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Dynamic Skip Fire Slashes Diesel NOx Emissions

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Executive Summary

Cummins and Tula combine forces to demonstrate the merits of applying cylinder-deactivation technology to diesel engines.



TULA SAYS DDSF INCREASES DIESEL FUEL EFFICIENCY 20%.

Tula Technology says the latest application of its cylinder-deactivation technology on a Cummins diesel engine yields a significant reduction in nitrogen oxide emissions as well as a smaller dip in carbon-dioxide.

In a California Air Resources Board low-load test applying Tula's diesel Dynamic Skip Fire (dDSF) on a Cummins diesel engine in a Class 8 truck, NOx emissions dropped 74% while CO2 fell 5%, the companies announce at the 2021 Society of Automotive Engineers World Congress. Fuel efficiency on the low-load cycle improved 20% compared with an enhanced current clean diesel, and about 3% on an overall driving cycle basis.

Dynamic Skip Fire, which shuts down individual cylinders depending on load and torque demand, has been in production on gasoline engines since 2018. More than 1 million vehicles employ the fuel-saving technology, including many of General Motors' V-8-powered pickups and SUVs where it is dubbed Dynamic Fuel Management.

The gas application of DSF shuts down spark, fuel flow and air flow by closing intake and exhaust valves cylinder by cylinder while diesel DSF (dDSF) drops out fuel supply and closes valves to achieve the same effect. Tula says there is no loss in power or torque with dDSF, with full power available on demand.

The engine used for the dDSF study was a 14.9L inline 6-cyl. Cummins X15 Efficiency Series with a maximum power of 500 hp and peak torque of 1,850 lb.-ft. (2,508 Nm), however Tula notes dDSF is equally applicable to all X15 variants.

The low-load cycle is a relatively new diesel certification test developed by Southwest Research Institute in Texas to measure real-world NOx emissions in low engine-load use, such as idling or at low speeds when exhaust aftertreatment systems operate a cooler temperatures. Low-load conditions typically require substantial extra fuel to be burned to keep the SCR emission-control system operating at high efficiency. The test is expected to be adopted by CARB in 2024.

Tula says dDSF shines in this cycle due to its ability to reduce NOx and conserve fuel at the same time by increasing the exhaust temperature and enabling better NOx reduction.

"NOx standards are becoming progressively more stringent for diesel engines and meeting those standards is increasingly challenging, even for a class-leading, efficient engine like the Cummins X15 HD," says R. Scott Bailey, president and CEO of Tula Technology.

“Our dDSF is a powerful and unique technology that enables original equipment manufacturers to significantly reduce NOx emissions that contribute to smog while simultaneously reducing fuel consumption and greenhouse-gas production.”

Lisa Farrell, director-Accelerated Technology Center for Cummins, says the dDSF research is a promising technical advancement.

“Many new technologies will be used to address these future emissions regulations and we will utilize those that are the best for our products and our customers,” Farrell says.



CUMMINS X15 EFFICIENCY SERIES
DIESEL ENGINE.