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Could SuperTurbocharger Become The Hero On Fuel Economy?

STREET SMARTS IS A MONTHLY COLUMN DEVOTED TO THE ON-HIGHWAY TRUCK MARKETS. STEVE STURGESS IS EXECUTIVE EDITOR OF *HEAVY DUTY TRUCKING.*

An easily missed announcement of a joint development program between Cummins and a start-up, VanDyne SuperTurbo, points the way to a future technology that could result in as much as 7% fuel savings for heavy trucks. This agreement is part of the Super Truck program, a cost-sharing initiative between the U.S. Dept. of Energy (DOE) and the private sector that has teams from Cummins/Peterbilt, Daimler/Detroit Diesel and International Truck and Engine.

In the case of the Cummins development with VanDyne, the distinctive technology is the combination of the turbocharger as a conventional inlet air charger but also as a power-driven inlet charging device — hence the name SuperTurbocharger. As such, it is mechanically coupled to the engine. When powered, it acts like a supercharger. When it delivers power — along with turbocharging — it functions in a turbo-compounded mode, adding a small additional horsepower boost through the combination of the turbocharger and its transmission. The key to its potential success is the constantly variable ratio for the gearing between the turbo and the power input/output shaft.

At low engine speeds, the turbocharger is powered by the engine through the CVT, resulting in instant throttle response and enhanced torque. As the engine speeds up and the turbo spools up, it extracts power from the exhaust to both charge the inlet air and to power the output shaft of the CVT to add to the crankshaft power.

Turbocompounding is not new to trucks — for a while, Scania offered the technology on its engines in Europe and some export markets. Currently, Detroit Diesel uses it with great success on the DD15 and DD16 engines, where the compounding is responsible for some of the fuel economy gains of the new engines and is also in part responsible for the extremely fast response of the DD15 and 16 to demands at the throttle pedal.

Cummins' Director of Strategic Planning and Advanced Engineering, Dr. Vinod Duggal, said this is what attracted Cummins to the VanDyne technology, "We are looking for how the SuperTurbo can help with turbocompounding and with the ability to improve the transient response of the engine."

Cummins was awarded $39 million under the DOE Super Truck program to specifically develop more fuel-efficient ways to move freight using heavy-duty Class 8 trucks. The goal is to improve vehicle freight efficiency by 50% through advanced and highly efficient engine systems and vehicle technologies that meet prevailing emissions and safety requirements.

According to VanDyne SuperTurbo President and CEO, Ed VanDyne, the Cummins development is timed for spring 2011 and will be on an existing engine platform that already meets 2010 emissions. "We are anticipating a 5 to 7% efficiency gain when using the technology in association with a heavy-duty diesel engine," Van Dyne commented. "This is nothing like the 36% efficiency gain when used with a downsized, normally aspirated gasoline engine, but in commercial transportation a 5 to 7% gain represents savings of many thousands of dollars every year.

"Downsizing is not on the list of features Cummins is looking to explore, even though the improvement in transient response does help vehicle launch," said Stanton. "Moving freight is the goal of the Super Truck project, and that takes the sort of heavy-duty engines that we have today."

So far there are two prototypes of the SuperTurbocharger running, one in the laboratory at Colorado State University and another with a passenger car OEM in Europe. There, the dual attributes of the SuperTurbocharger allow for a downsizing of the car engine by 50% with no loss of torque or performance. VanDyne said the efficiency gains from the gasoline engine far exceed the improvements for a big diesel. "Combining the downsizing of the engine and the efficiency gains from the SuperTurbocharging, we are looking for a 36% efficiency improvement using a gasoline engine," he said.

While the Cummins development program is likely to be several years before any commercial decision is made, VanDyne anticipates being in limited production in 2011 with volume production in 2012, by which time the predicted on-cost for a gasoline engine will be as little as $350.

In the announcement of the joint development with Cummins, Stanton said, "Exploration of the VanDyne technology is an exciting complement to Cummins' technologies portfolio to provide greater vehicle fuel economy and improved driveability." He added. "Our collaboration with VanDyne SuperTurbo exemplifies Cummins' commitment to provide innovative engine technologies to meet fuel-efficiency demands of the trucking industry." dp