



**BORGWARNER INTRODUCES FIRST**  
**THREE-STAGE TURBOCHARGING SYSTEM**  
**FOR MAXIMUM POWER DIESEL ENGINES**

*BorgWarner Sets New Benchmarks in  
Increased Performance and Improved Fuel Economy with  
Three-stage Turbocharging Technology for Premium Vehicles*

Auburn Hills, Michigan, November 8, 2012 – For the first time, BorgWarner supplies its innovative three-stage turbocharging technology for BMW's M Performance diesel engine, the most powerful six-cylinder in-line diesel engine in the world. Exclusively developed for BMW M Performance automobiles, the engine powers the M550d xDrive Sedan and Touring, X5 M50d Touring, and X6 M50d models. With a maximum output of 280 kW (381 HP) and a maximum torque of 740 Nm (546 lb-ft), the 3.0-liter engine uses BorgWarner's three-stage turbocharging system to deliver unparalleled performance and improved fuel economy.

“BorgWarner is proud to equip BMW's latest M Performance engine with the first three-stage turbocharging system for diesel engines in the world,” said Frederic Lissalde, President and General Manager, BorgWarner Turbo Systems Passenger Car Products. “Driven to lead the next breakthroughs in advanced powertrain technologies, BorgWarner is once again setting new benchmarks for maximum performance combined with improved fuel economy and reduced emissions.”

BorgWarner's powerful turbocharging system consists of two small BV45 high-pressure variable turbine geometry turbochargers integrated with one larger B2 low-pressure water-cooled turbocharger. By integrating an additional high-pressure turbocharger, the engine's capability to generate boost pressure reaches a completely new level compared with two-stage turbocharging systems. The three turbochargers are activated successively at different engine speeds. The first high-pressure turbocharger starts at engine speeds just above idle. With increasing revs, the larger low-pressure

## BorgWarner Inc. (BorgWarner Introduces First Three-Stage Turbocharging System for Maximum Power Diesel Engines)-2

Turbocharger comes into play. To further increase performance, the second high-pressure stage turbocharger comes on line as well with all three turbochargers working in harmony. For effective and efficient boost pressure, the exhaust flow and the supply of fresh air is regulated with maximum precision. At particularly high speeds of the low-pressure turbocharger, the wastegate valve is opened by a vacuum actuator to avoid backpressure, while pneumatically activated flaps precisely control the supply of fresh air. Indirect charge air cooling optimizes the compressed air temperature in all three turbochargers to increase engine output.

Compared with the 3.0-liter six-cylinder diesel engine in the BMW 740d boosted by a BorgWarner regulated two-stage (R2S<sup>®</sup>) turbocharging system, the BMW M550d xDrive Sedan with BorgWarner's three-stage turbocharging technology increases power output nearly 25 percent and improves fuel economy 8 percent while meeting Euro 6 emissions standards. The three-stage turbocharged diesel engine breaks new ground with its specific output of 93.6 kW per liter of displacement compared with 75.2 kW per liter in the two-stage version.

### **About BorgWarner**

Auburn Hills, Michigan-based BorgWarner Inc. (NYSE: BWA) is a technology leader in highly engineered components and systems for powertrain applications worldwide. Operating manufacturing and technical facilities in 57 locations in 19 countries, the company develops products to improve fuel economy, reduce emissions and enhance performance. Customers include VW/Audi, Ford, Toyota, Renault/Nissan, General Motors, Hyundai/Kia, Daimler, Chrysler, Fiat, BMW, Honda, John Deere, PSA, and MAN. For more information, please visit [borgwarner.com](http://borgwarner.com).

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