

KDI, The Game Changer

A winning solution for agriculture

After becoming a market leader in engines in the 37 to 100 kW range built for applications in the construction industry, the KOHLER KDI Engines series now faces a new challenge: to once again be "the game changer" for all farm machinery manufacturers. To succeed, it will rely on its ability to offer a clear, effective and functional solution for an ever growing demand for compact engines with high power density, low fuel consumption and a smooth, linear power delivery throughout the entire period of use. This will ensure maximum productivity and an emission containment strategy that is effective yet easy to manage both from a technical and maintenance viewpoint.

Their compact size and top ranking performance, in their category, as well as ease of installation have already convinced many manufacturers to choose the KDI engines for their own applications.

On the occasion of EIMA 2016 exhibition, KOHLER Engines will unveil KDI engine versions specially designed to meet the requirements of the agricultural industry.

Among the strong points of this new revolution are: the **proven bedplate architecture**, whose great strength and high torsional rigidity are particularly effective and suitable for installations on agricultural tractors; the distinctly **narrow profile**, which allows smaller steering radii and thus easier manoeuvring; the **structural crankcase** with a center tunnel for the drive shaft; and the two auxiliary lateral Power Take-Offs (PTOs) designed to deliver the highest possible power.

Their **performance**, *best-in-class* in their category, allows you to replace larger displacement engines, while **power delivery and torque curves have been optimised** to maximise machine productivity and obtain instant response to loads even at low rev speeds, ensuring pleasant and fluid driving.

GENERAL TECHNICAL DATA				
Model	KDI 1903TCR	KDI 2504TCR	KDI 1903M	KDI 2504m
Thermodynamic cycle	Diesel 4 stroke	Diesel 4 stroke	Diesel 4 stroke	Diesel 4 stroke
Air intake	TCA	TCA	NA	NA
Arrangement	In line 4 cylinder	In line 4 cylinder	In line 4 cylinder	In line 4 cylinder
Swept volume [cm ³]	1861	2482	1861	2482
Fuel injection system	DI Common Rail	DI Common Rail	DI Mech Rotary pump	DI Mech Rotary pump
Valves per cylinder	4	4	4	4
Cooling	Liquid	Liquid	Liquid	Liquid
Max Power [kW@rpm]	42@2400	55.4@2400	31@2600	36.4@2600
Peak torque [Nm@rpm]	225@1500	300@1400	133@1400	170@1400
After-treatment device	DOC	DOC	-	-
Emission compliance	Stage IIIB - Tier 4 Final	Stage IIIB - Tier 4 Final	Stage III A	Stage III A

GENERAL TECHNICAL DATA				
Model	KDI 3404TCR - (55.4kW)	KDI 3404TCR-SCR (75kW)	KDI 3404TCR-SCR (90kW)	KDI 3404TCR-SCR (100kW)
Thermodynamic cycle	Diesel 4 stroke	Diesel 4 stroke	Diesel 4 stroke	Diesel 4 stroke
Air intake	TCA	TCA	TCA	TCA
Arrangement	In line 4 cylinder	In line 4 cylinder	In line 4 cylinder	In line 4 cylinder
Swept volume [cm ³]	3359	3359	3359	3359
Fuel injection system	DI Common Rail	DI Common Rail	DI Common Rail	DI Common Rail
Valves per cylinder	4	4	4	4
Cooling	Liquid	Liquid	Liquid	Liquid
Max Power [kW@rpm]	55.4@2200	75@2200	90@2200	100@2200
Peak torque [Nm@rpm]	375@1400	475@1400	480@1400	500@1400
After-treatment device	DOC	SCR	SCR	SCR
Emission compliance	Stage IIIB - Tier 4 Final	Stage IV - Tier 4 Final	Stage IV - Tier 4 Final	Stage IV - Tier 4 Final

The KOHLER Engines KDI series has rapidly made its mark on the market, thanks to its innovative construction technology and flexible production platform, thus offering solid benefits to OEMs and final users alike.

This success is proven by the great number of OEMs choosing the KDI engines for their applications, many of which will be on display at EIMA 2016: ANTONIO CARRARO Spa, ARBOS-LOVOL GROUP Spa, BCS Spa, BERTOLI Srl, C.G.M. GRUPPI ELETTOGENI Srl, CARAVAGGI Srl, CARON OFFICINE E BREVETTI Srl, COMACA Srl, DURSO Srl, FACMA Srl, GENMAC Srl, IDROFOGLIA Srl, IRRILAND Srl, MDB Srl, MULTIONE Srl, NEGRI Srl, ORTOMECC Srl, PAZZAGLIA Srl, SRAY TEAM Srl, STARPOWER Srl, W.F.M. Srl. We asked them to describe their experience with KOHLER Engines, explaining the reasons that led them to choose the KDI engines and the benefits they offered their clients.

Antonio Carraro, a historic Veneto company that is among the world's leading manufacturers of compact tractors for specialised farming and the civil industry, chose to install the KDI 2504TCR engine on its new TTR 7600 Infinity, a highly versatile new-concept tractor equipped with hydrostatic transmission. As stated by Chiara Romanello, Head of Public Relations at Antonio Carraro, *"The TTR 7600 Infinity has highly distinguishing features, and consequently very special requirements, also in terms of powering. Particularly in its design phase, we sought a reliable, very compact and lightweight engine as driving unit, which at the same time could offer high power with, of course, emission control standards in line with future regulations."* Why did you choose KDI engines? *"Our choice fell on the KDI engine because after a long testing period under the most diverse operational conditions and at some of our major customers' farms, we observed performance levels that far exceeded our highest expectations, combined with a very low fuel consumption. With its particularly compact dimensions and an engine displacement of 2,500 cc, the KDI 2504TCR indeed offers a high power density and delivery characteristics that, in addition to being particularly suitable for applications involving tractors, allow to get the best performance under any operating condition."* What benefits have you gained by using this KDI engine? *"The first and most obvious benefit was no doubt its ease of installation, thanks to its compact size and*

narrow profile. Installing it on the machine was not only very easy but also allowed us to obtain perfect balance and weight distribution, which are essential under heavy duty operational conditions such as those of working on extremely sharp slopes. These benefits come combined with high performance and, equally important, a high comfort level thanks to low engine vibrations."

What is it that satisfies you the most in your relationship with KOHLER Engines? *"When it comes to implementing a new engine on a new machine, the support offered by the manufacturer is of critical importance during the engineering, development and testing phases. In this respect, KOHLER Engines fully supported us with meticulous care and prompt assistance in every step of this machine development process."*

Antonio Carraro will display the new **TTR 7600 Infinity** equipped with the **KDI 2504TCR** engine at its stand at EIMA 2016 (HALL 36 - STAND B5).

Why did Antonio Carraro choose the KDI engines?

The KDI engines offer the best performance in their category. Specifically, the high torque values at low speeds (up to 410 Nm/l for the 3404 model) as well as optimised power and torque curves (rising up to 50%) allow the use of the KDI engines also in place of higher displacement engines, thus reducing consumption and lowering costs. In addition, their high performance density means that our machine will be ready to respond to any condition of use, especially when it comes to required power peaks.

The removal of DPF, for compliance with the IIIB emissions level, further contributes to engine compactness and facilitates its mounting even on machines whose engine compartment size is small. Compact size is not the only feature that helps make KDI engines installation easy. The two auxiliary lateral Power-take-offs (PTOs), SAE A and SAE B, designed to transfer maximum power from the engine, ensure a perfect integration with the machine hydraulic system in order to effectively drive all commonly used accessories, to interface with any type of transmission and, finally, to reduce the space needed for implementing the application.

This versatility is also combined with the fact that the engines come ready to accept additional accessories, allowing the installation of compressors for air conditioning and pneumatic braking circuit (optional).

The positioning of some components has been optimised as well, according to the needs of farm machinery manufacturers. The fan, for example, was placed on the upper part of the engine, to move the cooling fan axis further from the engine crankshaft. This allows to use the front PTO and narrow and high profile radiators, contributing to both optimising cooling and facilitating installation in common tractor engine compartments.

BCS Group, the multinational corporation specialising in the design and manufacturing of agricultural and lawn and landscape maintenance machinery, uses the 50 HP KDI 2504M for most of its mid-range tractors, and is currently overseeing the implementation of the same engine in its 75 HP *common rail* version in its high-range tractors. "As manufacturers of specialised tractors," points out Roberto Pini, Export Sales Director at BCS, "the key features we look for in engines are an optimal ratio between compactness and performance, high reliability and, above all, low fuel consumption. Another topic of current concern is emissions. We are going through a particularly difficult time for diesel engines, with so many regulations affecting their use. The future will be played out also, and mainly, on that front. Last, but not least, factor is the availability of global service. Our machines now have a considerable impact on profitability, and consequently prompt assistance in case of a breakdown and fast worldwide spare parts availability represent the winning cards." Why did you choose KDI engines? "As I've already mentioned, our machines are extremely compact in size; in light of this our marketing department, followed by our R&D department, rated the various solutions available in the market before choosing KDI, which was judged to be the most innovative high-performance engine series, in addition to having the characteristics best suited to our tractors." What benefits have you gained by using this KDI engine? "We increased sales of tractors in the power range where we had introduced the KDI engines, but beyond that, our choice allowed us, in a sense, to inject new life in the "100% Made in Italy" concept which at this moment in history is very attractive in international markets." What is it that satisfies you the most in your relationship with KOHLER? "The special relationship between two companies that played a part in the history of agricultural mechanisation cannot be measured merely by certain specific aspects, as it was created and has been growing spontaneously and is based mainly on personal relationships and mutual trust. In the 50s Elvis released his "Jailhouse rock" hit, the national Italian power grid did not reach all homes, but BCS and Lombardini were already collaborating successfully. More than half a century of profitable business ties are an excellent starting point for facing together the challenges of tomorrow."

BCS Group will display the **Ferrari Cobram 60 RS** tractor, one of the Group's best-selling machines, equipped with the **KDI 2504M** engine, at EIMA 2016 (HALL 19 – STAND B2).

Why did BCS Group choose KDI?

The biggest challenge facing KOHLER Engines these days is to meet the increasingly more complex geography of emissions. It is accomplished using a streamlined and modular after-treatment system (DOC, DOC + SCR and fitted for DPF system integration in preparation for 2020 when Stage V emission standards will come into force).

The various models (KDI 1903, KDI 2504 and KDI 3404) with their different settings come with all the certifications required for their range (up to 100 kW) by the European Union (EU: Stage IIIA, Stage IIIB, Stage IV), by North America (EPA: Tier 4i, Tier 4 Final) and by other countries outside the EU (China and Korea: (Tier III or equivalent)).

In addition, the KOHLER Engines solution provides special dual stage fuel filtration systems, which also allows the use of low quality diesel fuel without risking engine operation.

Conversion kits allow the remapping of the ECU by *de-tiering* the engine in machines that are to be sold in countries where there are no limits on exhaust emissions. It is precisely this application and configuration flexibility that makes KDI the leading manufacturer of 37 to 100 kW engines. Being a common base platform, which by following simple steps can be adapted to locally required emissions standards, is a great benefit to all builders, who can design a single machine model intended for different markets with different required emission levels.

Facma, since 1971 a builder of farm machinery and equipment for harvesting, cleaning, sorting, storing, selecting, drying and transporting, installs the KDI 2504M engine on its C200S self-propelled nut harvester. *"We were looking for an engine that, in addition to complying with new pollutant emissions regulations, has very specific construction characteristics,"* says Michela Bellachioma of Facma, *"including a mechanical rather than common-rail injection system and a four-cylinder architecture; besides, it should deliver maximum power to suit the application (in our case the chosen engine power was 37 kW) and, last but not least, it should have very compact dimensions for easier installation on a harvester, which is very complex as it is."*

Why did you choose KDI engines? *"We decided to go with the KDI engine because it had all the features we had been looking for. The other solutions available on the market offered a three-cylinder configuration, which is inherently more likely to cause vibrations and therefore deemed unfit for our specific applications. In addition to these considerations, the engines also ensure excellent power delivery characteristics at low RPM speeds and great consumption control. Last but not least among other reasons was the important role played by our trust in a historical national brand such as Lombardini."* What benefits have you gained by using this KDI engine? *"Adopting the KDI engines allowed us to bring to market a very compact mid-size self-propelled harvester that could meet the needs of farmers operating in medium-small fields at a very competitive price, and, most importantly, equipped with an engine whose performance perfectly fits the type of work and operational requirements of its target machine."* What is it that satisfies you the most in your relationship with KOHLER Engines? *"Every aspect of our business relationship with KOHLER Engines, established after we chose and implemented its engines, has been extremely satisfactory: from the absolute transparency of the business offer and the excellent product quality-price ratio to the timely order submission and compliance with the established delivery dates,*

excellent after-sales service and, especially, technical assistance, helping us resolve and fix problems promptly on the field." The **C200S** self-propelled harvester, equipped with the **KDI 2504M** engine, will be on view along with other machines at the company's stand at EIMA2016 (HALL 29 - STAND A16).

Why did Facma choose KDI?

KDI engines boast fuel consumption rates that are much lower than other engines in the same category, with performance levels that match those of larger displacement engines thanks to an advanced injection system (common rail 2000 bar, EGR valve, and four valves per cylinder) and no DPF. Thanks to the high torque output at idle, machine productivity is maximised and the engine responds instantly to loads even at low speeds. This means a 15% productivity increase, compared to competitors' engines.

Negri, a manufacturer of bio-shredders, the machines used for shredding products of landscape pruning for composting purposes, called upon KOHLER Engines to provide an engine for its R640 shredder, the company's top ranking product. The requested engine was the 75 HP KDI 2504TCR. *"The first parameter that led us to choose this solution,"* says Marco Negri, the company CEO, *"was our need to build a machine that in its final form had to have an overall mass of around 3,500 kg; it was a mandatory condition for us, in order to allow the shredder to be towed by vehicles of similar weight. This condition dictated the use of a compact engine, with no DPF and none of the complex circuitry associated with it; an engine below 56 kW allowed us to keep the machine small and at the same time satisfy our functional requirements both in terms of performance and fuel consumption."* Why did you choose KDI engines? *"We decided to go with the 75 HP KDI 2504TCR for a very simple reason: after a detailed analysis of products available on the market we determined that the range of products offered by KOHLER Engines was the only one to offer the kind of solutions that would fit perfectly the design parameters of our machines, in terms of both engineering and final performance."* What benefits have you gained by using this KDI engine? *"The first and most obvious benefit, as I've mentioned, was the possibility of developing a machine based on an engine that did not require a diesel particulate filter, which in itself would have resulted in a considerable weight and size increase - and, quite importantly, a substantial cost hike - yet at the same was perfectly able to meet our power delivery requirements combined with low running costs."* What is it that satisfies you the most in your relationship with KOHLER? *"Our business relationship has been excellent from all points of view: starting from the timely technical assistance we have received as early as during our machine design phase and continued throughout the following engineering and testing phases, crowned by KOHLER's approval of the final application. This kind of support is essential for any manufacturer, and we are certain we can count on it also as regards an excellent and crucial after-sales technical assistance."* The **R640**

bio-shredder, equipped with the **KDI 2504TCR** engine will be on display at the company's stand at EIMA (HALL 35 - STAND B22).

Why did NEGRI choose KDI?

The combination of compact dimensions, best-in-class performance, low fuel consumption, ease of installation and a series of other characteristics designed specifically for agricultural applications make the KDI engine series a solution that maximises productivity and efficiency, reduces maintenance costs while ensuring compliance with emission standards -- from the most restrictive to the least restrictive. The strength and torsional rigidity of the *bedplate* architecture are ideal when it comes to installations on agricultural tractors, in which the engine becomes a structural part of the machine and must sustain considerable stresses that are common in these applications; also from the point of view of size, the KDI engines are suitable for applications in the farming industry, especially thanks to their narrow profile, which allows smaller steering radii and thus improves substantially machine behaviour during manoeuvring. We should not forget to mention, finally, the streamlined and modular after-treatment system (DOC, DOC + SCR and ready for DPF system integration in preparation for 2020 when Stage V emission standards will come into force), a common base platform, which by following simple steps can be adapted to locally required emissions standards.

Lovol Arbos Group, an industrial holding company specialising in the production of agricultural machinery and a complete line of integrated tools covering the entire agronomic cycle, decided to install the KDI engines on its new Arbos 5000 tractor series, to be officially launched at EIMA 2016. As stated by Alessandro Zambelli, Lovol Arbos Group's Marketing Manager, *"Our design philosophy is focused on a very well defined goal: deliver innovation, performance, reliability and ease of use and maintenance. Finding the right combination of these elements, which cover the entire machine life cycle, from its early design phases to after-sales customer service, was the challenge we faced in developing the new Arbos 5000 series. In light of these conceptual ground rules, choosing a KDI product - an engine featuring state-of-the-art design, high performance, reliability, low fuel consumption and easy maintenance - came almost naturally."* Why did you choose KDI engines? *"In summary, KDI engines follow and implement our own ambitions as well as meet similar technological challenges: consequently, they offer a solution combining performance with innovative technologies to make the engine compact, reliable and high-performing. On the one hand, their strength and rigidity are well suited to structural installations on agricultural tractors, as are their low vibration rates, narrow profiles and readiness to accept numerous optional accessories. And when we examine their performance, we find that their power density and delivery curves are ideal for agricultural applications. Without forgetting, of course,*

their very low fuel consumption." What benefits have you gained by using this KDI engine? *"Designing the implementation of the engine in the machine was particularly easy – thanks to its compact size and the external placement of the SCR system – and produced an optimised use of space and greater operational efficiency. Performance levels on the field completely satisfied our technicians, first, and our most demanding customers, later, mainly thanks to the KDI engine high and constant torque values even at low speeds, providing a wide operating range."* What is it that satisfies you the most in your relationship with KOHLER? *"KOHLER Engines has been one of our strategic partners during the Arbos 5000 project. Our cooperation has been tight and constant at every stage of the series development, enabling us to build a product that fully met our goals."* The new **5000 series**, equipped with the **KDI 3404TCR** engine, will be on display at the company's stand (HALL 19 – STAND B2); the new 5000 series models will also be available for an actual dynamic test by farmers who would wish to test their quality.

Why did Lovol Arbos Group choose KDI?

The KDI 3404 engine comes with a SMART AFTER-TREATMENT System: the entire range of KDI engines uses only DOC to comply with the current regulations for under 56 kW engines. This allows manufacturers to produce machines with compact engine compartments, increasing operator visibility and thus improving safety and productivity. With such a system, the external dimensions are reduced and the work cycle is not interrupted, thus increasing productivity. In addition, it is not necessary to shield the machines to prevent excessive heat loss and the consequent risk of fire. In models exceeding the 56 kW limit, the KDI 3404 engine complies with Stage IV - Tier 4 Final emissions standards thanks to the use of an SCR (Selective Catalyst Reduction) system to reduce NOx levels in exhaust gasses. The special SCR device was chosen by KOHLER Engines as part of its "best fit" philosophy. The all-in-one SCR system combines the DOC (Diesel Oxidation Catalyst), the mixing pipe and of course the SCR device in a single component. The extremely compact size of this entire component and the possibility of mounting it at any angle greatly simplify its integration with the machine.

KOHLER Engines welcomes Stage V

Once again, KOHLER Engines is committed to delivering the latest-generation solutions to our customers around the world, in line with our guiding principle, "To always be on the leading edge of technology and innovation."

By 2019, the new generation of KDI engines will come with integrated particulate filters in conformance with Stage V emission requirements. Our design team is developing a very compact innovative after-treatment solution.

The solution will be based on a passive regeneration approach and will be transparent to OEMs and end users. Passive regeneration is a continuous process that allows the DPF device to operate while the machine is in use.

Thanks to Stage V solution, our KDI platform will maintain its current best-in-class performance levels and its low operating costs.

The new generation of KDI Engines will be unveiled at the upcoming AGRITECHNICA fair (10-18 November 2017).