

Press release

Liebherr and Tula join research activities

- **New study on heavy machinery confirms significant reductions in greenhouse gases and NOX emissions with Tula’s dDSF technology**
- **Liebherr and Tula reveal results at International Engine Congress held in Baden-Baden (Germany)**

San Jose (CA, USA)/ Nussbaumen (Switzerland) – March 10, 2022 – At the International Engine Congress in Baden-Baden (Germany), Liebherr-Components AG and U.S.-based Tula Technology presented the results of their joint study on heavy machinery. Together, the companies carried out research on reducing greenhouse gases (GHG) and nitrogen oxides (NOX) produced by heavy-duty equipment. Based on simulations, Tula’s diesel Dynamic Skip Fire (dDSF™) software allows the reduction of NOX tailpipe emissions by 41% and carbon dioxide (CO2) by 9.5%. For this study, Liebherr Machines Bulle SA provided its D966 engine that operates in a variety of applications, like mobile or maritime cranes and wheel loaders.

Integration of software into other Liebherr engines possible

The results of the research could influence the development or manufacturing of off-road equipment worldwide in a positive way. Therefore, Liebherr-Components will continue its activities in designing a “proof of concept” hardware for the integration of Tula’s dDSF software into their engine system. The D966, a very compact 13.5 litres 6-cylinder diesel engine, will also be used in further tests. In the next step, Liebherr will consider the integration of the dDSF software into other engines in its portfolio.

“Liebherr is a forward-thinking company focusing already today on the challenges that customers around the world will face tomorrow,” says Ulrich Weiss, Managing Director for Research and Development of Combustion Engines at Liebherr Machines Bulle SA. “The reduction of greenhouse gases and nitrogen oxide emissions is the goal that we strive to achieve, while continuously improving our engine’s performance.” The results of the joint study indicate that dDSF play an important role in addressing these challenges, being part of future solutions, which will help in reaching zero emissions.

Efficient engine operation and low level of tailpipe emissions

R. Scott Bailey, the President and Chief Executive Officer of Tula Technology explains: “At Tula, we are driven by a passion to increase efficiency in engines and motors of all types and also improve the environment. While there are existing regulations to reduce emissions in off-road machinery and vehicles, more stringent standards are expected within the decade. To comply, equipment manufacturers need solutions like our patented dDSF software to operate engines more efficiently and produce dramatically lower levels of tailpipe emissions.”

Tula's technologies provide cost-effective solutions that are proven to increase engine efficiency. In series production since 2018, Dynamic Skip Fire (DSF®) uses patented algorithms that choose to skip or fire individual cylinders dynamically to meet an engine's torque demands. This enables near-peak engine efficiency for a cleaner burning, as well as more fuel-efficient vehicles. Noise and vibration are proactively mitigated by manipulating the firing pattern and cylinder loading. As a result, DSF has been deployed in more than 1.5 million passenger vehicles to date. The released study adds to the growing list of successful applications of Tula's technology for diesel dDSF, including passenger cars, commercial vehicles and heavy machinery – with its main goal to reduce GHG and NOX as major contributors to global warming.

About Tula Technology, Inc.

Silicon Valley-based Tula Technology provides innovative award-winning software controls to optimize propulsion efficiency and emissions across the mobility spectrum, including gasoline-powered, diesel, alternative fuel, hybrid, and electric vehicles. Tula's culture of innovation has resulted in breakthrough technologies and a robust global patent portfolio of more than 380 patents issued and pending. Tula Technology is a privately held company backed by Sequoia Capital, Sigma Partners, Khosla Ventures, GM Ventures, BorgWarner and Franklin Templeton. More information is available at www.tulatech.com.

About Liebherr-Components AG

In this segment, the Liebherr Group specialises in the development, design, manufacturing of high-performance components in the field of mechanical, hydraulic and electric drive and control technology. Liebherr-Component Technologies AG, based in Bulle (Switzerland), coordinates all activities in the Components product segment. The extensive product range includes combustion engines, injection systems, engine control units, axial piston pumps and motors, hydraulic cylinders, slewing bearings, gearboxes and winches, switchgear, electronic and power electronics components, and software. The high-quality components are used in cranes and earthmoving machinery, in the mining industry, maritime applications, wind turbines, automotive engineering or in aviation and transport technology. Synergy effects in s other product segments of the Liebherr Group are used to drive continuous technological development.

About the Liebherr Group

The Liebherr Group is a family-run technology company with a highly diversified product portfolio. The company is one of the largest construction equipment manufacturers in the world. It also provides high quality and user-oriented products and services in a wide range of other areas. The Liebherr Group includes over 140 companies across all continents. In 2020, it employed around 48,000 staff and achieved combined revenues of over 10.3 billion euros. Liebherr was founded in Kirchdorf an der Iller in Southern Germany in 1949. Since then, the employees have been pursuing the goal of achieving continuous technological innovation, and bringing industry-leading solutions to its customers.

Image



liebherr-d966-diesel-engine.jpg

Liebherr D966 inline engine is tested with Tula's diesel Dynamic Skip Fire software.

Contact Liebherr-Components AG

Alexandra Nolde

Senior Communication & Media Specialist

Phone: +41 79 538 53 46

E-Mail: alexandra.nolde@liebherr.com

Contact Tula Technology, Inc.

Ram Subramanian

Principal Marketing Strategist

E-Mail: ram@tulatech.com

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Liebherr-Components AG

Nussbaumen/ Switzerland

www.liebherr.com/components

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