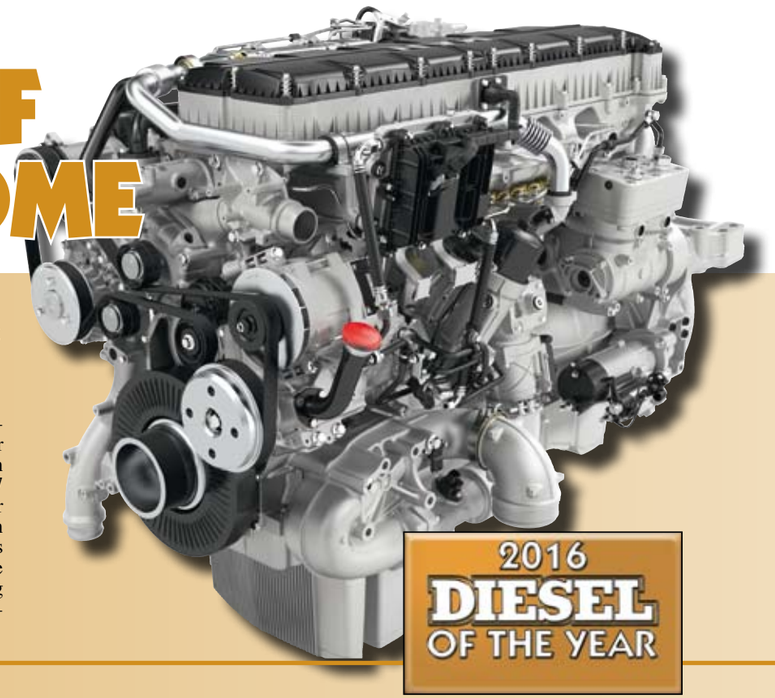
In 1993, Vado e Torno introduced the Diesel Index, flanked by a huge database amassed since 1989 with Diesel magazine, that has accompanied the release of every new engine, whether automotive or industrial, marine or stationary, to highlight their technological capabilities.

Over the years, LifeGate's Mobility Revolution and its MR rating tools (available online at lifegate.it) have increasingly become one of the criteria Italians use in choosing a car, assessing its true ecological impact, CO2 and NOx emissions, fuel consumption and factors such as savings on operating costs stemming from the incentives various Italian cities offer more environmentally-friendly vehicles.

A Green index that, for the first time, rates the entire vehicle and its design, including evaluation criteria that take their cue from the accumulated technical and technological experience of Vado e Torno Publishing and the sensibility for sustainability and environmental impact that has always been part of LifeGate's DNA. A compendium of knowledge which, in fact, has led to constructing a indispensable standard for the future. «The environmental impact of road transport, agriculture and passenger transport is remarkable,» said Stefano Corti, general manager of LifeGate. «We like to think that the birth of this new variation on Mobility Revolution will contribute beneficial effects to these specific areas of transport».

Diesel of the year 2016: Man D3876

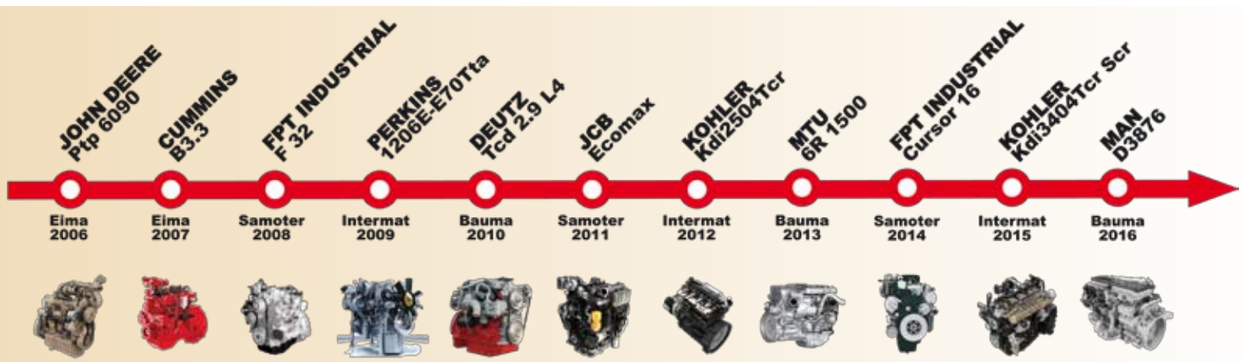
RUDOLF COME HOME



2016 DIESEL OF THE YEAR

It's a circular path the one that brought diesel home. The engine that bears the name of its creator was in fact born precisely here in 1897

Man evolved species has found his consecration. The D3876 is the Diesel of the year 2016. Since 2014 the 15.2 liters replaced on Man trucks the two-liter cylinder designed in 2007 with Liebherr. Two supercharging stages, two Egr and two heat exchangers, which on offroad version become simpler to follow atmospheric conditions and working cycles in industrial applications. The D38 is the most valuable piece of Man multitasking mosaic that also includes the D28 and D26, introduced in the agricultural market in 2013.



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.

FPT INDUSTRIAL. 2015 BALANCE SHEET AND PROJECTS

'Free' instinct

For the first time the engines supply to the parent company CNH Industrial drops below 50 percent threshold. The units sold were 507,700, biomethane is a priority, power generation embraces the Cursor 16. Sevel is the first partner in automotive, bus & coach share is growing

Revenues are increasing at constant exchange rates, turnover faces a significant drop, and it's time for the consecration as protagonist in the engine. 3,560 million dollars (3212.1 at the first decade of March Euro exchange rate) were registered in the books of Viale Puglia, one-fifth less than in 2014, which had left a legacy of 4.464 million dollars (4.03 million Euros), cause of the diminution of CNH Industrial applications and the 'stockpiling', that is the available stocks of Tier 4 Interim engines that contributed to the brilliant 2014 performance. Finishing with financial data, as mentioned above, the operating income was in line with the previous year, net of exchange rate. 2015 operating profit was 186 million dollars, 37 less than in 2014, with a 5.2 percent operative margin, above the 5 percent 2014 threshold. The prospect is an increase from 4.2 to 6.3 percent operative profit in 2018.
Speaking of units, 507 700 engines were sold, 13 per cent less, 55 per cent for the free market. Among the reasons are to be included the troubles with agriculture and the performance of Sevel, a joint venture between Fca and Peugeot Citroen, then outside CNH Industrial, which absorbs 31 percent of the domestic market, 10 percent is the share of agricultural machines and 4 of earthmoving. In the galaxy of the remaining 55 percent supplied to oem, apart from Sevel, automotive has always the main share with Vdl, Tata Daewoo, Daewoo Bus, Karsan, Hyundai for South America and Ford in Turkey and Latin America, historically a fertile ground for the companies of the Fiat galaxy, as evidenced by the upcoming launch of the Cursor 10 Euro 5 in Argentina. In the agricultural market the most valued brands are those of Landini and Claas, the offroad includes Tiger and Vermeer in North America, Bobcat and the telehandlers powered by Nef. In the marine market the strategy is clear, with 8.7 and 12.9 liter Cursor provided to Caterpillar and N6,7 provided to Mercury Marine. Coming to power generation, the Cursor 16 in G-Drive format and the renewed S8000, which replaces the F32, were introduced in Dubai. In this segment FPT offers engines, G-Drive, generators and framed generators.

In 2015, FPT Industrial also delivered 67,800 transmissions and 182,000 axles, gaining respectively 6 and 16 percent. **F.B.**

THE WAY OF BIOMETHANE

FPT Industrial offers for cng engines a range now under expansion which currently includes the F1C 3 liter, delivering 100 kW and 350 Nm, the 150 kW, 750 Nm Nef 6-liter and the 243 kW, 1,300 Nm Cursor 8-liter. The new chapter of this story is called biomethane, on which both Fiat Chrysler Automobile and CNH Industrial are investing, that could reconcile the sustainability of renewable energy and the paradigm of zero kilometer. Methane has several advantages, including a minimum amount of fine dusts and just 22 g/kWh of CO2. The prospects are favorable: cogeneration clashes with its dependence on public incentives and the limited use of thermal power. Meanwhile, other difficult topics are production and supply infrastructures, layout, with subfloor or above uprights mounting depending on the application, control and after-treatment strategies. But the road is drawn anyway.

CURSOR 16 AND S8000 IN DUBAI

FPT Industrial introduced at Mee the Cursor 16 and the S8000. The Diesel of the Year 2014 keeps proselytizing as evidenced by the consensus gathered in Dubai, relying on the same topic that won him the prize: power density. In its category the G-Drive version is distinguished by 600 kVA, that approach it to a higher displacement, and dimensions near those of 13 liters, with only 6 millimeters more in stroke. Among its strongpoints, the attention to structural strength and vibration reduction, with 22 thousand hours of stress tests on the test bank, steel pistons and a compact graphite iron cylinder head. The S8000 is the naturally aspirated 2.9-liter three-cylinder (AxC 104x115 mm) with rotary pump, which features the same maintenance intervals of the Cursor 16 (600 h) and delivers up to 36 kW.

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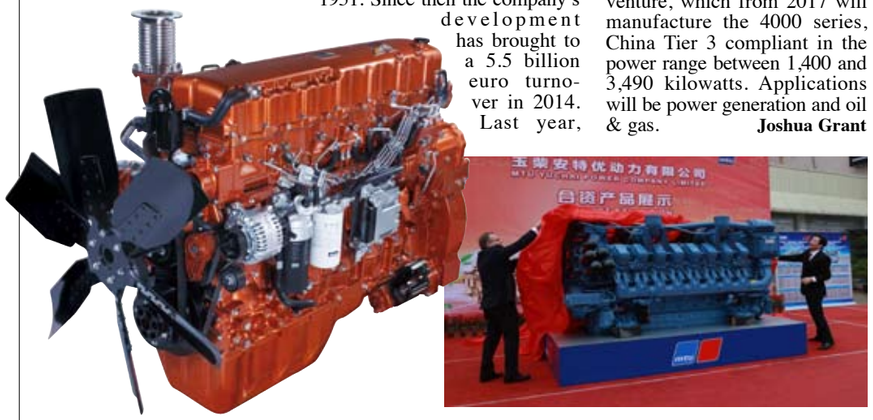
YUCHAI EUROPE

Feeling with Germany

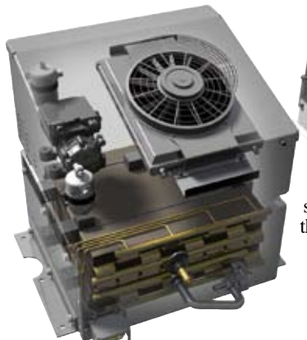
Yuchai Europe starts from Frankfurt to conquer Europe. The main applications in this first phase are stationary and Euro 6 ace in the hole. A joint venture with MTU will manufacture 4000 Series

Yuchai has landed in Frankfurt, laying the foundations of its European headquarters. The Chinese giant is among the best equipped manufacturers to meet the challenges of the saturated and demanding continental market thanks to a production potential of 700 thousand engines per year and the technical partnership with Bosch and AVL. Yuchai is not among the rising stars of Chinese market economy but is a strengthened institution: the foundation in Yulin, in the Guangxi region, dates back to 1951. Since then the company's development has brought to a 5.5 billion euro turnover in 2014. Last year, 364,567 engines were sold. Since 2011 they are ready for Euro 6, but the automotive fits among the 22 series which power output is between 24 and 1,650 kilowatts of power supplies, both with diesel and methane gas fuels. On the European market, besides the engines for applications such as sweepers, special machines, quarry and transport, Chinese can find space among motor pumps and generators, construction machines and service boats. Coming to stationary applications, the 4FA 3 liters, 60 kVA prime power, 6 K 12.1 liter, 350 and 400 kVA and 19.6 liter, 600 and 650 kVA in 50 Hz versions were displayed at Middle East Electricity in Dubai.
Also from Germany comes the news of the agreement with MTU for the creation of a joint venture, which from 2017 will manufacture the 4000 series, China Tier 3 compliant in the power range between 1,400 and 3,490 kilowatts. Applications will be power generation and oil & gas. **Joshua Grant**



WEBASTO AND THE BENEFITS OF CLOUD STORAGE

The ways to energy saving and endothermic stress reduction does not pass through combustion chamber only. This is the contribution of Webasto.
During breaks or rest periods, operators often keep the engine idling to power the cabin air conditioner. However, keeping the engine idling has a cost: even if the machine is not in working mode it burns fuel. The resulting costs are not only those of fuel but also include engine wear, which requires a more frequent maintenance. As for the cabin heating of construction equipment with the engine off, Webasto has already successfully consolidated on the market its Engine-Off heating technology. In cold regions, this system keeps the motor at the correct operating temperature, so as to ensure pleasantly warm temperatures in the cockpit. Cabins are often built with large glass surfaces, so they heat up quickly when the outside temperature is high. Therefore, operators keep the engine idling during breaks to cool the cabin. Given this situation, customers required a solution to be used in a flexible and efficient way for cooling their construction machines during downtime. If filling prolonged downtime with low electric power consumption is the top priority, Webasto uses the cold storage technology. This technology brings a coolant on graphite plates in the system storage core. These plates are filled with water and vacuum sealed. Cold is then taken away from graphite plates using a coolant and brought to the cockpit via a heat exchanger. This cold plate technology requires very little electricity, and batteries can be equally small. The Polar Cab Webasto introduced at Bauma provides all of these benefits. To fill little idle times, Webasto offers electric only solutions, which are tailored to specific machines according with the customer. **J.D.**



PERKINS DEO

Using a good quality oil is definitely good for the engine life span, and it also helps controlling emissions and reducing maintenance costs. That's because Perkins introduced a new diesel engine oil (DEO), specifically formulated to match the conditions in Perkins engines.

Sophisticated engine design and demands for reduced emissions means smaller working tolerances inside the engine, so the quality and performance of the oil becomes more important. With lower-quality engine oils, the levels and quality of additives can be significantly lower, dispersant levels may mean ash and deposits may not be kept in suspension, allowing them to stick to piston and rings causing cylinder wear, resulting in reduced performance, increased fuel consumption and potentially increased emissions. That's why Perkins chose for its DEO a formula based on three base oils that deliver the right viscosity across the working temperature ranges, and includes a combination of 12 additives, such as viscosity stabilisers to ensure a long and stable operating life, dispersants and detergents to prevent the build-up of sludge and ash, anti-wear agents and friction modifiers to ensure good lubrication and prevent wear.

PRAMAC AND GENERAC

The hands on the wordlmap

The acquisition of Pramac creates the third player of powergen. The two companies are highly complementary: Americans are leaders in North America, the Italian company is strong in EMEA

Similar names, almost the same age and complementarity both in amperage and markets: this is the premise that stimulated the American company Generac to acquire Pramac. Its technical-commercial area is that of power generation, where Generac waves the Stars and Stripes flag, with 2015 revenues of $ 1.3 billion, mostly in the NAFTA area, where the company is present since 1959, and 3,500 employees. The other protagonist of the transaction is Pramac, which was sold by the German company Prettl and the Campinoti family, who in 1966 established the construction company L'Europea and subsequently widened its focus on energy and material handling. In 2015, revenue was $ 170 million, 85 percent coming from export, 600 employees 200 of which in the parent company, in the idyllic Val D'Elsa panorama, in Tuscany: other factories are located in Spain, China and Brazil. The integration of the product range will expand the portfolio from diesel genset to light towers (in Italy Generac owns Tower light), gas gensets, welders, hand trolleys, electric pallet trucks and forklifts.
The engines also are complementary, since the two companies don't rely on a shared provider. Generac focuses on a duopoly: one is Japanese, with Kubota, Mitsubishi and Isuzu. The other is John Deere, which monopolizes the gensets above 55 kVA. Pramac relies on a number of suppliers: Weichai, Yanmar, Perkins, MTU for diesel air-cooled, Deutz for oil-cooled, Lombardini/Kohler for water-cooled. The gasoline mono are Honda. We'll see if the synergy which gave birth to the world's third largest group in power generation will change the balance.

Fabio Butturi

KOHLER AND 2.0 SERVICE

The importance of aftermarket

Kohler reorganizes the service and assigns the 'KDI Qualified' brand only to technicians who followed its training program. Updates are available both live and through iService multimedia platform

In the beginning were 1.9 and 2.5 liters. Then came the 3.4-liter. And twice the Diesel of the Year prize. Once reorganized the sales network and won the appreciation of oems, it's time for Kohler to reorganize the worldwide service network, which relies on the headquarters of Reggio Emilia, in Italy, the European subsidiaries in France, Spain, Germany and England, and the service departments in North America (where Kohler is based, Wisconsin), China and Asian Pacific, based in Shanghai, Latin America, in Mexico City. Training and information come from the heart of Kohler diesel division, in Reggio Emilia, which provides technical documentation, initial training and technical support to technicians all around the world.
Entering the 'KDI Qualified' service network requires a training course, which is dispensed both through traditional courses including technical and practice training that require assembly/disassembly and dynamic test, and through Distance Learning, included in iService multimedia platform. This area of the corporate website contains operating and maintenance manuals, workshop manuals, parts catalogs, guarantees, and above all the opportunity to take advantage of the 'Distance Learning' online training tool. The training makes use of 3D animations and is divided into seven sections: introduction, security, cleaning, maintenance, systems, functional groups and controls.

Ugo Righi

JCB AND BACKHOE LOADERS

Sometimes they come back ...

Backhoe loaders are living a second life. JCB has won a 43 4CX supply for Sardinia Region. Platinum is the name of the series of 70 backhoe loaders which celebrate the company's 70th anniversary

In football slang we should call a "twice" the one that JCB made with its backhoe loaders, one of the most penalized applications in those times of crisis, of which JCB is the global leader. The company scored its first goal in Cagliari, the capital of Sardinia, where last December 63 backhoe loaders landed for maintenance services, environmental protection and civil protection throughout the region. The supply regards the 4CX model, equipped with brushcutter arm, lift kits with heavy counterweight and additional hydraulic line. These machines are equipped with the 4.4-liter, 61 and 81 kilowatts Ecomax.

The second goal has a vintage taste and is called Platinum, the name of the limited series made for the 70th anniversary of JCB. This 70 units series replicates the four decades old 3C III model. The adjustments include the cabin, complete with air conditioning, heated seat and coffee maker, and the engine, in this case the 4.4-liter, 81 kW Ecomax.

Ugo Righi

HAULOTTE AND DIECI

Cisalpine Republic

The new Haulotte heavy duty range features two models manufactured by Dieci. The two machines are powered by FPT Industrial 4.5 cylinders engines, both Tier 4 Interim and Tier 3

The flag of the Cispadana Republic that became Italy's flag was flown for the first time In Reggio Emilia. That symbol came from the Italian-French pact, just as the one signed between Haulotte and Dieci, a company based in the province of Reggio Emilia. In the expansion program of Haulotte telehandlers range designed for heavy duty applications the Htl 6508 and Htl 7210 are made by Dieci. The loading capacities are respectively from 6.5 to 7.7 and from 7.2 to 9.5 tons, the engines are provided by FPT Industrial, both in 93 kW Tier 4 Interim version for European and North American markets and 93 kW Tier 3 version for South America, Asia-Pacific, Middle East and Russsia.

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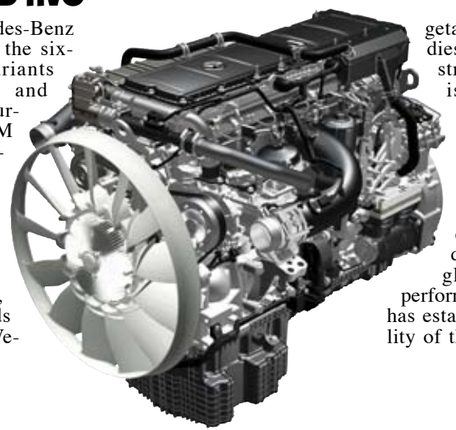
MERCEDES AND HVO



Last February Mercedes-Benz officially introduced the six-cylinder in-line variants OM 470, OM 471 and OM 936 and the four-cylinder Euro VI OM 934 using HVO alternative fuel. The innovative upgrade features all power settings available for those engines. HVO is a second-generation biodiesel fuel, whose acronym stands for "Hydrogenated Vegetable Oil". This 'green' diesel, produced on industrial scale since 2007, is completely sulfur free and no ashes are produced during the combustion process. This fuel can be used both pure as an alternative to conventional diesel fuel or as an additive to improve the global environmental performance. Mercedes-Benz has established the acceptability of the alternative fuel for its engines after a long series of tests. As HVO technical and performance characteristics are comparable to those of conventional diesel, no functional changes were needed for the engines. The injection process, the pipings and seals remain the same. The same also applies to oil change intervals and DPF cleaning. In addition, Mercedes-Benz stated that there will be no restriction in terms of guarantee confirming the proven reliability of the upgrade.

Volvo Penta from 2015 to 2016. Interview with Peter Karlsson

DESTINATION EARTH

Aiming for the heart of offroad for added growth. Among industrial engines, there's more than powergen. Historically strong in construction, especially in mining and material handling applications, Volvo has agriculture in its crosshairs. In 2014, they sent 8,500 engines into the European free market

At home at Agritechnica and Eima, as well as Intermat, Volvo Penta will soon paint one corner of the Bauma motorsport pavilion green.
Volvo Penta is changing direction, heading full sail towards new industrial beachheads. We spoke with Peter Karlsson, Director of Industrial power systems Sales and Marketing of the Gothenburg company.

Are you satisfied with your 2015 performance?

With only the European market numbers in my possession, we're talking about 8.500 motors for industrial applications. That's an improvement on 2014, both in installed power generators and regarding offroad.

What sectors performed best?

Power generation, certainly. Volvo is also well-equipped in material handling, such as forklifts and reach-stackers. Even in mining, despite the turmoil sweeping the sector, there was a slight increase compared to the previous year, particularly among the 13- and 16-liters.

What are the numbers for PowerGen and other applications?

The offroad sector took in a little over 3 thousand units, the rest is the reserve of powergen. Earthmoving is an important business area for Volvo, in crushers and other applications such as backhoes.
In agriculture, we have gained market share in the last two or three years, despite that not being our primary sector. At agricultural trade shows, where we are now a permanent presence, we have received encouraging feedback. Our 'SCR-only' technology is particularly welcome because without the dpf the casing is more adaptable and reduces temperatures.

What will the ratio industrial/marine be at the end of the decade?

Currently the ratio is 50 - 50. In our projections, industrial will overtake marine. Apparently, an inexorable trend. Just a few years back, marine was at 70 percent.

The hot topic is Stage V

Currently we do not feel obliged to say more about Stage V. We are collaborating closely with oems interested in a constructive dialogue. The status of the agreements is confidential. We certainly have internal technological resources, for example with Euro 6. Existing technologies are not the same as will be seen in 2019 and our engineers are methodically working on Stage V.

Volvo Bus has erased the word 'diesel' from urban buses. Will that happen in industrial?

Volvo Penta is working on hybrids together with colleagues in the Volvo Group. The focus is applications that have opportunities and infrastructure for growth, ones where you can recover energy during the work cycle or recharge batteries while running.

Can you transfer supercaps from buses and trains to wheel loaders, for example?

I can not comment on the intentions of Volvo CE, Volvo Buses and Volvo Trucks, I am referring to the prospects for Volvo Penta, which are designed outside the Group. Certainly vibration and noise reduction and inflating the torque curve are qualities we appreciate.

What will Volvo's technology strategies be?

In this case, I should let our engineers speak. Working on combustion chamber temperatures is important, as is post-treatment, we cannot focus on only one aspect or another.

Your major European market?

Concerning powergen, the most important markets are located in Southern Europe (Spain, Italy and France).
I want to emphasize that, as far as we are concerned, the entire European continent is experiencing a positive trend on the offroad front.

What are the best selling engines?

Redesigned in every respect, for consumption, torque, noise produced, the 5- and 8-liters are the most popular. For the price/quality ratio, the volume is in bigger sizes, like the 13.

Relations with Higher?

We are continuing the collaboration, but the 5- and 8-liters are assembled in Lyon, in the former Renault factory. The engine blocks for these unit are made in India, but the final assembly takes place in France. Even the 11-liters are assembled in France and the 13 and 16 in Sweden, at the plant in Skovde.

What are your thoughts on a hypothetical engine under 5 liters, possibly in cooperation with a compact manufacturer?

It would be strategic to propose engines in a competitive niche, offering a broad portfolio to our customers, but this option is not just around the corner. Everything is possible. For example, Volvo has started the production of a 13-liter genset in the Brazilian factory where they make truck engines; that allows us to be competitive on the local market.

Plans for gas-driven models?

Currently we only list diesel engines. However, we are researching different alternatives to diesel. In certain areas, we are selling a retrofit for dual-fuel power, a compression ignition and then conversion to gas. We are talking true diesel cycles: injectors starting cold, the electronics reads the fuel in the tank and manages the transition to gas. The average dosage is 70 percent gas and 30 percent diesel, depending on the work cycle.

At which fairs will we see the Volvo stand?

In 2016, in addition to Bauma we will be at Ifat, always in Monaco, at Cemat in Hannover, and we will repeat the experience at Eima. We are determined to carve out our role in agriculture.

Fabio Butturi

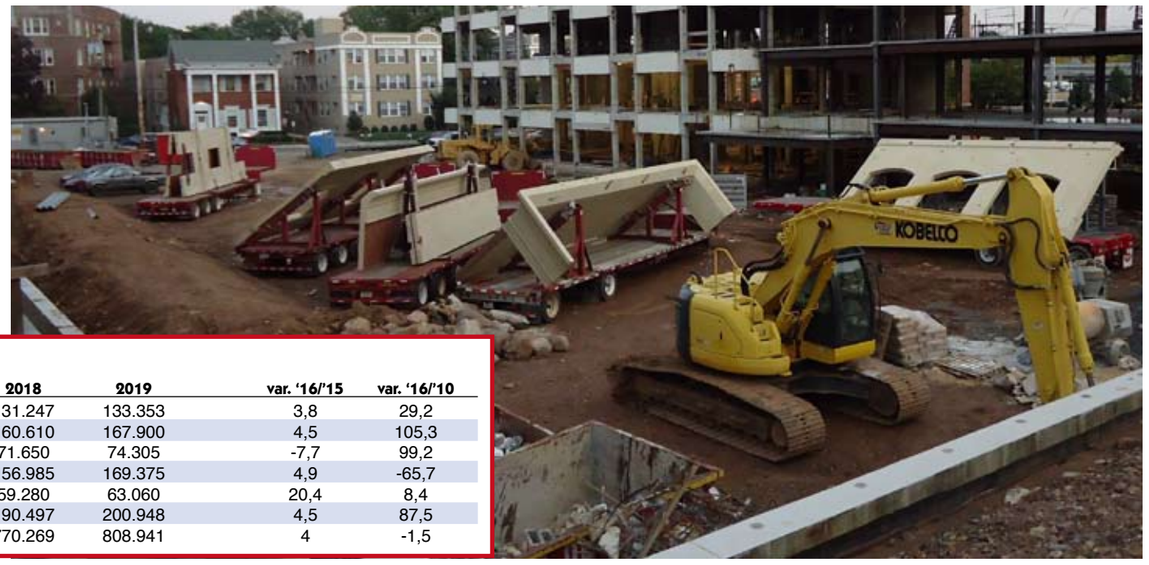
REVENGE OF THE MATURE MARKETS

By year's end, sales worldwide will reach 760,500 units. The overall market is in reasonably good health and recovering compared to 2015 with prospects for further development in the next three years. Positive Europe and North America, especially concerning the long-term, not bad in India. China remains in an abyss moving at one third the speed of 2010

Statistics, you know, are a nightmare. Numbers are difficult beasts to rein in, and even more often to collect, process, and compare... Speaking of construction machinery, the problem ratchets up another tenfold. We are, in fact, delving into the merits of an indistinct universe, inhabited by a huge range of products whose only common ground is their motors (no matter if they are a few kilowatts or close to megawatts of power) and the fact that we find them on construction sites. Full stop.

A kind of Babel

Otherwise, in any catalogue, we are confronted with asphalt pavers, graders, shovelers (wheeled or crawlers, that is), rollers, vibrating plates, excavators (mini, midi, maxi), compressors, backhoes, drills, aerial platforms, pneumatic hammers ... but also dump trucks, crawler dozers, cranes or telescopic lifts.
This list - from which some things are certainly missing - is not an end in itself; it is indeed essential for the reflections that follow. What are we talking about, then, when we speak of construction machinery? Or rather, what are we counting when we begin to count construction machinery?
Particularly, when making comparisons on an international scale - for example between the US market and the European one - this is a critical step, because you risk judging two entirely different shopping carts and then arriving at misleading conclusions. Some markets, for example, snub certain product categories considered minor (e.g. a vibrating plate), even while being counted in many other parts of the planet. Or there are statistical surveys that count four-wheeled vehicles as products. Since they physically enter construction sites or work on the building infrastructures, they are 'by definition' construction machinery. The same criterion is not however adopted in other areas. And so on...
Armed with these precautions, we will try going deeper into the numbers that, officially, describe the features of the market worldwide. The benchmark that we have chosen is the Off-Highway Research, a consultancy specializing in market analysis and, in particular, in their forecasting study released in late January (other upgrades are planned around Bauma). First the numbers and then some observations.



GLOBAL MARKET

The global market for construction machinery (number units)

	2010	2012	2014	2015	2016	2017	2018	2019	var. '16/'15	var. '16/'10
Europe	100.993	118.899	124.783	125.705	130.503	132.668	131.247	133.353	3,8	29,2
North America	90.600	146.830	171.310	177.935	186.025	175.610	160.610	167.900	4,5	105,3
Japan	37.060	64.860	84.225	79.998	73.825	71.620	71.650	74.305	-7,7	99,2
China	401.480	290.205	209.757	131.345	137.820	147.430	156.985	169.375	4,9	-65,7
India	42.811	50.795	36.808	38.554	46.414	54.175	59.280	63.060	20,4	8,4
Rest of the world	99.175	247.745	191.034	177.973	185.921	189.365	190.497	200.948	4,5	87,5
Total	772.119	919.334	817.917	731.510	760.508	770.868	770.269	808.941	4	-1,5

731,000 units worldwide

Last year, the world absorbed 731,000 units (this is an estimated value and therefore still subject to correction), while 2016 is expected to close on the threshold of 761,000 units. We are far from the peak of 2012 (919 thousand machines worldwide) but still, the moderate growth detected should lead nearer to 810 thousand units by 2019. The recovery underway (between 2016 and

AREA BY AREA

Construction Machinery: the specific weight of the various areas of the planet (% Values)

	2010	2012	2014	2015	2016	2017	2018	2019	differenza 2016-2015	differenza 2016-2010
Europe	13	13	15	17	17	17	17	16	0,0	4,1
North America	12	16	21	24	24	23	21	21	-1,5	12,7
Japan	5	7	10	11	10	9	9	9	-1,6	4,9
China	52	32	26	18	18	19	20	21	1,2	-33,9
India	6	6	5	5	6	7	8	8	1,8	0,6
Rest of the world	13	27	23	24	24	25	25	25	0,2	11,6
Total	100	100	100	100	100	100	100	100	0,0	0

2015) is none too fancy - 4 percentage points and 30,000 units in absolute terms - but it is nevertheless significant enough to be considered a recovery.

From dumper to cranes

The authors of the same study indicate the types of machines considered in this scenario: articulated dump trucks, asphalt pavers, backhoe loaders, crawler tractors, crawler excavators, crawler loaders, excavators, motor graders, rigid dump trucks, fork lift trucks (SUVs and telescopic handlers), skid steer loaders, excavators and wheel loaders, compacting machines with men on board and mobile cranes (but only for certain markets).

Going into more detail in the various geographical macro-areas, the positive surges and abrupt drops sometimes seem unbelieveable.

Take, for example, the Chinese market. From sales of 400,000 units in 2010, things sank to 131,000 in 2015. Basically, the volume sold in an entire year was the same volume of production as one 4-month period in its heyday! China is now trying to get back on top, but the trend is moving at a snail's pace, at least by the standards of the Great Wall. For the current year, the market is expecting sales of 138,000 units which, only in 2019, should climb to 170,000 units.

A definitively more dynamic North America has been able to double its sales in the 2010-2016 period and even the short term (2016 vs 2015) shows solid development. The inevitable contraction in the coming years should not be interpreted as the beginning of a major recession, but as a natural pause.

Positive results also in Europe. The considerations for the US are also valid for the Old Continent - and perhaps somewhat lighter. The last six years have been accompanied by a strong increase in sales (from 101 thousand to 131 thousand units, an increase of 29 per cent). There still seems to be a bit of fuel in the tank and, for the period 2016-2019, experts still forecast a rise in the numbers. But hopes for substantial spurts upward seem unfounded.

India's enthusiasm is back!

India's vitality is no surprise since it returned to producing important results starting in 2014. Take particular note of the expected increase in sales between 2015 and 2016 (from 38,500 to 46,400 units, plus 20 percent) and the average sales

of 63,000 machines / year predicted for 2019.

A different story in Japan. The barometer indicates 'bad weather' as it detects a fall in orders of 8 percentage points between 2015 and 2016 and a stabilization of sales at an altitude of around 74,000 units in the medium term (2019).

The earthquake effects

Remember, however, that in 2011 the country of the Rising Sun was shaken by a massive earthquake and the resulting tsunami. The sales data of the following years was then reshaped, so to speak, by the reconstruction policies and by economic stimulus programs launched by local governments; by definition a one-off.

Based on this data, it is also interesting to see how drastically the specific weight of the different macro-areas of the planet has changed over the years. In terms of sales (number of pieces) China was worth 52 percent of the global pie in 2010 compared with 13 percent in Europe and 12 percent of the US. Today the figures are, respectively, 18 percent, 17 percent and 24 percent. Consequently, the States have overtaken China in sensational fashion and Europe is nearly tied with China. Hail the revenge of the mature markets over the new economies!

At this point, let's go into greater detail, dividing sales based on three of the main macro-areas on the planet. Always according to the projections of Off-Highway Research, in China the reference product seems to be excavators, which as a whole - also including mini versions - cover 44 percent of the market in terms of numbers. Next, loaders (38 percent), mobile cranes and compacting machines. The rest are crumbs. In India the major attractions for customers seem to shift in the direction of loaders (48 percent of sales) and excavators (25 percent). With significant roles for cranes and mobile air compressors. The European market seems to be fertile ground for excavators (altogether they took 60 percent of sales), with a balanced distribution between minis and regulars unlike in other areas. Loaders were at 20 percent and telehandlers at 17.

Doubts about data

In a closer read, some doubts (many actually...) concerning the data inevitably emerge, taking us back to the initial considerations of this article. Indeed, it is highly unlikely that the market for mini excavators is limited to less than

MACHINERY

Construction Machinery: Market share by product type (% values)

	China	India	Europe
Road pavers	1,0	1,2	0,7
Loaders	38,1	48,3	19,6
Compacting machinery	6,0	4,6	0
Crawler dozers	2,4	0,9	0,7
Excavators	29,7	23,8	23,3
Mini excavators	14,0	1,1	36,4
Mobile air compressors	-	7,3	-
Mobile cranes	6,4	9,3	-
Telehandlers	-	-	17,1
Others	2,4	3,5	2,2
Total	100	100	100

700 units in India and instead rises to about 22,000 units in China and 48,000 in Europe. Probably in the three regions they used different detection parameters; otherwise, the imbalance is inexplicable. Similarly it is not possible that telehandlers are only sold in Europe, where they have a remarkable market penetration of about 22,000 units per year.

Compacting machinery

On the other hand, compacting machines appear to have a market of zero (0) in Europe. Also weighing on Europe are the missing mobile cranes, which can not really be considered a niche product (8,000 pieces / year in China and 3,500 in India).
No complaints or censuring of the valuable work by Off-Highway Research, heaven forbid. Only a further confirmation of how difficult it is to work with the numbers in this sector, and how certain direct comparisons should always be interpreted as a general indication and not as an absolute truth.

Prometeia-Samoter

Meanwhile Prometeia Samoter published some data from their research; under the umbrella term 'construction machinery' they include earthmoving equipment and vehicles, road vehicles and equipment for concrete, the preparation of aggregates, drilling, as well as, cranes. Well, just for one item 'earthmoving equipment' this survey evaluates the worldwide market for 2015 at 665,000 units and for the year 2017 at 885,000. Compared to Off-Highway Research's numbers, this suggests a considerably more dynamic growth rate (+33 per cent in just three years) and floats an additional 100,000 pieces both in the 2015 figures and regarding the estimates for next year (a decline in one case, growth in the other). Remember the cherries and melons?

The trend of industry

At the end of the day, the important thing is to understand that the industry is enjoying reasonably good health and still wants, and has room, to grow without the need to depend on China as the only global economic locomotive. Indeed, the strength of Europe should be emphasized once again. It is not happening in many industries, so let's hold on tightly to the few exceptions.

David Pierce

Bauma 2016 news: under 56 kW and Stage V

LOW ENTRY REVOLUTION

There are two guidelines for engine manufacturers: Stage V and the bottom of the catalogue. Deutz has the 2.2-liter, a 3-cylinder version of the Tcd 2.9: both available for LPG. Hatz brings the 3-cylinder H-series which won the performance spec challenge. And with its 4TNV94Fht, even Yanmar debuts in Tier 4 Final above 56kW

Early releases penned by the press offices suggest that the focus is on power under 56 kW, as well as on the Stage V boom triggered at Intermat this time last year. For a week, the beating heart of Bavaria becomes the capital of industrial engines. No other event indicates as precisely just which solutions manufacturers are gravitating around. If the 2013 edition was held on the eve of the Tier 4 Final/Stage IV, the current one is the springboard of the heralded Stage V (European legislation will go into effect during Bauma 2019) and, as anticipated, the excitement is concentrated in the aggressive strategy, which will not escape the law's powerful scissors. A triad of builders are leading the sprint (insights in the box at the bottom of the page).

Hatz has finally given birth to the 1.5-liter 3-cylinder, known as 3H50TIC. With the same capacity as a 4-cylinder, ditto the common rail and, looking ahead to 2019, external EGR and DOC.

Remaining in Germany, shifting from the Austrian border closer too Belgium, **Deutz** unveils two novelties: the first, the 2.2-liter, that 'extracts' a cylinder from the TCD 2.9 and compares well with the three-cylinders in the 2 to 2.5-liter range. The second concerns LPG fueling in the 750 cc cylinder capacity grouped in both 3 or 4 cylinders.

Yanmar completes its transition to Tier 4 Final in the TNV series. Three 'new' tickets: the 3Tnv86Cht (comparisons on these pages show the 3Tnv-86Ct), the 4Tnv86Cht and 4Tnv94Fht, in three settings, all over 56 kW.

Given the 3-cylinder at Hanover, the **Perkins** 400 series, fully-converted to common rail, is also present on Bauma's stage, keeping in theme with low power. Until now, the English have glided around Stage V, which they will re-launch investing under the hoods of vehicles below 100 kW capacity. Currently, collaboration with FPT Industrial continues on the 854 series as does the sterling moment of power generation in the 400, 1100 and 4000 series.

What else can we expect from the festival in Munich?

Everything revolves around Stage V, in legislative terms immature, but with clearly-outlined guidelines, now metabolized in manufacturer's playbooks.

Man is not just celebrating its Diesel of the Year (story below), but is customizing its motor divisions based on usages. The Bavarians are not just showcasing the D38, but are doubling down on the D28 seen at Agritechnica, positioning themselves for the entire market of earth-moving, construction and road work vehicles. The entire gamma presented in Hanover, from 588 to 816 kilowatts, has been confirmed. In the middle, 650 and 750 kW variations are available for 12-cylinder engines covering 1600-bar common rail pressure (for other applications, reaching 2500-bar), including one waste gate per bank and relying on the Tier 4 Final scr with an eye on Stage V. A challenge considering the dominant 'ideology' sees the dpf as inevitable, but do not forget the same was said at the time for recirculation, after Yanmar grafted egr on the IIIA and dpf for the IIIB.

MTU is not focusing solely on mobile applications, directing operators' attention to major power generators for construction sites, as shown in the 20-foot container, corresponding to 6.1 meters, delivering 1,250 kVA of prime power in the 2000 series. In terms of vehicles, MTU exhibits two 6-cylinder units, for ranges currently covered in the EU, i.e. up to 560 kW: the 7.7-liter 1000 series and 15.6 1500 series. Covering power ranges above the current threshold, there are a pair of 12-cylinders, the 1600 and 2000 series.

The **FPT Industrial** strategies are clear: Do not change the overall dimensions, integrate the DPF and SCR with the same coating and use passive regeneration. As Turin claims, this was accomplished during the transition from Tier 4 Interim to Tier 4 Final, concentrating the functions of the two units into one central electronic control. The software benefits from the synergy between Bosch and the FPT Research Center.

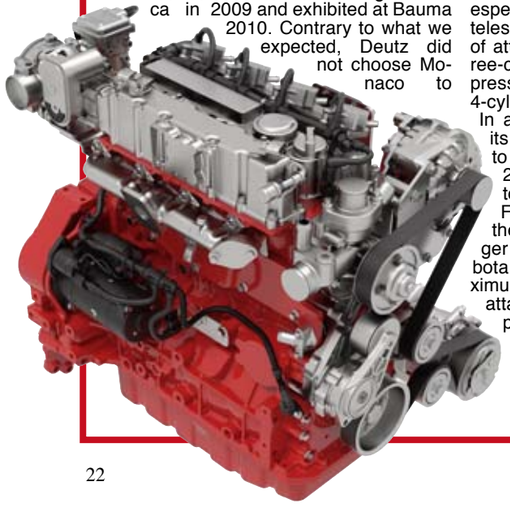
Egr? No thanks. In the future, just the F34 will continue. Always vivid on the horizon is natural gas, an ongoing reciprocal collaboration both on the road, for example, with Iveco, the Nef 6-cylinder for Eurocargo and the imminent evolution of the Cursor 8, as well as for off road applications. Here an example is the T6.175, New Holland's CNG (methane) tractor, which is only the beginning.

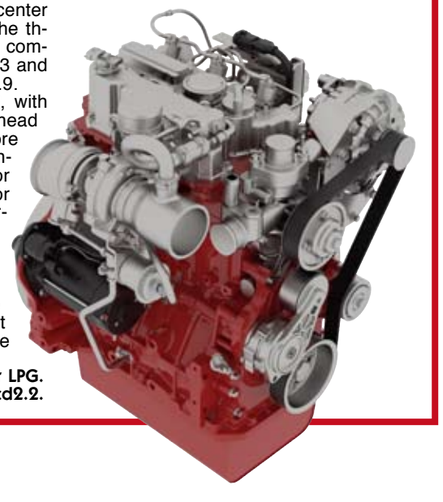
Kohler is persisting with the work undertaken at Intermat: in this case, the magic formula is that of the all-in-one, which marked a high road that many

DEUTZ TCD2.2 AND LPG SERIES

The catalogue from the banks of the Rhine continues the complete overhaul that started with the full line for Tier 4 Final announced in Intermat and Agritechnica in 2009 and exhibited at Bauma 2010. Contrary to what we expected, Deutz did not choose Monaco to spotlight the updates in the range above 4-liters, where in a short time however we will see some surprises, focusing instead on areas where it is already dominant, especially in some applications, such as telescopics. The 2.9-liter is still the center of attention, in a dual capacity: in the three-cylinder 2.2-liter model and with compressed LPG, already available for 3 and 4-cylinders, called Tcd2. 2 and Tcd2.9.

In a teeming markeplace, the 2.2, with its similar cubic capacity will go head to head with the Doosan Infracore 2.3, the 2.2 produced in the Cento (Italy) plant both in versions for FPT Industrial and VM Motori, for the 2.2-liter Perkins, and a bit larger for the 2.5-liter Kohler and Kubota's 2.6-liter. With 55 kW of maximum power it joins a coordinated attack on the 2.9, with a surge in power density. The curves of the LPG versions, a solution that Kubota has relaunched over the last two years, follow profiles that correspond with those of early diesels, an enormous challenge for alternative fuels: up to 45 kW for the 2.2 and 55 kW for the 2.9.





On the left side, the 2.9-liter LPG. On the right side, the Tcd2.2.

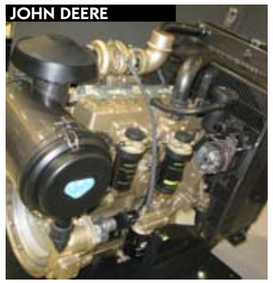
HATZ 3H50

Since the launch of the 4-cylinder H-series, Ruhstorf has set itself the objective of completing its low entry level. After the 4H50Tic update in two diametrically-opposed versions, one with a particulate filter designed to meet Swiss standards and the other stripped of all devices for non-compliant markets, a 3-cylinder named 3H50Tic has arrived. The engine capacity of 1.5 liters is the modular offspring of the 500 cc (AxC 84x88 mm) installed with a 1,800-bar common rail delivering three injections per cycle, similar to that of the 4-cylinder. The performances are commendable and allow Hatz to snag Kohler atop the grid of this comparison, even if it concedes something in terms of absolute torque (there is, however, a difference of 24 percent in cubic volume between the two).

Conceived primarily for North America and some Asian markets, the 3H50Tic adopts the same formula which launched the 4-cylinder: an HJS catalyst with external recirculation supplied by Wahler equipped with a mixer that regulates the temperature and allows a greater flow of gas to be 'deviated' to the combustion chamber.

The Hatz stand will also put two generators on display: the HEA-27TDCW5, equipped with 4H50TI, the stripped version of DOC and EGR to meet IIIA standards, with 27 kVA at 50 Hz, and the Haa-25Hdcw, 25 kW hydraulics generated from 4H50 Tic, IIIB compliant.

On the left side, the 3H50TICD. Below, the genset HAA-25HDCW



are following. For the company of Reggio Emilia this is a moment to take stock: it was towards the end of the 2007 edition that Kohler officially opened to the world, the KDI platform has been completed (as of now) and the results are coming in (to cite two names, Arbos in agricultural and JCB in construction).

Cummins will pull aces from its sleeve thanks to Cummins emission solutions. Spotlights shine on the Stage V that, according to Columbus, will bring an increase of 10 per cent to the torque, in the range between 55 and 300 kW.

Speaking of 'all in one', **Liebherr** has developed the Scrfilter module, capable of chemically acting on both NOx and Pm. Bauma is an occasion to arouse interest even in Liduro, the energy storage system for hybrid vehicles. To synthesize: based on double-layer capacitors, it furnishes and acquires energy in 15 seconds.

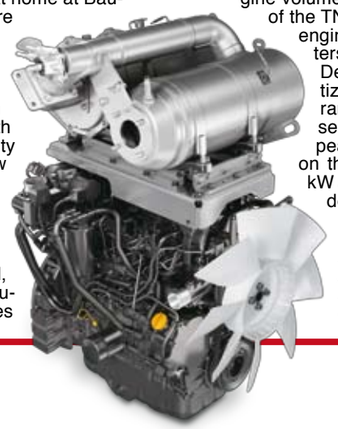
John Deere changes gears on all construction fronts. Tier 4 Final in place for some time, Bauma may offer buyers fixed gensets from 31 to 563 kilowatts. Among the applications for installed motors, John Deere is massively present in several niches including drill rigs, floating pumps, crushers and dust collectors.

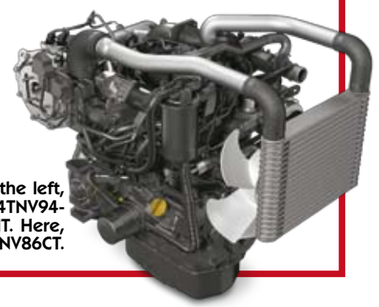
Representing Scandinavia, **Volvo Penta** is bringing industrial users competencies previously consolidated in heavy automotives and marine applications.

Little is known about what is happening to the Far East. There are no Chinese in sight, despite Yuchai's recent landing in Frankfurt. **Kubota** reaps consensus with its 07 and V3 series and will be present with its German dealer. No sound from **Isuzu**, active in recent European shows, same goes for **Doosan Infracore**. Isuzu could present some applications (e.g., 4LE2X Tier 4 Final on the Case midi excavator Cx80C). Doosan will certainly be present with the Portable Power division.

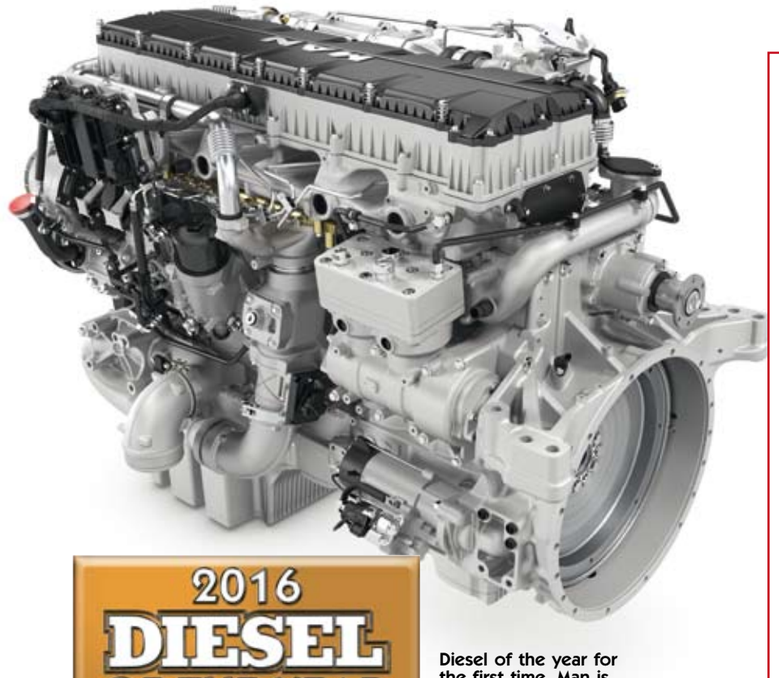
YANMAR TIER 4 FINAL

Subdued in Tier 4 Final, nearly invisible in the range above 56 kW, the Japanese place their bets on two fronts: on the one hand, in the very low entry category which is completely at home at Bauma and where the Tier III-certified TNV series has met triumphant approval; on the other, with engine capacity in three new products, getting a foot into the compact sector, where the scene is crowded and, in terms of volume, the stakes very high. The restoration, which completes the design for Tier 4 Final (approved for use in Europe and Switzerland, Stage IIIB and Foen), raised the stakes, and engine volume, on three high-end members of the TNV family. The newly-released engines are the 1.6, 2.2 and 3.1-liters, equipped with Bosch and Denso common rail and baptized 3Tnv86Cht (so far in this range Yanmar has been represented by 3Tnv86Ct, which appears among the comparisons on these pages), capable of 33.3 kW at 2,600 rpm, and two 4-cylinders, the 4Tnv86Cht from 48.5 kW to 2,600 and 4Tnv94Fht, in three settings: 69.8 kW at 2,000 rpm, 77.2 kW at 2,200 , 88.4 kW at 2,500. For the 2.2-liter, the same reasoning as the Deutz Tcd2.2 applies: too many players between 2 and 2.5 liters, a range that usually extends up to 3 liters. Also important is the segment between 3 and 4 liters, where the Japanese 3.1 directly challenges competitors without exasperating the curves and torque rise, as taught in the Eastern school, in favor of resistance to stress and wear and tear.





On the left, 4TNV94-FHT. Here, 3TNV86CT.



2016 DIESEL OF THE YEAR

Diesel of the year for the first time, Man is the cradle of diesel engine. The 15.2 liter is the apotheosis of the Man full line.

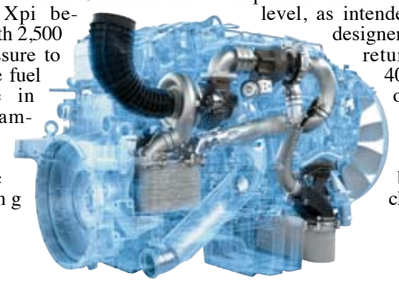
Brand	MAN
Model	D3876 LE12
I. D.	
B x S mm - S/B	138 x 170 - 1,23
N. cil. - dm³	6 - 15,25
Maximum power kW - rpm	485 - 1.800
Mep at max power bar	21,6
Piston speed m/s	10,2
Maximum torque Nm - rpm	3.000 - 1.050
Mep at max torque bar	25,2
% power at max torque (kW)	51,8
Torque at max power Nm	2.577
% power at max torque (kW)	68,1 (330)
Work range rpm	750
DETAILS	
Specific power kW/dm³	31,8
Specific torque Nm/dm³	196,6
Areal spec. power kW/dm²	54,07
RULES AND BALANCE	
Dry weight kg	1.337
L x W x H mm	1.462x940x1.170
Volume m³	1,61
Weight/power kg/kW	2,8
Weight/displacement kg/dm³	87,6
Power density kW/m³	301,2
Total density t/m³	0,83
Displacement/volume dm³/m³	9,48
SPECIFICATION	
Emission level	Tier 4 Final/Stage IV
Injection system	common rail 2,500
Air intake - Techno	Vtg Scr Egr

Man D3876: Diesel of the year 2016

TECHNOLOGICAL FLEXIBILITY

Designed for the TGX, the German manufacturer's trucks, the 15.2-liter won the most coveted prize among industrial engines. The reasons are mainly in Man's ability to adapt sophisticated technological solutions to specific applications

From trucks to industrials: Man's internal supply chain meant the D3876 LE12 took away the Diesel of the Year. Man displayed its entire innovation abilities on this project, which is distinguished through its flexible release and turbocharging strategies and the engineering approach to injections. The 6-cylinder 15.2-liter should be seen in the context of endothermic customization based on specific applications. 2014 was the turning point under the hood for the TGX, with Man planning a six-cylinder at the top of the range, in the range of 15 to 16 liters, and that approach should not be underestimated. Two main technological solutions distinguish the D38: the first is the third-generation common rail that leaves the Cummins and Scania Xpi behind, with 2,500 bar pressure to optimize fuel mixture in the chamber. The second strategic turning point concerns the double-egr. A delicate matter, that of recirculation, which poses problems in the area of thermal management (and consumption) and wear and tear on rings and other piston components. The double cooling level, as intended by the designers, should return up to 40 percent of the exhaust gas to the combustion chamber.



Let's have a look at the industrialist's details. A fully in-house platform, unveiled in a version for the farming community at Agritechnica, that sets itself apart from its trucking origins with the adoption of VTG instead of a two-stage and by using a single EGR recirculation. The variable turbine geometry is an advanced solution for the machine operators sector and, as with recirculation, to repropose the two-stage adopted on trucking thrusters would make the work of the air filtration system more difficult. In the work environment, the air is dusty and torque rise is not an issue, especially when the maximum torque is more than enough at 3,000 Nm, as in the case of the D38 offroad. For emissions, which are candidates for Stage V without any further elaborations, the egr accompanies the SCR: a hot solution, then, that favors the preventive containment of soot within legal limits and delegates the reduction of NOx exhaust to upstream and downstream devices.

With 485 kW at 1,800 rpm and 3,000 Nm between 1,050 and 1,450 rpm, the choice is clear: keep stress low without penalizing torque and calibrate the right electronics recipe to the specific application.

Industrial 3-cylinders between 1.5 and 2 liters

COMMON CHOICE

Common rail is taking over even under the two-liter threshold and is chosen by all the players in the comparison. The Hatz 3-cylinders, who have won the challenge for specific performances, has come after the Perkins 3-cylinders introduced at Agritechnica in november. Kohler has the best torque peak

The time of Hatz 3H50TIC has come, changing the balance in this range and matching Kohler power at 42 kilowatt. Ultra-compact and technologically advanced, the half liter cylinder by Hatz have found its natural expression in 3-cylinders engines, that wins the Diesel Index. The more rewarding aspect for Ruhstorf engineering is that of specific curves: 28.6 kW and 126.4 Nm place this engine on top. The best for absolute performances is still the smallest Diesel of the Year 2012, the vanguard of Kdi series, with the same 42 kW of Hatz but 40 Nm more. However we need to clarify the power range choice, measured with a gauge that takes into account only the 3-cylinder strictly for displacement reasons in the ever changing ground of under 2 liters displacement. Industrial applications in this range vary significantly in a no man's land haunted by extremely variable units, ranging from large single-cylinder (for example, on vibrating plates and minidumpers) to ultra-compact 4-cylinders (on rollers or small aerial platforms). And then there are the odds, being rediscovered also in important displacements, which have never depreciated in these latitudes (see riding mowers, low entry isodiametric and groups) and then became great. Perkins extended the use of common rail to the whole 400 series, so even on the 3-cylinders seen at Agritechnica. Electronics thus invaded the low power range, although a consideration is necessary. The near future will put under the spotlight the 19-56 kW range , restricted by Stage V regulations. There are dual positions in several catalogues meant as cohabitation of electronic and mechanical units, which will still require the installation of after-treatment systems though elementary, as the Doc, and will reduce the price gap compared to higher powers. To get things clear, the whole 400 Series is segmented into a cross-over between chips and residues of in-line pumps; Yanmar already took a step towards Stage V, while using both aspirated and turbo for Tier4 F, and the trend is not leaving room for mechanicals; Reggio hosts both the above cited cylinder and its 'rotary' twin, which stops at 31 kW; Kubota also has one of its strong points in 'basic' 1803, that is worth 28 kW but will however have to deal in 2019 with a very reduced price gap compared to 'our' D1803Ct.

All the protagonists

Let's go back to the comparison protagonists. Perkins updated the 400 series equipment, covering the common rail also in 3-cylinder conjugation (see p. 31). Substantially aligned with the Yanmar unit, having the lower displacement of the lot, it shows lower weight and size. Yanmar, for its part, features in this range two almost symmetrical units with rail and Egr, a solution mastered by the Japanese much earlier than their competitors: this unit shows two millimeters in bore and a blower pushing the power. Should the market require it, mep may allow Yanmar to extract more kilowatts. Kubota does not show any peak but stays in the reliability perimeter, taking down engine speed and making the usable range elastic. Doosan Infracore pushes on specific curves, which put it behind the winner of this challenge, the Kdi, in terms of absolute performances. The specific curves and Diesel Index are matter for Hatz. Kohler flexed its muscles and placed its smaller engine excluding mono - on specialized and multifunction mini. While its power is the same of Hatz and pretty close to Doosan and Kubota, torque wins by far with 24 - 50 percent gap.

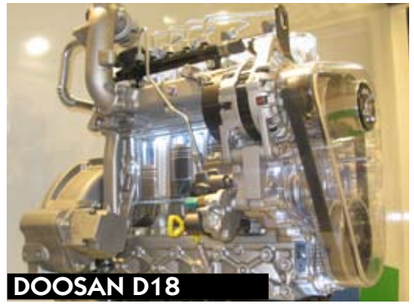

HATZ3H50TIC


PERKINS 403F


KOHLER KDI 1903TCR

From left to right: the 4-cylinder by Hatz, 4H50Tic, Perkins 403F-E17, Kohler Kdi 1903TCr, Yanmar 3Tnv86Ct, Doosan Infracore D18, Kubota D1803Cr-T-E4.


YANMAR 3TNV86CT


DOOSAN D18


KUBOTA D1803CR

ALL IN 12 KILOWATTS

Brand Model	DOOSAN INFRACORE D18	HATZ 3H50TIC	KOHLER KDI 1903T CR	KUBOTA D1803CR-T-E4	PERKINS 403F-E17T (4)	YANMAR 3TNV86CT
I. D.						
B x S mm - S/B	90 x 94 - 1,04	84 x 88 - 1,05	88 x 102 - 1,16	87 x 102 - 1,18	84 x 90 - 1,07	86 x 90 - 1,05
N. cil. - dm³	3 - 1,79	3 - 1,46	3 - 1,86	3 - 1,82	3 - 1,49	3 - 1,56
Maximum power kW - rpm	37 - 2.800	**42** - 2.800	**42** - 2.600	37 - 2.700	30 - 2.800	32,4 - 3.000
Mep at max power bar	9	12,5	10,6	9,2	8,8	**8,4**
Piston speed m/s	8,8	**8,2**	8,8	9,2	8,4	9
Maximum torque Nm - rpm	165 - 1.600	185 - 1.600	**225** - 1.500	150 - 1.600	125 - 1.800	125 - 1.900
Mep at max torque bar	11,8	16,2	15,5	10,5	10,7	**10,2**
% power at max torque (kW)	34,9	34,1	**43,8**	30,8	31,7	28,5
Torque at max power Nm	127	147	**157**	127	98	108
% power at max torque (kW)	74,8 (28)	73,90 (31)	84,40 (**35**)	68 (25)	78,60 (24)	76,80 (25)
Work range rpm	**1.200**	**1.200**	1.100	1.100	1.000	1.100
DETAILS						
Specific power kW/dm³	20,4	**28,6**	22,5	20,1	20	20,6
Specific torque Nm/dm³	91,9	**126,4**	121,1	82,1	83,5	79,7
Areal spec. power kW/dm²	19,37	**25,30**	23,08	20,79	18,07	18,62
Dry weight kg	163	133	233	196	149	175
L x W x H mm	573x536x673	576x541x603	598x521x716	744x573x735	514x422x643	781x536x762
Volume m³	0,21	0,19	0,22	0,31	**0,14**	0,32
Weight/power kg/kW	4,4	**3,2**	5,5	5,3	5	5,4
Weight/displacement kg/dm³	**90,9**	**90,9**	125,2	107,3	99,6	111,6
Power density kW/m³	176,2	**221,1**	190,9	119,4	214,3	101,3
Total density t/m³	0,78	0,70	1,06	0,63	1,06	0,55
Displacement/volume dm³/m³	8,54	7,70	8,46	5,89	**10,69**	4,90
SPECIFICATION						
Emission level						
Injection system	common rail	common rail	common rail	common rail	pompa in linea	common rail
Techno	waste gate Egr Doc	wg Egr Doc	wg Egr Doc	wg Doc Dpf	wg Egr Doc	wg Doc Dpf
INDEX						
Torque	13,7	**14,1**	13,1	12,5	11,7	12,6
Performance	4	4,9	4,8	3,9	3,8	3,8
Stress	6,9	8,1	8,1	6,6	6,4	**6,4**
Lightness	10,4	10	13,5	11,8	11,7	12,9
Density	24,8	**37**	30,7	15,2	33,4	14,1
DIESEL INDEX	6,5	7,5	6,6	6,1	6,2	6,1

PSA&VW 4-CYLINDER

Although performances are out of reach for the units of this comparison, there are however a couple of powerful engines that show dimensions and volumes suitable for compact machines needing kilowatts and torque.

PEUGEOT. Compared to the German twins, displacement changes. The French shows a specific power that has nothing to envy to others: the 1.5-liter, 4-cylinders delivers 23.9 kW/dm³, which is in line with Hatz 4H50Tic

and VW, but featuring ultra-slim dimensions. VWPS. Feels the pinch of Dieselgate in terms of image, but no one can complain about performance, equal to Hatz. Sweepers are its killing application.

On the left Psa Dv6Nr.- On the right side VWPs Tdi 2.0.

Six-cylinder engines with two liters cylinder swept volume

ROOTS ON THE ROAD

13 liters engines for industrial applications often derive from original truck engines, the winner is Cursor 13 that shows over the top performances followed by Cummins, thanks to its outstanding compactness and lightness

After the fireworks that accompanied the Stage IIIB/Tier 4 Interim regulations, the 12 to 13 liters range has not experienced major changes, firmly standing on 400 kilowatt threshold apart from the Cursor 13, leading the segment with its 500 kilowatt. Coming to Tier 4 Final, Cummins sent a clear message retiring the QSX 11.9 replaced by the Qsm, that has shorter stroke and larger bore than the predecessor, renamed Qsg for agriculture. For the sake of accuracy we should not forget **Man**, that introduced at Agritechnica 2013 an agricultural adaptation of its D26, testifying the conversion of the 6-cylinder towards versatility. The taste for flexibility showed by Man units, usually designed for heavy duty machines then adapted to industrial applications, is confirmed by the construction character given to D28 and D38 by Man. The compliance strategy of the Bavarian units pursues a compromise between electronic control unit settings, crank drive and power supply, and the need for simplification and sturdiness expressed by off-road applications such as farming and construction. The need for versatility was interpreted in Nuremberg by adapting the electronic system, which works at 12 or 24 Volt and a 24 Volt alternator, using aluminum-forged cylinder cover, inserting a third Pto on the flywheel and using a control unit to monitor all parameters.

IS IT A LUCKY 13?

Brand Brand - Model	CATERPILLAR Caterpillar C13	CUMMINS QSG12	DEUTZ TCD 12.0 V6	FPT INDUSTRIAL C13 2ST T	JOHN DEERE PSS13.5L (7)	LIEBHERR D946 A7-04	MAN D2676 LE131	MTU 6R 1300	SCANIA DC13 070A	VOLVO TAD1375VE
I. D.										
B x S mm - S/B	130 x 157 - 1,21	134 x 142 - 1.06	132 x 145 - 1.10	135 x 150 - 1.11	132 x 165 - 1.25	130 x 150 - 1.15	126 x 166 - 1.32	132 x 156 - 1.18	130 x 160 - 1.23	131 x 158 - 1.21
N. cil. - dm3	6 - 12.5.	6 - 12.01	6 - 11.90	6 - 12.88	6 - 13.54	6 - 11,94	6 - 12,41	6 - 12,80	6 - 12,74	6 - 12.77
Maximum power kW - rpm	388 - 2,100	382 - 2,100	390 - 2,100	**500** - 2,100	448 - 2,100	380 - 1,900	382 - 1,950	390 - 1,700	405 - 2,100	405 - 1,900
,900										
Mep at max power bar	**18.1**	18.5	19.1	22.6	19.3	20.5	19.3	21.9	18.5	20.4
Piston speed m/s	11	9.9	10.2	10.5	11.6	9.5	10.8	**8.8**	11.2	10
Maximum torque Nm - rpm	2,381 - 1,400	2,300 - 1,400	2,127 - 1,400	**2,901** - 1,400	2,754 - 1,550	2,600 - 1,250	2,401 - 1,150	2,450 - 1,300	2,430 - 1,500	2,587 - 1,150
Mep at max torque bar	24.4	24.6	**22.9**	28.9	26.1	27.9	24.8	24.5	24.5	26
% power at max torque (kW)	51.3	50.2	44.6	48	51.5	**58.4**	52.8	52.9	50	53.9
Torque at max power Nm	1,764	1,735	1,774	**2,274**	2,038	1,911	1,872	2,185	1,842	2,038
% power at max torque (kW)	90 (349)	88.30 (337)	80 (312)	85.10 (426)	99.80 (**447**)	89.60 (341)	75.70 (289)	85.60 (334)	94.3 (382)	77 (312)
Work range rpm	700	700	700	700	550	650	**800**	400	600	750
DETAILS										
Specific power kW/dm³	31	31,8	32,7	**38,8**	33	31,8	30,7	30,4	31,7	31,7
Specific torque Nm/dm³	190.4	191.4	178.6	**225.2**	203.2	217.6	193.3	191.2	190.7	202.4
Areal spec. power kW/dm²	48.74	45.15	47.50	**58.21**	54.57	47.74	51.07	47.50	50.88	50.06
RULES AND BALANCE										
Dry weight kg	1,143	862	995	1,430	1,542	1,341	1,070	1,140	1,075	1,322
L x W x H mm	1,272x996x1,132	1,294x931x1,002	899x925x1,116	1,365x912x1,213	1,547x961x1,542	1,428x903x1,151	1,376x925x1,288	1,375x980x1,260	1,406x889x1,108	1,148x868x1,237
Volume m³	1.43	1.21	**0.93**	1.51	2.29	1.48	1.64	1.70	1.38	1.23
Weight/power kg/kW	2.9	**2.3**	2.6	2.9	3.4	3.5	2.8	2.9	2.7	3.3
Weight/displacement kg/dm³	91.4	**71.7**	83.6	111	113.8	112.3	86.2	89	84.4	103.5
Power density kW/m³	271.3	315.7	**419.4**	331.1	195.6	256.8	232.9	229.4	293.5	329.3
Total density t/m³	0.80	0.71	1.07	0.95	0.67	0.91	0.65	0.67	0.78	1.07
Displacement/volume dm³/m³	8.74	9.93	**12.80**	8.53	5.92	8.07	7.57	7.53	9.23	10.39
SPECIFICATION										
Emission level	epa tier 4	epa tier 4	epa tier 4	epa tier 4	epa tier 4	epa tier 4	epa tier 4	epa tier 4	epa tier 4	epa tier 4
Injection system	meui	iniettori xpi	common rail	common rail	common rail	common rail	common rail	common rail	common rail xpi	common rail
Air intake - Techno	Acert	scr dpf	Eat (scr doc dpf)	double stage Hi-eScr	scr egr doc dpf	scr	vgt scr egr	t.compound egr scr	vgt egr scr	waste gate scr egr
INDEX										
Torque	10.4	10.4	10.2	10.8	9.2	10.1	**11.2**	7.3	9.4	10.9
Performance	7.1	7	6.7	8	7.6	7.6	7.2	7	7.2	7.3
Stress	11.8	**11.5**	11	13.1	12.6	12.5	11.9	11.1	11.9	12
Lightness	12.1	9.4	11.6	15.4	15.4	14.8	11.7	12.2	112	13.5
Density	8.9	10.5	**13.1**	10.2	6.1	9.5	7.8	7.5	9.4	11
DIESEL INDEX	7.6	7.9	7.7	**8**	7.3	7.5	7.7	7.1	7.6	7.6

Cursor 13 the 'powerful'

As anticipated, the leading force is the Cursor 13, the flagship of the Cursor range and **Fpt Industrial** top of the range before the introduction of the Cursor 16. We're talking about the double turbine version, which was firstly used on Stralis trucks confirming its 'truck footprint': under the hood of the Stralis Hi-Way the Cursor 12, 9 liters is the choice for long-distance missions, waiting for Fpt Industrial to introduce the automotive version of the above cited Cursor 16 which at the moment is shrouded in the mist. While John Deere only is in pole position inside this lot for displacement, focusing the magnifying glass on specific values leaves no doubt: you do not even need to scroll through the table, since the characters in bold highlight its primacy, testified by a gap between 15 and 22 percent for available kilowatts at maximum power and 10 and 21 percent for Nm, both referred to displacement.

Cummins deliberately turned over direct on road derivation to give priority to offroad tones of the 'son' of Columbus, though the Sino-American project (the godmother of the project is Foton, China is the forge of compact red units). Despite lacking exuberance, as soon as you take a look at power and torque specifications things fall into place and the 12 liters lines up to the rest of the lot, except for the aforementioned Fpt Industrial and John Deere. Pss champions the deer front. **John Deere** performs quite well in the comparison, not only in terms of peak values, with only a 10 percent less power than Cursor: only Deutz stands close with 33 kilowatts per liter. The twin 's' in the Pss acronym stands in the American taxonomy for double turbocharging stage and the all-inclusive formula adopted for emission: coming from the muffler with catalytic converter and dpf, gases pass into the mixer through an elbow fitting then are processed by a selector with technical urea. Overall dimensions are a disadvantage, while being on the other hand a strongpoint for **Deutz**: 13,54 liters for the heavyweight of the lot, 11.9 for the slim one made in Cologne, the only one under a cubic meter. There are rumors about future upheaval in over 4 liters range. We do not know if - besides the highly popular one liter cylinder in 4 and 6 configurations - the Rhine designers are also going to change the character of the 2 liters cylinder used on 6 and 8 cylinders. This engine for sure looks good, even if it does not have the same commercial appeal of its little brothers Tcd2.9 and Tcd3.6; its 19.1 bar mep may be improved. Maybe a few millimeters longer stroke could give a few more kilowatts…

Mtu pushes on mean effective pressure with its 12.8, which derives from Om471 coming from Detroit Diesel shore. Among the refinements of the truck version we find the dual overhead cam head and the X-Pulse pressure amplifier, which acts on the pressure during the main injection. The cylinder head is cooled by the transverse flow within the head in vermicular graphite. Despite its origins, stresses are under control: a 8.8 m/s piston speed is a paradigm of moderation, and the same is for the engine speed at maximum power.

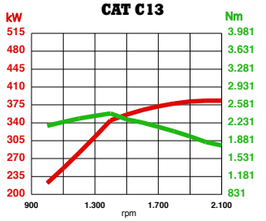
Liebherr is another German competitor. Robust and hard-working, the 12 cylinders from Bulle begins to take hold in cogeneration with its gas version, while being at ease in mobile applications. Premises are good: an extreme flexibility in integration and customization of specific components and curves, which comes almost entirely from Swiss valleys. Torque is second only to John Deere and FPT, while density brings the Liebherr almost at the top.

Using Acert on crawler excavators, articulated dump trucks and a couple of special machines, **Caterpillar** keeps mep very low, even if increasing the rotation speed could improve performances. All in all, dimensions and weight/power ratio are in line with the middle class, allowing the Big Yellow to become an option even outside Peoria borders. Acert means scr, doc and passive Dpf regeneration.

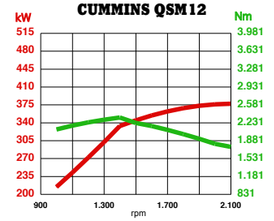
In conclusion (not only alphabetic), here come the Swedish cousins. **Scania** engages a fierce fight, with a gap of just 0.03 dm^3, while Volvo slows down to 1,900 rpm instead of the canonical 2,100 of the DC13. Volvo shows a better stress control and pushes on mep. The results? Slightly higher torque values (6 percent), which are reflected in the index performance.

Weight is a different story: **Volvo** declares 187 kilos, making Södertälje 18 percent lighter than Gothenburg. In Tier 4 F/Stage IIIB Volvo turbocharger marries wastegate, Scania Vtg.■

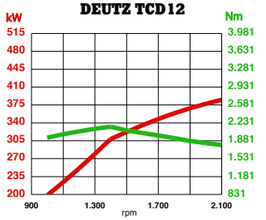
CATERPILLAR



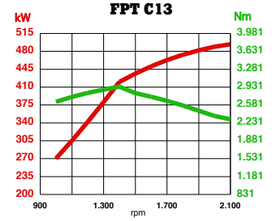
CUMMINS



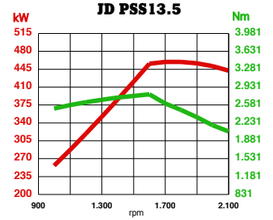
DEUTZ



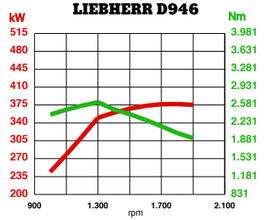
FPT INDUSTRIAL



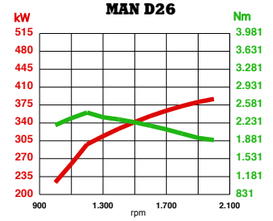
JOHN DEERE



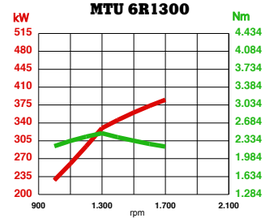
LIEBHERR



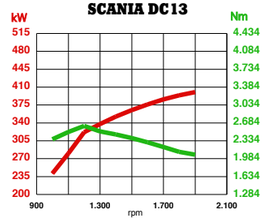
MAN



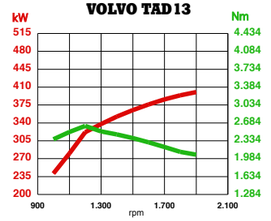
MTU



SCANIA



VOLVO PENTA



800-900 kilowatts comparison

A STRUGGLE FOR FOUR

The presence of Swiss engines in large displacements range is at the moment entrusted to the Man twin, that proves again to be unbeatable for specific curves. The other two players are Caterpillar and MTU. Above this threshold, Liebherr is investing with its 16 and 20-cylinders (see box)

Units for stationary applications, or designed for pleasure craft, engines for large offroad mobile applications: when it comes to the megawatt threshold, the number of competitors for Diesel Index is reduced to the usual elite, the German duet consisting of Man and MTU, and the Caterpillar variable. Now this oligopoly gained another manufacturer which consolidates the German hegemony. His name is Liebherr, that while using for its engines a Swiss passport - since Bulle is located in a French-speaking canton of the Swiss Confederation – is owned on the other hand by a multinational company that has its roots firmly planted in the tradition of German industrialists. Its V12 is the other side of the Man medal, because even if this is a four hands project, the two-liter cylinder was identified up to now with the brand from Nuremberg and in recent years has been freed from the autarkic choice which saw it used only on Liebherr machines, gaining a share of the free market. Initially, this expansion takes place in gas cogeneration, at least as regards the 24 liters, more difficult to place than smaller displacements. The 12 cylinder is the top range and stands close to its Man twin, which shows a more exuberant character, shown by 9 percent power and 7 per cent torque. Overall, the D9512 specific curves are softer and shorten the gap with the D28, leaving behind the Cat - MTU pair by a 10 percent. Nevertheless Man came out from the deep post-Agritechnica restyling with modified characteristics, a few kilowatts less than the previous calibration and much more torque. That's what it takes to defeat the inertia and move an about ten tons and over total mass, as in the case of combines and dumpers. Cummins is excluded from this comparison since the QSX stops at 15 liters, which bring in Columbus 503 kilowatts and 2,800 Nm. Caterpillar firmly stays on top for performances, confirming the 2.6 liters cylinder and inevitably swelling power and torque. Cat tactics on this displacement range rewards stresses, with top speeds going hand in hand with MTU, and is reflected by a piston stressed like no other here and a mep which is instead very low: to understand why, just put your finger on kW/liter and Nm/liter entries in the table. These items enhance the performances of the two cousins Liebherr and Man, with the D28 leading the race just followed by the D9512. Nuremberg holds down the rotation speed, which consequently moderates piston speed and vibration, also thanks to the effect of the bedplate. The cylinder features four crown valves, as for all others, common rail is made by Bosch, while Cat relies on the proven chip – controlled MEUI system, while Liebherr keeps everything in house as usual. The goal of Bulle is to manufacture 60 thousand common rail systems a year in 2020. MTU stops at 783 kW, showing an effective torque profile over the entire range. In over 900 kW range we find the 16-cylinder of 2000 Series. The royal road of the post-treatment is SCR, and recirculation appears on MTU (external cooled EGR) and Cat, coupled with DOC and DPF.
Despite different performance profiles, the Diesel index rewarded the Made in Switzerland pair.

LIEBHERR D916

Not just the identical twin of the two-liters cylinder, but a true protagonist thanks to a 16 and a 20-cylinder. The D96 series from the German manufacturer integrates Liebherr top range. The 16-cylinder, 2.25-liter per cylinder born from a bore increased to 135 millimeters might almost be part of this challenge, tackling the equal-cylinder MTU thanks to a 36-liter displacement placed in 900 - 1,200 kilowatts range and 6,000 Nm rated torque, which suggests a torque peak between 7,500 and 8,000 Nm (these data rely exclusively on our assumptions). The adjustments involve the pistons, that have to withstand higher loads, the cylinder heads that feature a better cooling, the reinforced crankshaft, the gear wheels and the flywheel, whose size has been increased to ensure a 65 percent more torque to be transferred to transmission. Emissions management rely exclusively on Scr.

A rendering of 16-cylinder.

IN THE RANGE 24 - 32 LITERS

Brand / Model	CATERPILLAR C32 ACERT	LIEBHERR D9512 A7	MAN D2862LE13	MTU 12V 2000
I. D.				
B x S mm - S/B	145 x 162 - 1.12	128 x 157 - 1.23	128 x 157 - 1.23	135 x 156 - 1.16
N. cil. - dm³	12 - 32.10	12 - 24.24	12 - 24.24	12 - 26.79
Maximum power kW - rpm	**895** - 2.100	750 - 2,000	816 - 1,800	783 - 2,100
Mep at max power bar	**16.3**	18.9	22.9	17
Piston speed m/s	11.3	10.5	**9.4**	10.9
Maximum torque Nm - rpm	**5,488** - 1,400	4,675 - 1,450	5,000 - 1,400	4,635 - 1,100
Mep at max torque bar	**21.9**	24.7	26.5	22.2
% power at max torque (kW)	51.3	**52.3**	51.3	49.2
Torque at max power Nm	4,067	3,577	**4,332**	3,557
% power at max torque (kW)	90 (**805**)	94.70 (710)	89.90 (733)	68.20 (534)
Work range rpm	700	550	400	**1,000**
DETAILS				
Specific power kW/dm³	27.8	30.9	**33.6**	29.2
Specific torque Nm/dm³	170.9	192.8	**206.2**	172.9
Areal spec. power kW/dm²	45.16	48.58	**52.85**	45.58
RULES AND BALANCE				
Dry weight kg	3,004	2,050	1,950	2,950
L x W x H mm	1,874x1,600x1,370	1,856x1,236x1,314	1,660x1,333x1,391	2,028x1,278x1,461
Volume m³	4.11	**3.01**	3.08	3.79
Weight/power kg/kW	3.4	2.7	**2.4**	3.8
Weight/displacement kg/dm³	93.6	84.6	**80.4**	110.1
Power density kW/m³	217.8	249.2	**264,.9**	206.6
Total density t/m³	0.73	0.68	0.63	0.78
Displacement/volume dm³/m³	7.81	**8.05**	7.87	7.07
SPECIFICATION				
Emission level	Tier 4 final	Tier 4 final	Tier 4 final	Tier 4 final
Injection system	meui	common rail 2,000 bar	common rail	common rail
Techno	Acert	Scr	Scr	Egr Scr
INDEX				
Torque	10.3	8.9	7.6	**13**
Performance	6.6	7.1	7.5	6.6
Stress	**11.1**	11.7	12	11
Lightness	13.6	11.1	10.5	14.9
Density	3	4,2	**4.5**	3.1
DIESEL INDEX	7.2	7.5	7.5	7.3

LIEBHERR D9512

MTU 12V 2000

CAT C32 ACERT

MAN D2862LE13

Visa. The Italian GenSets. From northeastern Italy to the world

STEP BY STEP

As the leading genset manufacturer in Italy, Visa follows a modular logic, furnishing over 36,000 configurations. Production is organized in three branches and, thanks to twenty years of close collaboration with Perkins, has guaranteed a near monopoly among the 9 to 2,200 kVAs

PERKINS 4000 SERIES

Powered with both gas and diesel, the 4000 series embodies the top of the Perkins range of power generation motor platforms. Product segmentation is divided in 6, 8, 12 and 16 cylinders with 4 valves per cylinder head, turbo-chargers with fixed rotors, intercoolers, a cast-iron block, oil cooling circuits and electronic controls. Top values for 50 Hz diesel are as follows: 720 kWe and 900 kVA for the 4006 Tag, 725 kWe and 906 kVA for the 4008 Tag, passing up to 1,504 kWe and 1,880 kVA in the 4012. One step further, the 4016, offers 2,000 kWe and 2,500 kVA.
Starting in January, the 4008-30 has entered into production in three sizes (Tag 1, Tag 2 and Tag 3), including renovated manifolds, with electronic controls, new filter configurations and cooling circuits. All designed to augment power: the Tag 3 delivers the power of the previous 12-cylinder.

After half a century, the 9 to 3,000 kVA gamma has now placed an estimate of more than 4,000 machines (closer to 4,300 units) in 2015 and 36 thousand product configurations. Four focus areas define the Visa phenomena: markets, applications, engines and technology, design and production.

Markets

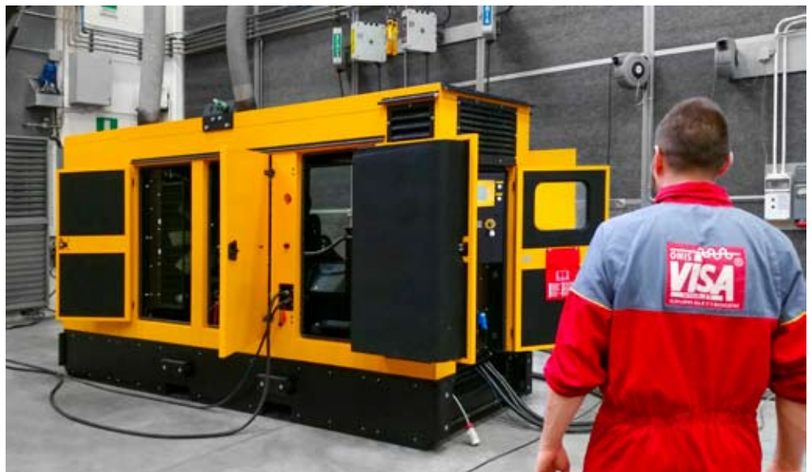
The Visa sales network spans sixty diverse markets and is particularly entrenched where the electric grid is underdeveloped, such as in Africa, Russia and the Arabian Peninsula. In emerging markets like Bangladesh, the Philippines and Australia, Visa works mainly in 50 Hz. Despite the long-term relationship with Perkins, their primary supplier for the past twenty years, Visa has adopted a multi-brand strategy, working with key partners like Peterborough among 9 to 2,200 kVA and Mitsubishi and MTU for their 2,500 to 3,000 kVA needs.

Applications

Visa generators are designed for raw performance power, even in so-called developing countries, like Northern and sub-Saharan Africa, where poor network stability makes daily emergencies the norm.
Diverse applications extend from hotels and hospitals to data processing centers, border posts and government offices. For example, an Algerian dealer signed a contract with the Ministry of Education to provide all universities with 250 kVA groups. Of particular note, the sales network organizes distributors on a regional scale, offering both serial standardization and customization. Importers are trained directly by Visa and handle both sales and support.

Engines and technology

Divided from 9 to 3,000 kVA, the Perkins 400, 1100 and 4000 series reliably cover everything under 2,200 kVA. The 404 turbo and the entire 1100 Series, in particular the air-cooled models, are very popular. The 200 and 250 kVAs represent 70 percent of production, while product ranges between 251 and 650 kVA cover 20 percent, ending with those between 651 and 3,000 kVA. Among alternators, the choice may fall on Venetian companies Marelli and MecAlte, even if the strongest brand remains Stamford. The main variables in customized solutions are the electric power, the alternator and the mechanical variables: the same machine comes open, boxed, soundproofed or super-soundproofed. For mobile applications, which require large tanks, precise specifications and noise exhaust emissions, the electrical equipment and accessories come with integrated monitoring via plc or remotely.



Design and production

The 36,000 product variants are made possible by SAP, the information management system. Critical issues relate to installations that would be penalized by an interruption in the electrical supply and those in industrial cycles where thermal shocks are an issue. Design capabilities skillfully reconcile factors like temperature and noise with actual working conditions while meeting the designated workload. Product vetting takes place in collaboration with Perkins, through synergistic performance compliance tests.
With the acquisition of a company specializing in sheet metal working, Visa is capable of producing metal parts, such as bonnets, bases and tanks. To circumvent delays in delivery, Visa holds over one thousand engines and as many alternators in stock.
The work flow, as mentioned, is spread over three islands, each dedicated to a specific size (small, medium and large), within which each operator observes SAP requirements: sequences, phases, component serial numbers and procedural transparency. Each worker follows one single machine through assembly according to the Lean system. Generators are mechanically tested for periods of 45, 60 or 120 minutes, for load tests at 10, 25, 50, 75, 100 and 110 percent and for simulating reliable alarms and protection protocols.

Conclusions

According to Lorenzo Barro, together with his brother Marco, owner of Visa, variable speed generators are «an application which we will surely develop. It involves energy storage for those utilities that need constant power across variable work cycles and electrical coverage: in those contexts, hybrid generators are very valuable. It is an emerging application that we are working on. We are aware that right now the key is convenience. We're trying to figure out which savings and business plans we can offer our customers».

Dellorto and industrial engines. EGR and throttle bodies

FROM BIKES TO OFFROAD

Guide to a chat with Paolo Colombo, R & D Innovation Manager, reviewing Dellorto industrial breakthrough which started from motorcycles and cars then shifted to off-road, focusing on EGR and throttle bodies for industrial applications

The evolution of Dellorto, a manufacturer of radiators for motorcycles since 1933, led the company based in Lombardy to focus on industrial applications with EGR and throttle bodies. How it all happened? We asked Paolo Colombo, R & D Innovation Manager.

How did you come to recirculation?

«We started from electric EGR valves and left out the pneumatic drive step. Our valves are driven by a DC motor featuring a position sensor for feedback control. The first industrialized application was with Fiat, later joined by GM. Other customers are Kohler/Lombardini and Vm, the latter both for automotive, with the V6 used by Maserati, Chrysler and Dodge Ram 1500, and industrial with the R754, while the 3-cylinder R753, renamed R22 by FPT Industrial, features our throttle body. Our egr solution completes the whole KDI range by Kohler. Iveco uses the egr on Sofim 2.3-liter (F1A) for Daily and Ducato commercial vehicles, together with Psa. Staying in the industrial world we provide the throttle body for the F5C, the 3.4-liter known as 854 in the Perkins range. The throttle body came on diesel engines at the beginning of the new millennium with the "air valve shut off" function: when the valve is off and closed the engine stops the compression work that generates the shaking.

Managing regeneration

After that it was necessary to split the aspiration on diesel engines in order to manage the temperature control in the chamber during DPF regeneration so to help the engine thermal management in the initial operating stages. In summary, its functions are shutdown, thermal management during the warm-up, even where there's no DPF but only SCR, pressure differential through the EGR valve and DPF regeneration process. Unlike throttle bodies for gasoline engines, diesel throttle bodies have a wide open default position to ensure engine operation even in case of power failure of our electrical component».

Any indiscretion about the future?

«There is much talk of HCCI with constant use of the electronic throttle body and egr to achieve cold combustion with premixed charges as much as possible, homogeneous and diluted by exhaust gas. We also believe that the EGR will soon also be used on supercharged turbo gasoline engines with direct injection. Position sensor contacts in the throttle have been removed in favor of electromagnetic Hall effect. The sensor includes a magnet built in the throttle shaft, and a specific integrated circuit (Ascic) that senses the magnet. In the KDI case we've been working on brushless motors and used a 'smart' valve, so that the control unit no longer drives the DC motor receiving the position feedback; the control unit refers to the electronics that controls the DC motor, which checks the correct position. This system is also used by Vm for industrial applications, when ten thousand hours of operation are required.
Temperatures is also a factor which will increase together with emission test cycles carried at increasingly high loads, up to 800 °C in the gases passing through the valve. We developed solutions to avoid the deposit of dirt or the valve sticking in its seat by means of profiles which limit the contact of linear surfaces, or with devices that eliminate the incrustations on the valve stem. We used acid condensate resistant materials: apart from the body, which is made of aluminum, the other components are made of stainless steel».

Headquartered in Lombardy, Italy, Dellorto has a plant also in india. Specialized on radiators for bykes Itaian company broadened its focus on Egr and throttle bodies for industrial applications.

Isn't the EGR too complicated?

«The EGR is a mandatory and technically mature device that does not require additives as the SCR. Indeed the test cycle for industrial engines requires operating points at higher loads than automotive approval. In trucks sector the so-called PEMS – Portable emission measurement tests are also taking over because of Real drive emission. This is a trend that is also coming in the automotive sector, where a test cycle called Wltc 'Worldwide light duty test cycle' which will have most severe acceleration submitting the egr to higher loads is expected. Then there could be a significant impact on the radiators.

Looking for new solutions

In terms of innovation, experiences such as the research program 'No waste' with Rankine cycle are currently hardly applicable to smaller size motors. In road vehicles it is possible to recover heat from the exhaust gas as a source to accelerate the engine inlet, heat the gear or the cockpit more quickly. If temperature is very low, vehicles in normal use cannot reach the working temperature and systems of this type may help, although it is obviously easier recovering heat from the engine, because the exhaust gas is relatively cold. So far there has been talk of heat recovery with coolant, but it can work also as heat storage, for example on start&stop».

Are industrial synergies in sight?

«We consider some market players as possible interlocutors with which to establish 'win to win' relationships on niche products or markets, such as those started with Bosch and Magneti Marelli, with whom we have a license to produce throttle bodies in India. We are looking at EGR for gasoline engines in automotive applications. It must be said that full EGR also includes heat exchangers. We now buy them, and after all there are no electric actuators, position sensors, die-cast or derived by mechanical machining components on heat exchangers. By contrast, heat exchanger has peculiar molding and welding technologies, because it must be lossless, extremely reliable and have just slight pressure losses».

Dante Ferrari

NO WASTE PROJECT

«We are participating in 'No waste' European research project for exhaust gases heat recovery on long-haul trucks via a Rankine cycle, which resembles a steam cycle even if the operating fluid is water. The fluid exchanges heat with the exhaust, that hosts a heat exchanger, and with the EGR cooler; the mixture is heated and made into the expander, a turbine, producing mechanical energy which can be converted into electricity for on-board services. It is a closed loop cycle: the fluid returns into the compensator, condenses and goes back again into the circuit. The project cluster includes Fiat Research Center and Renault Trucks. The project has already been used by CRF on Iveco engines and by Renault Trucks on its engines. Cummins is also working on this project. The success of this solution will depend on a number of factors, in the first instance diesel price, as a matter of total cost ownership».

Bondioli & Pavesi between past and future

LONG-TERM STRATEGY

Radiators with integrated bypass and automotive system are the current reality of a company that now boasts an institutional presence among transmission shafts and gearboxes. The next challenge involves hydraulic components

From 1950 to Munich today, the creature of Edi Bondioli and Guido Pavesi followed the high road of specialization, consistently differentiating the technical-manufacturing range and renewing its original vocation towards an environmentally sustainable development in the anthropological meaning of the phrase.
The culture medium is power transmission, while transmission shafts are the milestone and the land to be conquered by the company. Based on an approximate annual volume of 2.5 million drive shafts, the share of Bondioli & Pavesi is about 400 thousand units. In the nomenclature of Suzzara, in northern Italy between Lombardy and Emilia where the company is headquartered, transmission shafts are identified by SFT, which stands for 'Safety, function, technology', both with simple and constant-velocity joint. After the transmission shafts revolution that went beyond belts, the natural expansion involved gearboxes, the component that gathers the 'sprocket chains' (for instance, chains, belts, pinion and crowns) and represents a further area of development. It is a synergistic element, which brings the product evolution to a completely different depth, involving a thousand applications in the industrial world. After the gearboxes, available both in standard and parallel shaft version (made by Bima from Reggio Emilia, officially acquired by the Group in 1997) and on OEM specifications, the Eighties were the age of hydraulics. Even in this area the strategy remains the same: building up expertise. Expanding the viewpoint from drive shafts to hydraulic products, this policy applies also to directional control valves and piston pumps of axial motors.
The strategy is always radial: where the expansion does not start straight from the heart of the company, it is undertaken through acquisition. In the decade between 80's and 90's the grouping of some hydraulics Italian companies boosted up and made extensive the firepower in this area: HP Hydraulic manufactures pumps and axial piston motors, pumps and gear motors and actuators; SM Oleodinamica manufactures components for pumps and hydraulic motors, mechanical joints, and

HISTORICAL LEGACY

We are in Suzzara, on the left bank of Po river, the echo of the war is fading away and in the early Fifties Edi Bondioli and Guido Pavesi convert old car engines to power generation, and civil and industrial machines in hybrid machinery suitable both for transport and agricultural processing in their workshop. The next steps were the construction of three tractors and the final leap to transmission shafts as first pioneers on the Italian then international scene, creating in 1952 a plastic shield for the universal joint. What is the scenario in which Bondioli & Pavesi blossomed? Let's think to a still image, that of Iveco, which faces the company headquarters. The factory that today manufactures Daily industrial vehicles previously housed OM and originally Officine Casali, that assembled agricultural machinery from 1885 to the postwar era, including the corn sheller named Invincible.
This ferment justifies the fame that once Suzzara - also called the 'little Manchester' - had in agricultural mechanization, due to its strategic position in the Po Valley, an area that later became the world leader in luxury cars manufacturing, industrial motors and mechatronic components. The driving force of mechanical skills was the 'School of Arts and Crafts', that was attended also by Edi Bondioli. Established October 9, 1877, this evening night school was intended to 'raise the underprivileged people', and in the words of Edi Bondioli «was a total university because we did so much, whe learned everything, and usually the owner was an artist».


A look on the Bondioli & Pavesi history at the hall of the Italian headquarter.

axial piston pumps; DINOIL and its subsidiary Tecnomek deal with directional control, monoblock, modular and load-sensing valves.
The last frontiers are by-wire distributors and heat exchangers. The latter are made by Fira, another subsidiary focused on large machines. The company originally used external suppliers for radiators, then bought ovens suitable for high-vacuum brazing.
It is very rare finding in today machines a system where hydraulics do not work together with mechanics and electronics. This is the real meaning of product differentiation in Bondioli & Pavesi.
And what is behind the scenes of R&D? Two emerging solutions: the integrated bypass in radiators and automotive system for machines featuring hydrostatic transmission. Speaking of radiators, the patent is the fully integrated bypass management, which makes no use of any external support and welding inside the radiators. The advantages affect dimensions and functionality, eliminating liquid loss, reducing seals from eight to two and heat dispersion, thereby facilitating thermal management.
The implemented new edition of the automotive system is used to manage the pump used by mobile equipment such as backhoe loaders and telescopic handlers, adjusting the pump flow to the engine speed according to work cycles. The hydraulics of the automotive system records pressure changes according to rpm, automatically adjusting the pump flow rate. This results in a more prompt response of the translation pump that's useful for short and quick trips.

BONDIOLI & PAVESI IN THE WORLD

The operational autonomy promotion could be imprinted in the Bondioli & Pavesi brand, as evidenced in the branches' nomenclature, 'commercial and logistics'. The founders guessed that the sales network should be made of dealers to personally promote the products. The company's policy was driven since 1967 by the creation of branches that not only manage sales but are also able to provide expertise and technical advice. Subsidiaries are sensitive organizations that collect technical issues from customers, work together with the head office and diversify response depending on application and cultural context. Let's recall some examples. In Brazil, where there are customs duties, drive shafts and control valves are produced on site. In Spain, a market that needs flexibility, the subsidiary import the components of the transmission shafts and manages the assembly. Almost all subsidiaries are equipped with hydraulics assistance banks, but some branches do not feel this need that much. Each company operates as a local structure, while being fully owned and controlled by Bondioli & Pavesi, and refers to the parent company for commercial, financial and administrative management, logistics support and other services (advertising, communication, etc). The production facilities located outside Italy are based in Czech Republic, Brazil and China. The export sales is 84 percent of the total turnover.

OPTIMIZATION IS THE KEY WORD

This was the theme of the latest edition of the most important agricultural fair. Whether it's consumption, flexibility or engineering, the leitmotif of many new products shown in Hannover was the improvement of machine performances through a better reliability, energy efficiency and ease of installation of its components

What do OEMs expect from transmissions, axles, hydraulics and electronics components? We've seen a couple of replies to the offroad world in 2016 at Agritechnica, and the answers are to be found in the optimization of fuel consumption, versatility and ease of integration and use in machine construction.
Let's start with transmissions.

Bpw

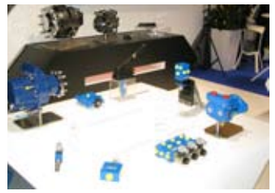
The Agro Turn steering axle by Bpw features a particular architecture in which the traditional steering bar is replaced by a steering fork with integrated hub, and a brake assembly with a holder that can be mounted in different positions, allowing the use of different tire sizes and greater ground clearance. Its constructive peculiarities do not end here: the position of the brake camshaft, for example, has been rotated by 10° backwards in order to create the needed space to obtain a superior steering angle, equal to 28 degrees, and facilitate the suspensions mounting.

Carraro DriveTech

Carraro focused on Twin Shift dual clutch transmissions, inspired by automotive versions, that was represented in Hannover by the T100 model, suitable for 73.5 to 132.3 kilowatts power range, completing the low end of the product range. Eight dual clutch speed in power shift mode and three or four ranges for a total of 24 or 32 speed, range changing with hydraulic actuator and Master Clutch (starting friction) are the prominent features of this range, representing an effective alternative solution to cvt transmissions thanks to its minimal power and torque loss. TC4 transmission is addressed to telescopic handlers: 4 or 6 speed in power shift mode, a power range from 62.5 to 81 kW (85-110 HP), and a layout specially developed for these machines, characterized by the side mounting of the kinematic chain.

Poclain High Performance Program

The High Performance Program, a flagship of Poclain Hydraulics, was enriched by the new generation of hydraulic motors Mhp20 and MhpP27, developed with the ambitious goal of combining performance, reliability and optimized fuel consumption. The configuration of the rotation unit, specifically designed to allow high rotational speeds (up to 370 rpm) and power levels



(up to 280 kW) -key features for improving productivity and performance of the machine) - is its hallmark, together with an optimized engineering of all components. Thanks to its innovative design, the Mhp20/27 are able to bring down the usual load losses of any hydraulic unit: this way it is possible to achieve an efficiency rate of more than 90 percent, even when operating at full speed thanks to the limited displacement. When it comes to comfort, in addition to the solutions used on each component to reduce noise, the Mhp20/27 technology takes advantage of the direct transmission without reduction ratios, which results in a reduction of noise and frequency level even at maximum rotation speed. This new range is available in several displacements from 1,430 to 3,500 cc, distribution valve configurations which allow to calibrate the engine characteristics to suit the required performances, and built-in braking systems. Maximum reliability is assured by solutions such as sealed and protected caps, which allow the engine to operate in chemically aggressive environments, dust and dirt, withstand shock and stress.

Fad Assali

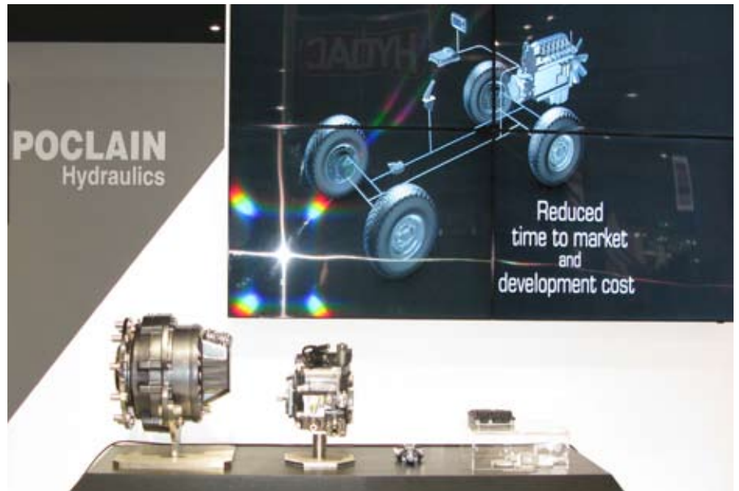
Sidra One Evolution 2.0 is a hydraulic modular independent suspension from Fad Assali. Using the same self-supporting module a self-steering mode or controlled steering is obtained without cylinders change. Another recently introduced product is a 'powered' fixed and steering axle, approved for 9 tonnes per axle, therefore for a load capacity of 18 tons. The hydraulic motor is developed in collaboration with Poclain.

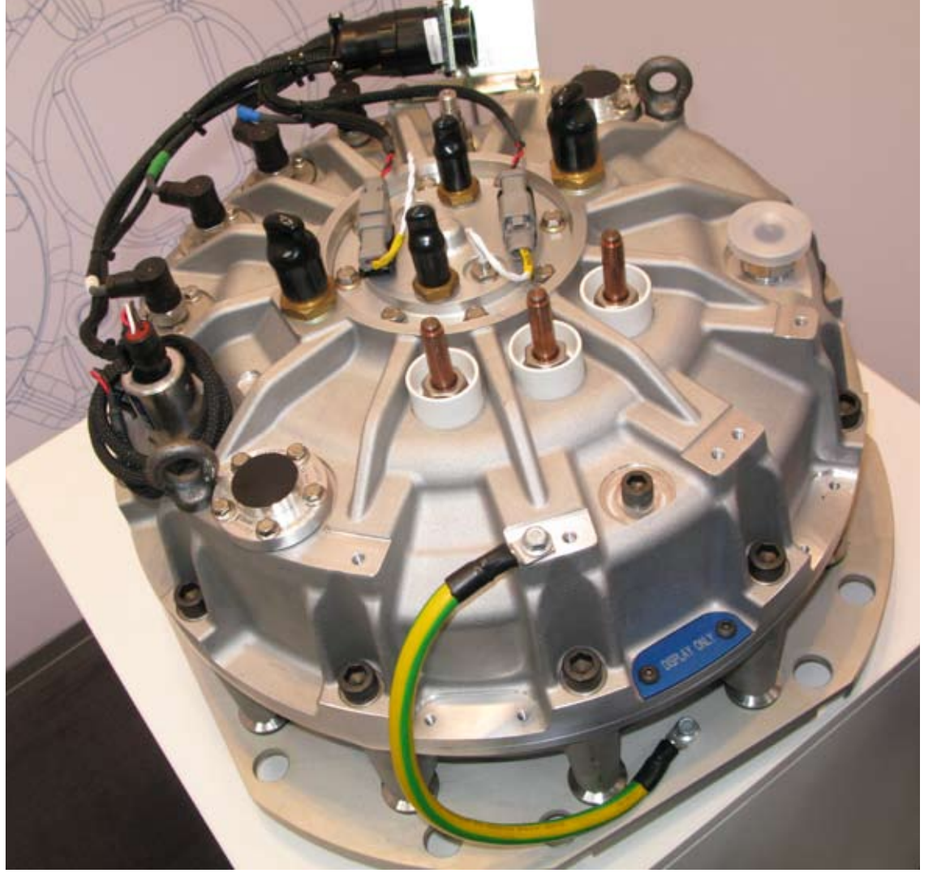
Gkn Land Systems

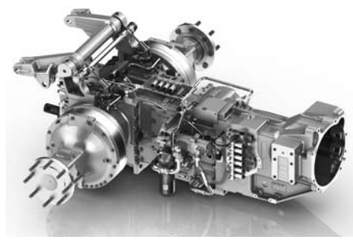
The Gyrodrive GKN Hybrid Power by GKN Land Systems is based on a flywheel system of braking energy recovery. An electric generator, integrated in the transmission line, converts the kinetic energy into electricity, which feeds a flywheel that stores energy until the vehicle needs to accelerate. At that point the cycle is reversed: the electricity is generated from the slowing down of the flywheel and is used to operate the electric motor, which contributes to the acceleration of the vehicle. The system is being tested on prototypes of wheel loaders and telehandlers.

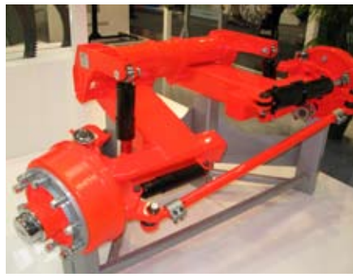
Oerlikon Fairfield

Oerlikon Fairfield's Champion Series is a line of hydrostatic drives, specifically designed for the operational needs of self-propelled sprayer. The three models in range - CO13, CO17 and CO26 - feature the same design and the ability to adapt to different machine weights, speed, tires and braking performance, and may be used on sprayer from 2,200 to 6,000 liters. These aspects are particularly relevant in an application segment in which larger tanks mean increased productivity and optimized fuel consumption. Among the prominent features of the new series, the adoption of tapered bearings across a wide spread to allow for higher radial loads and a patented internal service brake. Thanks to its common design, Champion









hydrostatic units may be also mounted on different machines such as aerial platforms.

Zf

Zf completed the power transaxle Terra range - which now includes eight models in power ranges from 47.8 to 235.3 kW (65-320 hp) - with Tpt 20 axles. The latest, in particular, is addressed to the medium power segment between 132.3 and 154.4 kW (180-210 hp), and fits easily thanks to its design on applications with a maximum total weight of 12.5 tons and a maximum speed of 50 km/h; other special variations of the Tpt 20 are available for driving speed ranges up to 40 km/h, which are thus manageable without compromising towing power or gears scaling.

Borg Warner

Performance, operational efficiency and fuel consumption are the criteria that inspired BorgWarner; the company focused on the R2S two-stage turbocharger which implements the recirculation of exhaust gases even in full load conditions via an EGR system that integrates radiator, recirculation valve and bypass valve, high efficiency vtg and cooling solutions such as electronically driven Visctronic units.

Bosch Rexroth

Bosch Rexroth has shown in Hannover four new products calibrated on machine power. The SB24 and SB34 sandwich valves, a modular system for auxiliary valves and hitch control valves; regardless of the type of drive (mechanical or electro-hydraulic) and flow rate (up to 120 or 170 l/min), all sections can be freely combined. The electrohydraulic hitch control is driven by the EhR12 valve with open center technology, optimized to be integrated into the SM12 Rexroth modular distributor which is capable to manage up to ten feeds. The new size 28 of the A1Vo axial piston pumps series is addressed to the 37 to 66 kW power range. Last but not least, the new axial piston, variable displacement engine A10Ver, designed for mobile equipment fan drive and featuring speed reverse function; the motor does not need an additional speed reverse valve, simplifying integration and improving the overall efficiency of the fan drive.

Danfoss

What we've seen at Danfoss stand ranges within engine, steering systems, valves, pumps, electronic and telematic controls catalogs. Among the latter, the platform 'plug-and-perform' solutions for off-road machines and equipment that combines the technology built into the machine, satellite technology and cellular network connectivity, and a user interface that allows to remotely control how, when and where machines are used; the system includes multiple complete functionalities, including data analysis, remote diagnostics, system parameters transmission, remote software updates, machine localization and tracking, geofencing, automated reporting, monitoring and analysis of machine efficiency, frequency and duration of use reports. Best point control stands out in software solutions area, an intelligent system focused on the management of hydrostatic transmission components (pump and motor) in the way as close as possible to optimal efficiency in order to make better use of engine power. Thanks to Bpc software the operator just controls forward and backward movements of the machine through the accelerator and directional control; the software instantly adjusts the engine and the hydrostatic transmission to provide maximum efficiency in any operating situation, providing fuel savings up to 25 percent depending on the type of application, the working cycle and the system configuration.

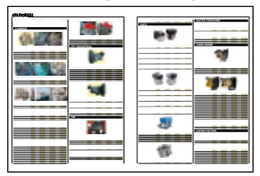
Mee Dubai: Fpt launches Cursor16 and S8000

Contship Italia: at La Spezia harbour Scania works hardly

Fish-Eye: Hitachi and Isuzu for the hybrid excavator

PRICE LIST

The update prices of the new engines ranges



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Interpump Hydraulics

LEADING LEADERSHIP

"Design For SAE 2 medium power engines". It should be the real title of this article. Among the features 400,000 cycles with max power on the PTO clutch of 63 kW at 600 Nm and 1000 rpm PTO output speed

Originally developed for Iveco Tector engines, the new sandwich PTO suitable for engine SAE 2 size by Interpump Hydraulics is addressed to heavy duty applications (100% of engine available torque) such as fire-fighting (Including pump & roll function), concrete mixer, sewer cleaner, snowplough and refrigerator(cooler) vehicle. The PTO features three different mounting positions, located between truck diesel engine and gearbox, in order to get power directly from the engine independently from the use of the vehicle clutch; the PTO output - up to 1000 Nm - may be either Constant Drive or detachable by using a Multi Disk Clutch. Other features include a pre-arrangement for external oil cooler, temperature control option, oil level inspection, PTO output sensor speed, oil cooler (water/oil & air/oil) and an auxiliary PTO window opening located at 4 and 8 O'clock to avoid chassis collision.
The new sandwich PTO by Interpump is compatible both with SAE 2 and several SAE 1 engines and all transmission (mechanical, automatic and automated).

Roberto Negri

EASYFIT 240. FITTING IS EASY

The upgrade of Flex Kit distributor unit called Easyfit240, designed to allow removing the oil filter by the upper body of the valve support, is now available. Oil filter is accessible by removing the air filter and its cap. Another advantage resulting from this "patent pending" integrated architecture results from the elimination of the second hole for tank filling and its threaded inserts for air filter mounting, housed in the same oil filter cap. Compared to Flexykit other options are available such as the oil level electronic control, the electronic or analog control of air and oil filter clogging and the control of the lubricant temperature.

Scania G 320 Hybrid: it's ok for Mobility revolution truck

Iveco Stralis: LNG is the real alternative to the 'alternatives'

On road test: good consumption for VW Caddy

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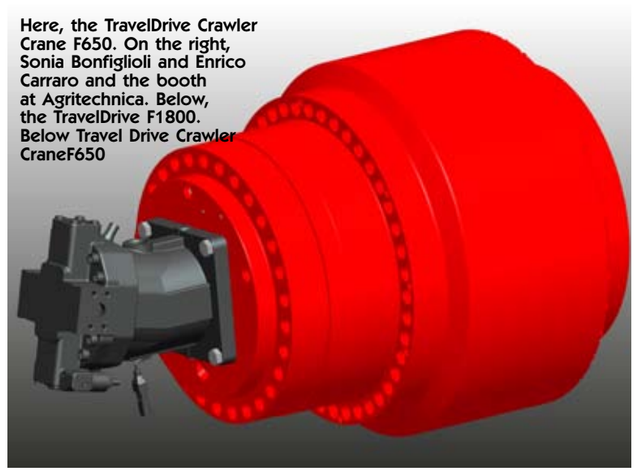


Here, the TravelDrive Crawler Crane F650. On the right, Sonia Bonfiglioli and Enrico Carraro and the booth at Agritechnica. Below, the TravelDrive F1800. Below Travel Drive Crawler CraneF650

Bonfiglioli and O&K

AN EXPANDING PORTFOLIO

An agreement between Bonfiglioli and Carraro ratified the acquisition of the majority stake of O&K. Now the planetary gear product portfolio is strengthened

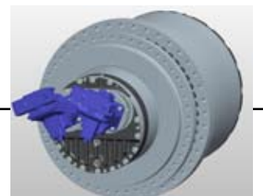
Last december, the agreement between Sonia Bonfiglioli and Enrico Carraro ratified the acquisition of the majority stake of O&K Antriebstechnik by the company based in Bologna. Carraro kept a 45 percent share of the German company, specialized in planetary gear units for tracked machines and cranes, machinery for mining and port. The acquisition of O&K Antriebstechnik GmbH in Hattingen serves as an ideal addition to the Bonfiglioli planetary gear product portfolio in the performance range of up to 3 million Newtonmeters. Hence, the family-run business Bonfiglioli can be relied on as a single source to meet the performance requirements of its customers in the construction machine industry. Moreover, the two companies complement each other perfectly in terms of previous sector focus and regional strengths. O&K Antriebstechnik provides Bonfiglioli with a strong quality brand as well as access to the mining industry, while O&K benefits from Bonfiglioli's global distribution network.

With a turnover of 730 million euros in 2015, the specialist for drive systems, Bonfiglioli, registered a record year. Drives for mobile machinery made up around one third of turnover, and drives for wind turbines made up around one fifth. The other half was generated by industrial applications, mining and steel works, power generation and process technology. At the end of 2015, Bonfiglioli had 3,375 employees of which 2,100 were located in Europe, around 1,100 in Asia/Pacific and 170 in the Americas. These figures especially reflect the locations of the production sites in Italy, Germany, Slovakia, India and Vietnam.

Roberto Negri

AT BAUMA AND MINEXPO

This year Bonfiglioli will introduce two new products at Bauma in april and MINExpo 2016 in november. The first one is the drive F650 by Bonfiglioli - O&K Antriebstechnik, a solution designed for mining and crane industry machines weighing up to 350 tons. With its peak torque of up to 650,000 Newtonmeters and its robust construction, it is a suitable drive for cranes and drills on chassis with caterpillar traction. In Las Vegas will make its debut the heavy-duty drive F1800 by Bonfiglioli - O&K Antriebstechnik, a component capable of a peak torque up to 1,800,000 Newtonmeters designed for vehicles weighing up to 800 tons. The construction is geared towards the most challenging excavator conditions in the mining industry. Special models tailored to specific vehicle requirements are also available.



Tests on the fields: Deutz-Fahr 5115.4G and Merlo Turbofarmer

Combines: New Holland TC. It comes the HillSide

Special Vehicle: Diverto QS 100. For thousands applications

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QUOTES

DIESEL

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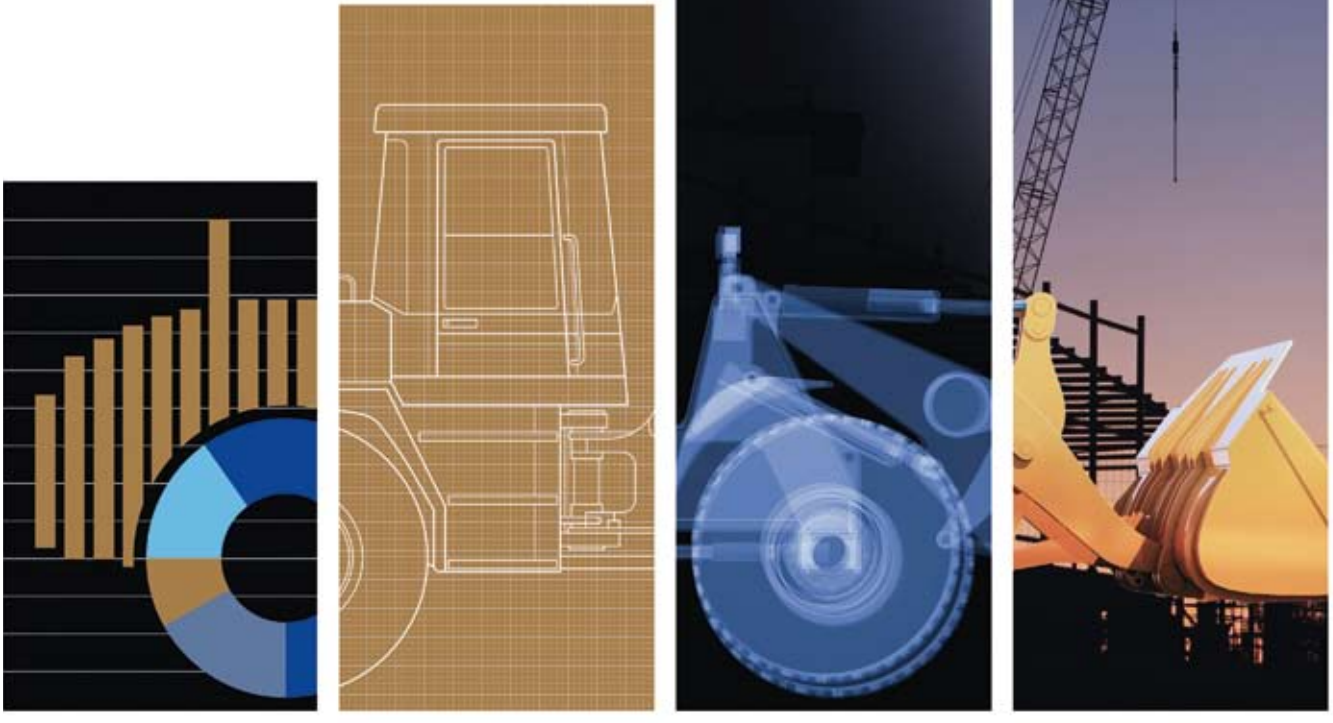

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