IT4 Emissions Solutions

New John Deere PowerTech™ PSX 9.0 L Engine for the 2011 8R/8RT Series Tractors

We’ve given a lot of thought about IT4 emissions regulations so you don’t have to

At John Deere, we understand your concerns about Interim Tier 4 (IT4) emissions regulations. That’s why we developed an advanced engine system using cooled exhaust gas recirculation (EGR) and paired it with an exhaust filter. This simple, single-fluid solution doesn’t compromise on performance, reliability, or ease of operation. We call it the new John Deere PowerTech™ PSX 9.0 L engine. You’ll call it the most hassle-free and worry-free emissions solution available.

- **We focus on you.** We’re committed to you more than any other agricultural company. In fact, we’re the only North American farm-equipment manufacturer that uses the same brand name under and on the hood of our large-horsepower tractors. We’re unique in the industry, and our IT4 solution is unique as well. That’s because we don’t take on-road engines and adapt them for the off-road market. Instead, we use proven technologies and add innovations to build an integrated solution to meet your needs.

- **We build on success.** We’ve been working since 1967 to reduce engine emissions, that’s 27 years before the current government standards were set. In 1996, we launched the PowerTech family of engines to meet Tier 1 emissions regulations. Building on our success, we pioneered the use of many advanced technologies with Tier 2 and Tier 3 engines. Every step of the way we’ve delivered reliable engines that take care of emissions compliance so you don’t have to. It’s no different with IT4. You’ll get in the cab and go ... just like you do today.

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### Cooled EGR: Simply the right choice for IT4

Beginning January 1, 2011, the United States Environmental Protection Agency (EPA) will require engines in new agricultural equipment to meet stringent IT4 emissions regulations. These regulations affect diesel engines with 174 to 750 hp, and will require a 90-percent reduction in particulate matter and a 50-percent reduction in oxides of nitrogen emissions from Tier 3 levels.

- **Particulate matter and oxides of nitrogen.** Particulate matter (PM) is called “smoke” because it comes out of the exhaust pipe in the form of smoke. It’s essentially an incomplete combustion of diesel fuel. Oxides of nitrogen, also referred to as nitrogen oxides (NOx), are called “smog” because they contribute to atmospheric pollution.

- **How cooled EGR works.** As its name implies, cooled EGR cools and mixes measured amounts of exhaust gas with incoming fresh air to lower the engine’s peak combustion temperature, thereby reducing oxides of nitrogen to an acceptable level. Exhaust gases are routed through an exhaust filter. Particulate matter is trapped in the filter and – through a process called filter cleaning – oxidized into nitrogen gas and carbon dioxide, then expelled through the exhaust pipe.

- **The right choice.** We chose cooled EGR with an exhaust filter because it’s simply the right choice for IT4. This approach requires less operator involvement and is a simpler, proven, fuel-efficient, and less-costly technology compared to alternative solutions.

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Cooled EGR doesn’t require the added cost of a second fluid (urea), and it doesn’t require you to change how you operate your equipment. There’s virtually no difference in performance between our Tier 3 and IT4 engines – and that’s by design. In fact, many of our customers who’ve driven our test machines said they didn’t notice it had an IT4 engine. What’s more, the filter-cleaning process is so simple that you may not notice it happening. This is what our customers told us they want.
The advanced design of the new PowerTech PSX 9.0 L engine provides the most convenient and cost-effective IT4 emissions solution for farmers like you. It’s built upon the legendary performance of the PowerTech Plus engine platform with all the power and performance you’ve come to expect from a John Deere. Here’s how it works on the new 2011 8R/8RT Series Tractors:

- **Increased cooled EGR flow rates.** To meet IT4 regulations, we’ve increased the cooled EGR flow rates, which are precisely measured by the new venturi and controlled by the new engine control unit. This highly evolved and patented system also provides outstanding fuel economy and improved engine performance.

- **Series turbochargers.** A fixed turbocharger and variable geometry turbocharger (VGT) provide a more efficient means to increase the intake air pressure. Filtered ambient air is drawn into the fixed turbo, pressurized, passed to the VGT, cooled, and introduced into the intake manifold. Two turbochargers enable much higher intake air pressure than what is capable with a single turbocharger. This also broadens the engine’s operating range with higher power density, increased low-speed torque, and improved performance.

- **High-pressure common-rail fuel system.** The PowerTech PSX engine is an in-line, six-cylinder design with a high-pressure common-rail fuel system. The fuel system provides constant control over fuel injection variables such as pressure, timing, and duration. Delivering higher injection pressures results in a more complete and efficient combustion to improve fuel economy and helps reduce particulate matter emissions. Other advancements include high-strength steel pistons with an integrated oil-cooled gallery for improved durability; a four-valve cylinder head for excellent airflow, and greater low-speed torque; and air-to-air aftercooler to help reduce emissions while maintaining low-speed torque, transient response time, and peak torque.

- **Smart exhaust filter.** While the engine’s more efficient fuel-delivery system reduces particulate matter, the exhaust filter removes the remaining particulate matter to meet IT4 requirements. The exhaust filter contains a Diesel Oxidation Catalyst (DOC) and a Diesel Particulate Filter (DPF). The filter automatically cleans itself during normal machine operation. There’s little operator involvement during this process and tractor performance is not impacted.

- **Simple.** The John Deere cooled EGR approach is simpler, more operator friendly, and less complex to maintain when compared to engines equipped with selective catalytic reduction (SCR) systems.

- **Proven.** John Deere was the first engine manufacturer to widely commercialize off-road Tier 3 cooled EGR diesel engines. We were the first manufacturer to incorporate a cooled EGR system with VGT technologies for off-road use. And the new exhaust filter is designed specifically to meet the high demands of off-road applications. In addition, we have over 200,000 hours of testing on our new engines.

- **Fuel-efficient.** Our cooled EGR approach leverages the proven fuel efficiency of our PowerTech Plus engine platform, which achieved best-in-class fuel economy at the Nebraska Tractor Test Lab on the 7030 Series Large-Frame, 8030 Series, and 2010 8R Series Tractors.

- **Integrated.** John Deere designs, builds, and services the engine, drivetrain, hydraulics, cooling system, and other vehicle systems as part of a complete solution to improve performance, convenience, and value. You can count on all the components working together because they were designed in tandem.

- **Fully supported.** With more than 1,600 service locations throughout North America, you’re never far away from expert assistance and advice. In addition, John Deere service personnel are highly trained technicians who stay on top of changing engine technologies and service techniques.
Questions and answers

Is this the same technology used in diesel trucks?
The demands placed on tractors and other pieces of agricultural equipment are different than the demands placed on diesel trucks. Therefore, we design the engine, its turbochargers, cooled EGR components, and the exhaust filter to specifically meet the demands of farming operations. This integrated design approach is what John Deere excels at: We design, manufacture, and service the complete package to improve performance, convenience, and value.

Does the exhaust filter technology mirror that of filters used in diesel trucks?
The exhaust-filter technology John Deere is using is similar to the technology being used in diesel trucks today. However, our exhaust filters include a diesel oxidation catalyst, not a burner. Both the filter and catalyst are designed to accommodate the more rugged conditions encountered in farming operations.

Will we continue to see similar emissions technologies trickle down from the on-road market to the agricultural industry or will there be a divergence?
Some technologies used in on-road engines will continue to trickle down into the agricultural industry. However, one of the biggest challenges is the rate at which these technologies — originally developed for on-road use — must be adapted for off-highway use. The time between adoptions has continued to decrease. Additional development time is required to make on-road technologies suitable for off-road applications. John Deere is one of the very few companies that manufacture engines exclusively for the off-road market. This specialization has given us unparalleled experience in developing, packaging, and mounting exhaust filters and engine controls rugged enough to withstand the extreme vibration, temperatures, and duty cycles found in farming operations.

What is SCR?
SCR stands for selective catalytic reduction. It’s another technology used to reduce emissions to meet IT4 requirements. Engines equipped with SCR technology usually operate at higher combustion temperatures. This in turn reduces particulate matter. Any further reduction in particulate matter is accomplished by a chemical reaction in the diesel oxidation catalyst. However, because of the higher combustion temperatures, the engine creates more oxides of nitrogen.

To reduce oxides of nitrogen, a diesel exhaust fluid (DEF), also called urea, is injected into the exhaust stream. When the exhaust gases combine with the urea in the SCR catalyst, oxides of nitrogen are broken down into nitrogen gas and water vapor and expelled through the exhaust pipe.

Why didn’t John Deere go with SCR?
There are a number of reasons. First, we spent hundreds of hours talking with our customers, during which they told us they don’t want the hassle, nor the added cost, of dealing with urea. So for IT4, John Deere is looking at not only fuel economy, but also total fluid economy. We have prioritized the needs of the owner and operator during every step of developing our complete IT4 engine lineup. The single-fluid approach of cooled EGR means the technology will be easy for operators to use and will not require additional fluid costs. Our customers asked us to keep it simple and that’s precisely what we did.

Second, we’re looking to the end result, and that’s Final Tier 4 in 2014. Proven technologies such as cooled EGR and exhaust filters will be the foundation for meeting Final Tier 4 regulations. If we removed the EGR components from our engines to meet IT4, we would need to put them back on for Final Tier 4. So from a logical engineering progression, it makes more sense to build upon our already-proven cooled EGR technology for IT4 and add the exhaust filter.

We’ve researched the different technologies, and from a global perspective, believe that cooled EGR with the addition of an exhaust filter is the best approach for meeting IT4 emissions regulations. Cooled EGR is a simple approach, has a proven track record throughout Tier 3, and is already supported by our global network of John Deere dealers.