1. What is the John Deere Integrated Emissions Control system?

To meet increasingly stringent emissions regulations, John Deere has followed a “building block” approach in which it has systematically adopted technologies to meet each regulatory Tier. Depending upon the power level and engine platform, the John Deere Integrated Emissions Control system encompasses different combinations of aftertreatment and emissions reduction components. John Deere will continue to tailor its Integrated Emissions Control system configurations to fit a variety of off-highway applications. These tailored configurations will provide an optimized solution that delivers emissions compliance without sacrificing power, performance, fluid efficiency, reliability, durability or economical operating cost.

2. Why is John Deere implementing selective catalytic reduction (SCR) for Final Tier 4/Stage IV?

Until facing the more stringent NOx emission levels required by Final Tier 4/Stage IV, John Deere has been able to achieve the mandated NOx levels with its cooled exhaust gas recirculation (EGR) technology and a single fluid, diesel fuel. With the additional 80 percent reduction in NOx required for Final Tier 4/Stage IV, John Deere will continue to utilize its proven cooled EGR technology but will combine this with SCR technology to achieve the more stringent Final Tier 4/Stage IV NOx emission levels.

3. Is John Deere abandoning cooled EGR technology developed for Interim Tier 4/Stage III B?

John Deere will continue to utilize the field-proven cooled EGR technology developed for Tier 3/Stage III A and Interim Tier 4/Stage III B. For Final Tier 4/Stage IV, the optimization of Integrated Emissions Control system components enables a reduction in cooled EGR flow rates, reducing the amount of heat rejection to the engine coolant. The lower cooled EGR flow rates allow an OEM to work with smaller, lower-cost cooling system components and further improve fuel economy.

4. How is the John Deere SCR solution different from the solutions of other engine manufacturers?

John Deere will use a combination of our proven cooled EGR technology and SCR technology to meet the more stringent Final Tier 4/Stage IV NOx emission regulations. The John Deere solution is different because the combination of the two technologies will allow John Deere engines to utilize less diesel exhaust fluid (DEF) than alternative SCR technology solutions. Less consumption of DEF means DEF tanks can be smaller, impact on equipment applications are minimized, DEF filter service intervals can be extended, and operator involvement is reduced.

5. Why does John Deere plan to use an exhaust filter (DOC/DPF) for Final Tier 4/Stage IV while some competitors do not?

Some manufacturers have chosen to calibrate their engines to produce less particulate matter (PM) emissions out of the engine, which reduces or eliminates the need for treating PM downstream of the engine. This approach increases engine combustion temperatures and NOx emissions out of the engine requiring higher levels of diesel exhaust fluid (DEF) to treat the increased NOx downstream of the engine.

John Deere has chosen to utilize cooled EGR and an engine calibration which reduces both engine combustion temperatures and NOx out of the engine. This calibration results in increased PM out of the engine, which is then reduced downstream of the engine with an exhaust filter consisting of a diesel oxidation catalyst (DOC) and a diesel particulate filter (DPF).

Our optimized Integrated Emissions Control system components reduce the remaining PM and NOx downstream of the engine. This optimization of our Integrated Emissions Control system components allows the engine to deliver the highest level of engine performance and world class fluid economy while meeting the most stringent emission levels mandated in all regions of the world … today, tomorrow and into the future.
6. Will exhaust filter regeneration intervals remain the same for Final Tier 4/Stage IV?

John Deere expects to see longer intervals between exhaust filter regenerations with Final Tier 4/Stage IV. In general, the SCR technology and more efficient fuel delivery systems with Final Tier 4/Stage IV engines will reduce PM out of an engine and, as a result, increase the time between any exhaust filter regeneration.

7. How will engine performance be impacted for Final Tier 4/Stage IV?

Engine performance for Final Tier 4/Stage IV will meet or exceed that of Interim Tier 4/Stage III B engines. John Deere engines will continue to provide the same or higher levels of power density and torque along with transient response that meets or exceeds that provided with Interim Tier 4/Stage III B engines.

8. How is the durability of the engine impacted by Final Tier 4/Stage IV technologies?

For the most part, base engine platforms will not change with Final Tier 4/Stage IV. As a result, our proven durability will continue from Interim Tier 4/Stage III B to Final Tier 4/Stage IV. The new aftertreatment components associated with SCR and Final Tier 4/Stage IV engines are designed to meet the unique needs of off-highway equipment and achieve the same durability goals as our proven Interim Tier 4/Stage III B engines and exhaust filters.

9. What is regeneration?

The exhaust filter is integrated into the engine design to provide a simple and reliable solution for reducing particulate matter (PM). A single engine control unit (ECU) manages both the engine and exhaust filter, via an exhaust temperature management (ETM) system, to regenerate (clean) the exhaust filter.

If passive regeneration cannot be achieved due to low temperature, load, or speed, then PM is removed using active regeneration — an automatic cleaning process. In most cases, the regeneration process does not have an impact on machine operation or require operator involvement. Another benefit of the exhaust filter is that it replaces the muffler in most applications.

Passive regeneration

John Deere engines and exhaust filter components are designed for uninterrupted operation using passive regeneration, a natural cleaning process where engine exhaust temperatures are sufficient enough to oxidize the PM trapped in the exhaust filter. The process occurs during normal engine operating conditions, which is the most fuel-efficient way to clean.

Active regeneration

If conditions (temperature, load, or speed) for passive regeneration cannot be achieved, then PM must be removed using active regeneration, an automatic cleaning process. This requires injecting a small quantity of fuel in the exhaust stream for a short duration and elevating exhaust temperatures to clean the filter. Remember, active regeneration cleaning occurs only when passive regeneration is not possible based on temperature, load and speed. It serves as a backup system.

Parked or stationary regeneration may be necessary if active regeneration is overridden by the operator, or in rare instances when the engine does not reach normal operating temperatures because of lighter loads, reduced speeds or cool ambient conditions for extended periods of time.

10. How does ETM work?

If conditions (ambient temperature, speed, and load) for passive regeneration cannot be achieved, ETM is an automated engine operating mode used to increase the DOC inlet temperature to initiate and maintain an active regeneration. To increase the DOC inlet temperature, ETM may reduce the amount of fresh air entering the engine via an intake air throttle valve, include a later post injection (after main injection event), retard engine timing for the main injection event, or vary the VGT vane position and elevate low idle speed. Once the needed DOC inlet temperature is achieved, a small quantity of fuel is injected into the exhaust stream. This process creates the heat needed to oxidize the PM trapped in the DPF when passive conditions cannot be achieved. In addition, ETM provides an additional benefit of a controlled warm-up and cool-down period, increasing the durability of the exhaust filter.
PERFORMANCE

1. Does a cooled EGR-equipped diesel engine have a higher internal combustion temperature than an SCR-only engine?

As its name implies, John Deere cooled EGR technology cools and mixes measured amounts of exhaust gas with incoming fresh air to lower an engine’s peak combustion temperature, thereby reducing most engine-out nitrogen oxide (NOx) emissions. Remaining particulate matter (PM) and NOx emissions are reduced to acceptable levels downstream of the engine using an exhaust filter and an SCR catalyst, respectively. The exhaust filter traps and oxidizes PM while low levels of diesel exhaust fluid (DEF) injected into the exhaust stream ahead of the SCR catalyst reduce NOx emissions to an acceptable level.

In contrast, engines equipped with only the SCR technology utilize an engine calibration that operates at higher combustion temperatures in order to reduce PM to acceptable emissions levels within the engine. This places additional heat on internal components of the engine and creates more engine-out NOx. To reduce these higher levels of NOx downstream of an engine, larger amounts of DEF are injected into the exhaust stream and combine with the exhaust gases in the SCR catalyst to reduce NOx emissions to an acceptable level.

John Deere cooled EGR engines actually have cooler internal engine combustion temperatures than SCR-only engines. Cooled EGR engines do place more cooling requirements (higher heat rejection) on the cooling system. However, John Deere has adopted new cooling system designs and variable speed fan drives that meet these cooling needs in the most efficient method possible. With the addition of SCR for Final Tier 4/Stage IV, optimized John Deere Final Tier 4 engine calibrations will utilize lower cooled EGR flow rates than Interim Tier 4/Stage III B, reducing the engine’s heat rejection.

The optimized John Deere Integrated Emissions Control system approach for Final Tier 4/Stage IV enables cooler engine combustion temperatures. The Integrated Emissions Control system of cooled EGR, an exhaust filter and SCR results in higher power density, higher peak torque values, improved levels of engine durability, lower diesel fuel consumption and the lowest DEF consumption. The net result is world-class total fluid economy.

2. How does the PowerTech PWL 4.5L engine reduce PM with an Integrated Emissions Control system consisting of a DOC and SCR, but no DPF?

Through extensive combustion optimization and aftertreatment development, John Deere achieved levels of PM emissions reduction and performance in the 56 to 104 kW (75 to 140 hp) power range that enabled removal of the DPF for Final Tier 4/Stage IV.

The development of a new combustion system, associated changes in engine calibration and the optimized Integrated Emissions Control system allow the PowerTech PWL 4.5L engine to achieve engine-out PM levels near zero. Any remaining PM is then oxidized passively in the DOC without the need for regeneration.

With the no-DFP Final Tier 4/Stage IV emissions technology solution, the PowerTech PWL 4.5L engine achieves customer performance expectations, improves engine packaging and reduces cost.
FLUID ECONOMY/DEF

1. What is the expected fluid economy for John Deere Final Tier 4/Stage IV engines?
The total fluid economy (diesel fuel and DEF) with Final Tier 4/Stage IV engines is expected to meet or exceed that of our proven Interim Tier 4/Stage III B engines with cooled EGR and exhaust filters operating on diesel fuel only. When you consider that our Interim Tier 4/Stage III B engines have been tested in many applications globally and have established the benchmark for fluid economy, we are confident that John Deere Final Tier 4/Stage IV engines will continue to provide world-class fuel economy while delivering improved performance and higher machine productivity.

2. How much DEF will be consumed with John Deere Final Tier 4/Stage IV engines?
DEF consumption will be 1–3 percent of diesel fuel consumption depending on the application.

3. How is John Deere dealing with the potential for urea freezing in cold environments?
DEF is made of 32.5 percent urea and 67.5 percent de-ionized water and will begin to gel at 12° F (-11° C). From an engine perspective, there will be heated DEF lines between the DEF tank and the decomposition tube where DEF is injected into the exhaust stream. When the engine is shut down, DEF is pumped out of all lines and the supply pump back into the DEF tank. The DEF tank itself is equipped with a heating element that utilizes engine coolant to thaw DEF in temperatures below 12° F (-11° C). The engine can be operated immediately and throughout the DEF tank thawing process.

4. How often will users need to fill tanks with DEF?
DEF consumption varies depending on DEF tank size, engine load and speed. Typically, the DEF tank should be checked and filled as part of routine service checks.

SERVICE REQUIREMENTS

1. What are the additional service requirements for Final Tier 4/Stage IV?
For the most part, the service requirements for Final Tier 4/Stage IV mirror the service requirements of Interim Tier 4/Stage III B engines. One additional service requirement for Final Tier 4/Stage IV will be the replacement of a small DEF filter that can be easily changed during other routine engine service.

2. Will there be a change in oil or fuel requirements for Final Tier 4/Stage IV?
There will be no change in oil or fuel requirements for Final Tier 4/Stage IV. Owners and operators should use only ultra-low sulfur diesel (ULSD) fuel with a maximum of 15 mg/kg (15 ppm) sulfur content and engine oils meeting API Service Category CJ-4, ACEA Oil Sequence E9 or ACEA Oil Sequence E6. Oil change intervals of 250 or 500 hours will also remain unchanged for Final Tier 4/Stage IV.

To find the most current FAQ, please go to JohnDeere.com/tier4FAQ