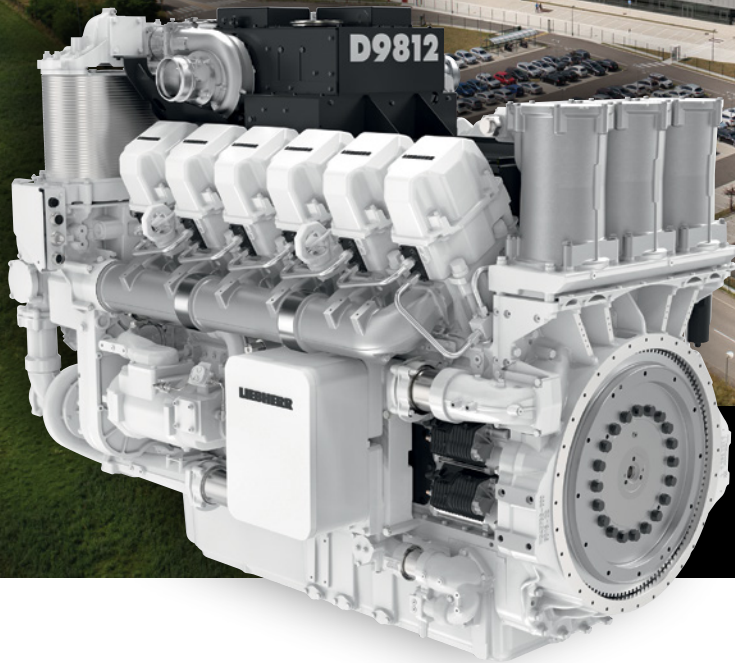


ENGINES

The new D98 series diesel engines by Liebherr have been designed, developed and tested at Liebherr's new facility in Colmar, France, where they will also be produced. The manufacturing plant was erected in the newly developed Colmar industrial zone and has room for expansion.



With a rating of 2699 hp, the 12-cylinder, vee-configuration D9812 diesel engine by Liebherr is the first model of the new D98 series of large diesel engines designed for mining applications. The engine series will include also V16 and V20 variants that will reach the market by 2018, the company said.

NEW MINING ENGINES

Liebherr launches large diesel engine series developed for mining vehicles, calls them its most powerful engines ever

BY ROBERTA PRANDI

Liebherr Components is launching a new family of diesel engines for mining equipment as well as other off-highway applications. They will offer up to 58.3 hp/L, the company said.

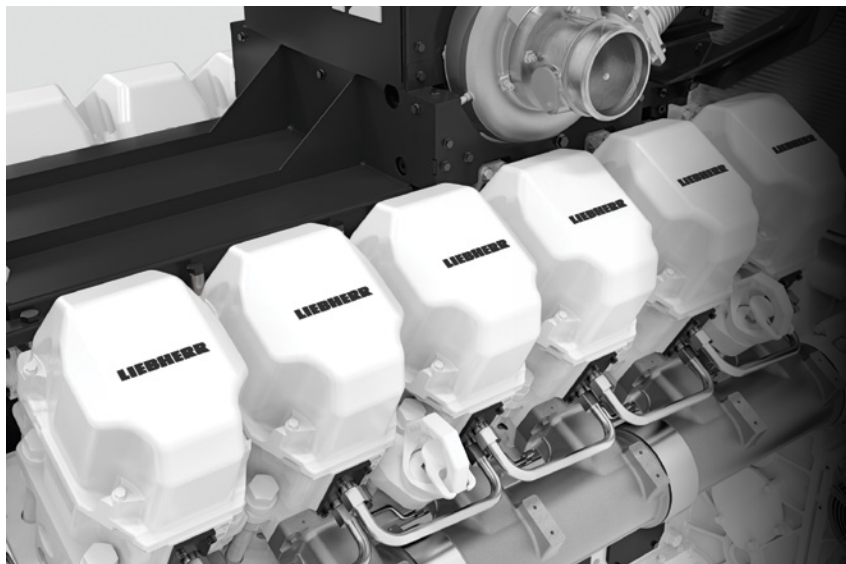
The first engine variant — a 12-cylinder rated 2699 hp — will be introduced at MINExpo 2016 and be available in 2017 from Liebherr's manufacturing plant in Colmar, France.

Diesel Progress talked to Diethard Plohberger, managing director, Liebherr-Components Colmar SAS, who was responsible for the development and design of the new engines, and to Jens Krug, managing director, Liebherr-Components Colmar SAS, responsible for production, about the new developments.

Diesel Progress: Liebherr is developing a new family of diesel engines and launching the first model — the 12-cylinder, vee-configuration D9812 model. What are the features of this new engine?

Diethard Plohberger: Liebherr has designed the new D98 engine series as a mining engine. As such, it features some specific characteristics and important components particularly designed for work in a mining excavator or a truck. These are, for example, an improved oil and cooling system, special wiring harness and connectors and other small but important details.

As the new D98 engine series will also be used for other applications in the future, we set up the engine



The engines in the Liebherr D98 series will use common components intended for high standardization and modularity. These include Liebherr's 11.5 common rail fuel injection, turbocharger, engine control unit (ECU) and high-pressure fuel pump.

family in a standard and modular design to deal with the different requirements. This entails minimum hardware changes between the different applications and power output levels. All engines use only one common type of turbocharger, with their number varying according to the respective power output.

Following that principle, one type of engine control unit (ECU) and high-pressure fuel pump, among others, are used for all engines. Different power output and rated speed levels are available according to the requirements of the customer. The simplified design allows for better serviceability of the engine and the machine, for lower spare parts stock, less training for operating and service personnel and lower effort in production and development.

Another feature of the new D98 engine is the built-in safety function. This regulation ensures low vibration levels of the engine and the respective drive train.

Our design goals for the new D98 engine family have been ease of industrial use and lowest cost of ownership. Overall, we put extensive effort into the simulation of the engines and their installation in the machines.

DP: The new D98 Series offers high system integration, with all key components coming from Liebherr in-house developments. Can you give us some examples and explain if this approach will become common on all Liebherr engines?

Plohberger: All variants of the D98 series feature, among other parts, ECUs and common rail fuel injection systems designed and manufactured by Liebherr. We started to use our own components back in 2013 in our D93 and D94 inline engine series and have since incorporated Liebherr ECUs in the D9508 and D9512 vee-configuration engines that are manufactured in the Bulle plant in Switzerland. So yes, a high degree of vertical integration will become common on all Liebherr engines. We have a long tradition in the so-called vertical integration of products and have insourced many major and strategically important components.

DP: The new D9812 is said to have very low fuel consumption. Can you share some figures and explain for which applications and duty cycles they apply?

Plohberger: With the D9812, we achieved fuel consumption values down to 0.312 lb./hph on the test stands for many duty cycles. We expect to exceed the benchmark fuel efficiency for excavators and trucks, and we are confident regarding other future applications. This is possible due to a low mechanical friction layout and the very high peak pressure capability of 3626 psi.

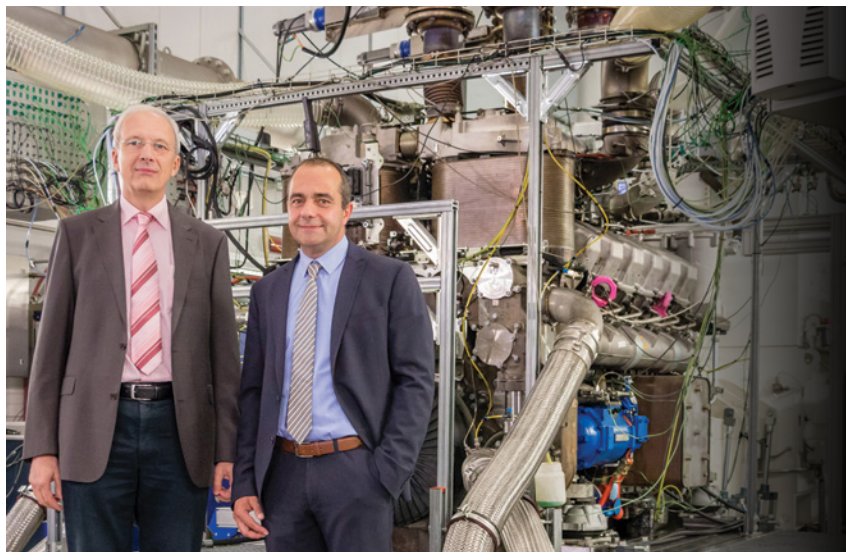
Further in-operation fuel efficiency improvements will result from down-speeding the engines in excavators and trucks. With our system approach and the resulting close cooperation with the customers, we believe the new Liebherr D98 engine will set a new benchmark in terms of efficiency and total cost of ownership.

DP: The new engine has a newly developed selective catalytic reduction (SCR) system. What are its characteristics and how does it differ from SCR systems previously used by Liebherr?

Plohberger: For Tier 4 emissions requirements, Liebherr will use SCR-only technology. During the optimization of the internal combustion process, we minimized the emissions levels to such a degree that we can use a simple and maintenance-friendly SCR system for the nitrogen oxides (NO_x) aftertreatment. The new system will be as modular as the D98 engine. The minimal hardware variations provide flexibility with regard to different emission levels and applications.

DP: The D9812 engine is being launched for the mining market first. What makes it especially attractive for this market?

Plohberger: The D98 engine has been designed according to customer requirements on engine operation under the most demanding environmental conditions. These are heat, dirt, humidity, bad fuel and oil qualities, high altitudes, arctic conditions and others. The new engine family deals with these challenges by means of a rugged and clear design.



Diethard Plohberger (left), managing director Liebherr-Components Colmar SAS, was responsible for the development and design of the new D98 engine series. Jens Krug (right), managing director Liebherr-Components Colmar SAS, is responsible for production.

Special features, such as an adapted oil and cooling system, and a specialized electrical system complement the basic mining engine. For the first time, our customers will get an engine dedicated specifically to the mining business.

DP: What other markets and applications do you expect the D98 Series to reach?

Plohberger: The first focus is mining applications. However, the compact and powerful engine design also makes the engine attractive for the power generation industry. Additionally, the rugged design and the high-performance turbochargers would also be beneficial for industries such as oil and gas or railway applications.

DP: The D98 series engines have been designed, developed, assembled and tested in the new Liebherr facility in Colmar, France. What are the main characteristics of this plant? Is it new construction or an updated facility?

Jens Krug: Liebherr already has two machinery plants in Colmar. However, the facility of Liebherr-Components Colmar SAS was a greenfield project to be ideally prepared for the present and future requirements of the market with regard to flexible and cost-efficient production.

During the design phase, the latest production technology was incorporated in the factory layout. Particular emphasis was placed on keeping all the processes in logistics and assembly lean and efficient. During the construction period, these ideas were consequently implemented and optimized.

We are especially proud of our state-of-the-art test benches. They are not only equipped with everything we need for development and series testing but are also environmentally friendly, as we recover the energy they need for combined heat and power generation.

DP: What is the manufacturing capacity of the plant when reaching full production?

Krug: The production capacity will be set up according to the market demands and requirements. Our modular and lean production and logistic concept can follow the highly

dynamic markets we are facing in certain applications, such as mining. The facility will be able to produce cost-efficient quantities during the production startup phase and has a lot of potential to grow in the next years, especially as it is a greenfield factory.

DP: What is the expected schedule for the other members of the D98 family — the V16 and V20 variants — to reach the market?

Krug: The V12 is currently in the field test phase and will be ready for production startup over the course of 2017. The plan is to launch the V16 after that and then the V20. Our aim is to provide the full range of the D98 engine program by 2018.

DP: Are there further developments being expected in terms of new investments or new products? Any particular market or application that is being targeted?

Krug: In the next few years, we will focus on bringing the models of the D98 family into series production. Aside from that, we will expand our modular engine concept to fit the requirements of other applications besides mining, including the various relevant emission regulations. As Mr. Plohberger mentioned, we will target the oil and gas, railway and power generation industries.

DP: The worldwide market for mobile working machines has changed a lot in recent years and is still undergoing many transformations. How do you see Liebherr-Components Colmar SAS positioning in this arena, perhaps five years from now?

Krug: At the moment, the market is stagnant in certain applications. Nevertheless, we are positive that there is good potential for the D98 engines in different industries in the future. As mentioned before, the setup of our production facility enables us to follow the high dynamics of those markets. **dp**



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