Updated March 29, 2010

Interim Tier 4/Stage III B frequently asked questions

Contents

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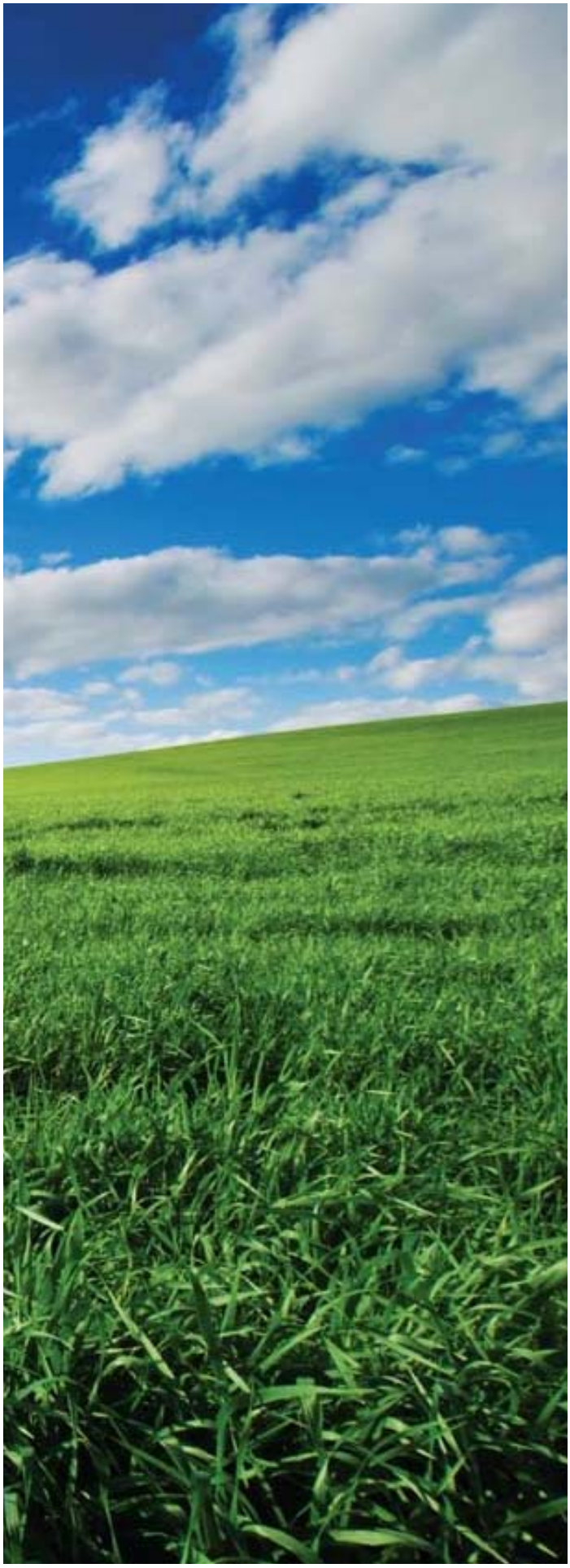
Acronym Glossary

BSFC	Brake specific fuel consumption
CARB	California Air Resources Board
CO_2	Carbon dioxide
DOC	Diesel oxidation catalyst
DEF	Diesel exhaust fluid
DPF	Diesel particulate filter
ECU	Engine control unit
EGR	Exhaust gas recirculation
EPA	Environmental Protection Agency
ETM	Exhaust temperature management
EU	European Union
FT4	Final Tier 4
IT4	Interim Tier 4/Stage III B
NOx	Nitrogen oxides
OEM	Original equipment manufacturer
PM	Particulate matter
PPM	Parts per million
SCR	Selective catalytic reduction
SiC	Silicon carbide
VGT	Variable geometry turbocharger
WGT	Wastegated turbocharger

Emissions Background



1. What's the background on these regulations?

The drive to reduce emissions has been in the works for more than 10 years and has followed a tiered approach. Tier 1 regulations set limits on particulate matter (PM) and nitrogen oxides (NOx) emissions. Final Tier 4 regulations take effect in 2014 and require the air coming out of the exhaust to be virtually as clean as the air going into the engine.

2. What tier are we at today?

We are at Tier 3 for engines 56 to 560 kW (75 to 750 hp).

While Final Tier 4 takes place in 2014, there's a step between it and Tier 3. That's Interim Tier 4 (IT4) and it's the biggest step yet.

IT4 takes effect in 2011 and requires diesel engines with 174 horsepower or more to reduce PM emissions by 90 percent, and NOx emissions by 50 percent.

3. What is PM and NOx?

Particulate matter, or PM, is called "smoke" because it comes out of the exhaust pipe in the form of black smoke. It's essentially an incomplete combustion of diesel fuel – just like a smoky fire that provides less heat than a hot, clean-burning fire.

NOx interact with other chemicals and sunlight to form ground-level ozone, commonly referred to as "smog."

4. What is the difference between EPA and EU regulations?

The U.S. EPA requirements (designated as tiers) came into effect independently from the European Union's (EU) regulations (designated as stages). Because the EPA and EU regulations are different but similar, there has been a continuing need to meet both sets of requirements. John Deere has addressed this situation by providing engines with dual certification.

The deadlines, test cycles and levels of PM and NOx are slightly different between EPA and EU. See the emissions brochure (DSWT41) for more details on emissions regulations.

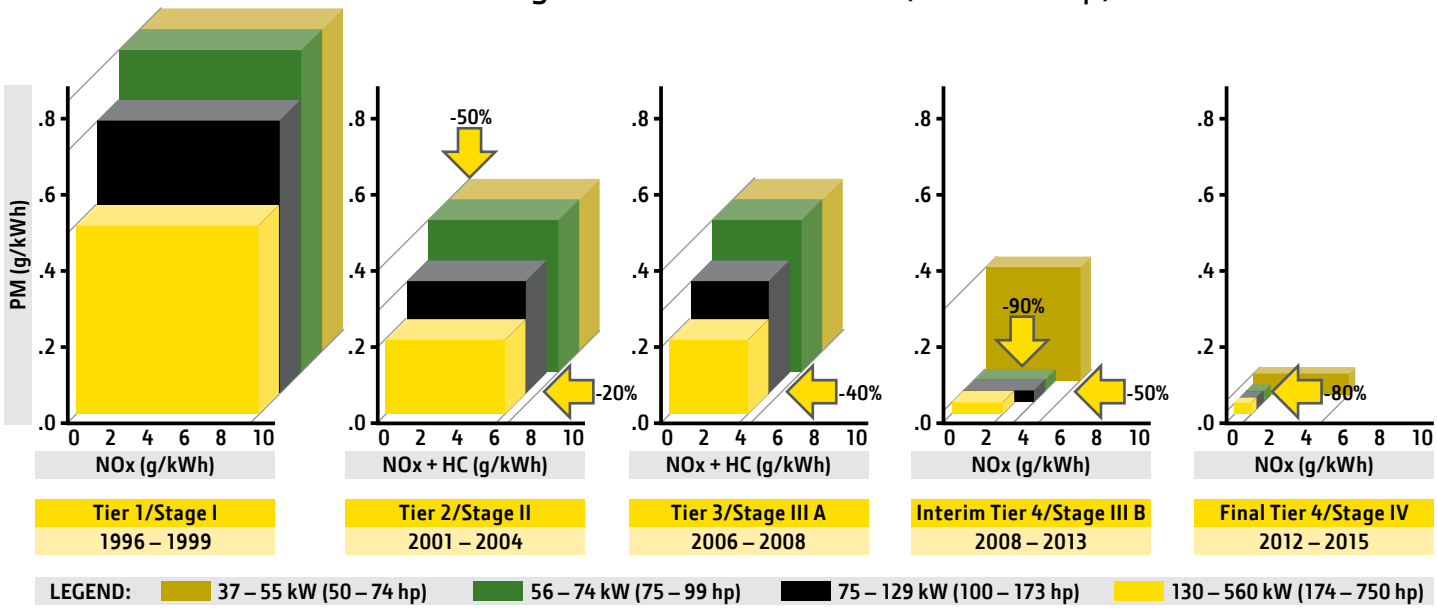
5. What are the differences between Interim Tier 4 and Final Tier 4 regulations?

The major difference between IT4 and FT4 is an 80 percent reduction in NOx emissions. See DSWT69, Emission Regulations Pocket Notebook or DSWT41, Emission Technology Brochure for specific details by power category. Originally, the EPA designated Tiers 1, 2, 3, and 4. But the challenge of moving from Tier 3 to Tier 4 was so significant, when compared to the differences among the previous tiers, that the EPA adopted the Interim and Final Tier 4 emissions regulations in order to allow engine manufacturers and their customers more time to make the necessary changes. The EPA regulations for nonroad compression-ignition engines apply to engines of all power levels.

Emissions reductions:

- Tier 3/Stage III A emissions regulations required a 40 percent reduction in NOx compared to Tier 2/Stage II.
- Interim Tier 4/Stage III B regulations require a 90 percent reduction in PM along with a 50 percent drop in NOx compared to Tier 3/Stage III A.
- Interim Tier 4/Stage III B and Final Tier 4/Stage IV must pass additional emissions tests including the steady-state 8-mode test (ISO 8178) and the rigorous nonroad transient cycle (NRTC) test.
- Final Tier 4/Stage IV regulations, which will be fully implemented by 2015, will maintain levels of PM and require an additional 80% reduction in NOx compared to Interim Tier 4/Stage III B.

EPA and EU nonroad emissions regulations: 37 – 560 kW (50 – 750 hp)



6. What is the timeline for EPA Interim Tier 4 and Final Tier 4 regulations?

Power	Interim Tier 4	Final Tier 4
19 kW – 56 kW (25 hp – 74 hp)	2008	2012*
57 kW – 129 kW (75 hp – 174 hp)	2012	2015
> 130 kW (174 hp)	2011	2014

* For this power band, engine manufacturers had the option to move from Tier 2 to either Tier 3 or Interim Tier 4 regulations in 2008. Manufacturers that chose to move to Tier 3 in 2008 will skip IT4 and must comply with FT4 regulations in 2012. Manufacturers that chose to move to IT4 in 2008 must comply with FT4 regulations one year later in 2013.

EPA nonroad emissions regulations

kW	hp	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
0-7	0-10					7.5 0.80			7.5 0.40							
8-18	11-24					7.5 0.80			7.5 0.40							
19-36	25-49				7.5 0.60				7.5 0.30					4.7 0.03		
37-55	50-74				7.5 0.40				4.7 0.30	Option 1*				4.7 0.03		
									4.7 0.40	Option 2*			4.7 0.03			
56-74	75-99				7.5 0.40				4.7 0.40				3.4 0.19 0.02			0.40 0.19 0.02
75-129	100-174			6.6 0.30				4.0 0.30					3.4 0.19 0.02			0.40 0.19 0.02
130-224	175-299			6.6 0.20			4.0 0.20					2.0 0.19 0.02			0.40 0.19 0.02	
225-449	300-599	6.4 0.20														
450-559	600-749		6.4 0.20													
≥ 560	≥ 750						6.4 0.20					3.5 0.19 0.10				3.5 0.19 0.04

*In the 50 to 75 horsepower category there are two options. Option 1 requires a reduced PM level (.30 vs .40) but allows Final Tier 4 to be delayed one year (2013)
NOTE: The vertical dashed lines separating the years show when the seven-year life of the Tier 2/3 Equipment Flexibility Provision ends and engines can no longer be placed in vehicle production.

Legend

EPA	Tier 1	Tier 2	Tier 3	Interim Tier 4	Final Tier 4
EU	Stage I	Stage II	Stage III A	Stage III B	Stage IV

New emissions regulations take effect January 1 of the year indicated by color change unless otherwise noted.

Examples

NOx NMHC PM	2.0 0.19 0.025

2.0, the maximum amount of nitrogen oxides (NOx) allowed in g/kWh.
0.19, the maximum amount of nonmethane hydrocarbons (NMHC) allowed in g/kWh.
0.025, the maximum amount of particulate matter (PM) allowed in g/kWh.

NMHC + NOx PM	7.5 0.80

7.5, the maximum amount of NMHC + NOx allowed in g/kWh.
0.80, the maximum amount of PM allowed in g/kWh.

7. What is the timeline for EU Stage III B and Stage IV regulations?

Power	Stage III B	Stage IV
19 kW – 36 kW (25 hp – 49 hp)	n/a	n/a
37 kW – 56 kW (50 hp – 74 hp)	2013	n/a
57 kW – 129 kW (75 hp – 174 hp)	2012	2014 (Oct)
130 kW – 559 kW (175 hp – 749 hp)	2011	2014
> 560 kW (750 hp)	n/a	n/a

EU nonroad emissions regulations

kW	hp	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
0-7	0-10	Not regulated in EU														
8-18	11-24	Not regulated in EU														
19-36	25-49	8.0 1.5 0.80						7.5 0.60								
37-55	50-74				7.0 1.3 0.40				4.7 0.40					4.7 0.025		
56-74	75-99				7.0 1.3 0.40				4.7 0.40				3.3 0.19 0.025			0.40 * 0.19 0.025
75-129	100-174			6.0 1.0 0.30				4.0 0.30					3.3 0.19 0.025			0.40 * 0.19 0.025
130-559	175-749		6.0 1.0 0.20				4.0 0.20					2.0 0.19 0.025			0.40 0.19 0.025	
≥560	≥750	Not regulated in EU														

*October 1, 2014

Legend

EPA	Tier 1	Tier 2	Tier 3	Interim Tier 4	Final Tier 4
EU	Stage I	Stage II	Stage III A	Stage III B	Stage IV

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Examples

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NMHC + NOx PM	7.5 0.80

7.5, the maximum amount of NMHC + NOx allowed in g/kWh.
0.80, the maximum amount of PM allowed in g/kWh.

8. What is the timeline for EPA and EU off-highway fuel sulfur regulations?

	Sulfur content	Deadline
EPA	500 ppm	June 2007
EPA	15 ppm	June 2010
EU	1000 ppm	January 2008
EU	10 ppm	January 2011

Fuel sulfur regulations

9. What kind of testing is required for engines to be Interim Tier 4/Stage III B emissions-certified?

Interim Tier 4/Stage III B continues to require the 8-Mode Steady State Test but also adds the requirements of the nonroad transient cycle (NRTC) test. These tests combine to dramatically increase the effort and time needed by manufacturers to certify engines for emissions regulations compliance.

Interim Tier 4/Stage III B also provides authority for in-use testing. The actual provisions of this program are presently in development by the EPA. The provision will require the engine manufacturer to test engine emission outputs of vehicles in-use.

What this means is that, in addition to the base test needed for emissions compliance, there are now two additional groups of rigorous tests (NRTC and In-Use) that must be completed.

10. What will happen after Final Tier 4/Stage IV regulations?

The complete implementation of Final Tier 4/Stage IV emissions regulations represents an enormous effort for all involved. It is difficult to predict what might happen after Final Tier 4/Stage IV.

Reductions in particulate matter on the basis of size and greenhouse gases, such as CO_2, are considered likely candidates for future emissions regulations.

Technology Path Choice

▶ 1. How do IT4 engines reduce nitrogen oxides and particulate matter?

▶ 2. How does cooled EGR work?

▶ 3. How does SCR work?

▶ 4. What technology will John Deere use to meet IT4 regulations?

▶ 5. Why use cooled EGR and exhaust filters for Interim Tier 4 engines greater than 56 kW (75 hp)?

▶ 6. Why not SCR?

▶ 7. Is cooled EGR the right choice for IT4?

▶ 8. What are the Tier 3/Stage III A technologies that John Deere is currently using?

▶ 9. What drives the size of an exhaust filter?

▶ 10. Does cooled EGR add more complexity than other technologies?

▶ 11. Does use of cooled EGR decrease power density?

▶ 12. When will the John Deere Interim Tier 4/Stage III B engines be available?

▶ 13. What John Deere engines are included in the 130 kW (174 hp) and above category?

▶ 14. What technologies will John Deere use to meet emissions regulations for Interim Tier 4/Stage III B engines?

▶ 15. What are the differences between the technologies used on Interim Tier 4/Stage III B engines that are rated 56 kW (74 hp) to 130 kW (174 hp) versus 130 kW (174 hp) and above?

▶ 16. What engine ratings will be available for Interim Tier 4/Stage III B?

▶ 17. Will John Deere offer a mechanical injection engine for Interim Tier 4/Stage III B?

▶ 18. What will John Deere do to meet Final Tier 4/Stage IV regulations?

▶ 19. Please describe naming convention for Interim Tier 4/Stage III B engines.

▶ 20. Does the exhaust filter technology for off-highway engines typically mirror that used in on-highway engines?

▶ 21. Will we continue to see the same emissions technologies trickle down from the on-highway market to the off-highway market, or will there be a divergence?

1. How do IT4 engines reduce nitrogen oxides and particulate matter?

There are two ways to reduce emissions: The first is with cooled exhaust gas recirculation (EGR) and an exhaust filter. EGR lowers NOx and the exhaust filter reduces PM. The second way to reduce emissions is with selective catalytic reduction (SCR) and a diesel oxidation catalyst (DOC). The SCR system lowers NOx while the diesel oxidation catalyst reduces PM.

2. How does cooled EGR work?

Cooled EGR is essentially the opposite of SCR. It cools and mixes measured amounts of exhaust gas with incoming fresh air to lower the engine's peak combustion temperature, thereby reducing NOx to an acceptable level.

Because of the lower combustion temperatures used to reduce NOx, there is an increase in PM. To reduce PM to acceptable levels, exhaust gases are routed through an exhaust filter containing a diesel oxidation catalyst and a diesel particulate filter. PM is trapped in the filter and — through a process called regeneration — oxidized into nitrogen gas and carbon dioxide, then expelled through the exhaust pipe.

3. How does SCR work?

Let's go back to the smoky fire example. SCR raises the peak combustion temperature in the engine so the engine runs like a hot, cleaner-burning fire. As a result, there is less particulate matter created. 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 NOx.

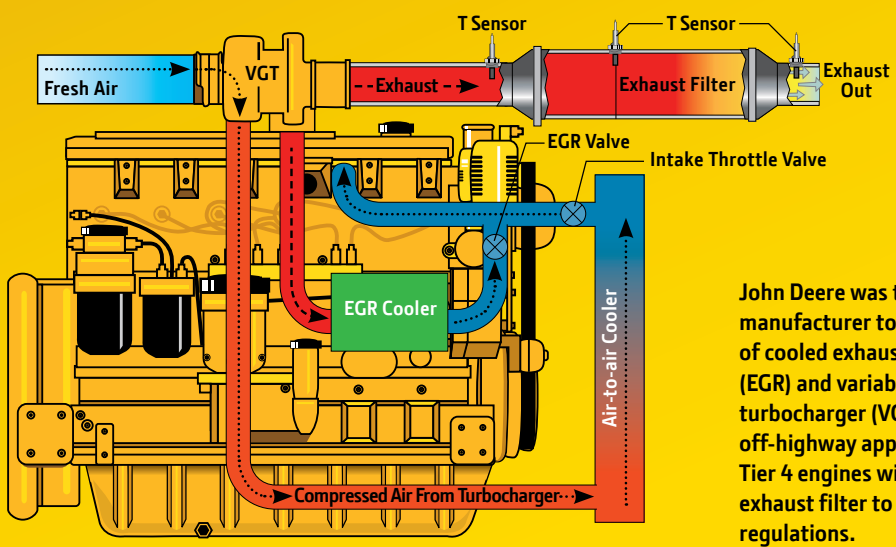
To reduce NOx, a diesel exhaust fluid (DEF), also called urea, is injected into the exhaust stream. When the exhaust gases combine with the urea in the SCR catalyst, NOx is broken down into nitrogen gas and water vapor and expelled through the exhaust pipe.

4. What technology will John Deere use to meet IT4 regulations?

Cooled EGR. We're taking our proven Tier 3 PowerTech™ Plus engine platform with cooled EGR and adding an exhaust filter. It's a more operator-friendly technology and less complex to maintain when compared to SCR systems. In addition, it's field-proven. We were the first manufacturer to widely commercialize off-highway Tier 3 cooled EGR diesel engines. We've used these engines with a proven record of reliability.

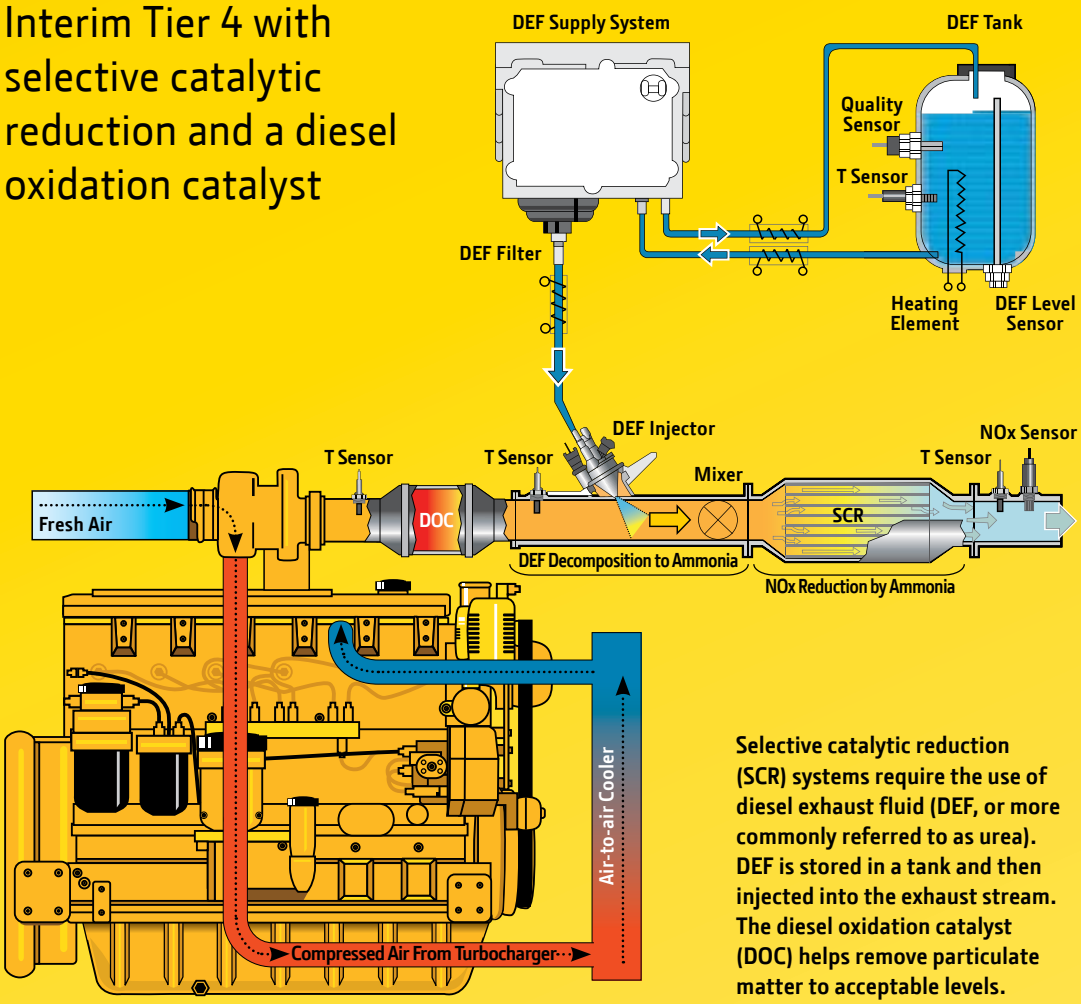
See illustration on the next page for a comparison of Interim Tier 4 engines using exhaust gas recirculation and selective catalytic reduction.

Interim Tier 4 PowerTech PVX technology utilizing cooled exhaust gas recirculation



John Deere was the first engine manufacturer to take advantage of cooled exhaust gas recirculation (EGR) and variable geometry turbocharger (VGT) technologies in off-highway applications. Interim Tier 4 engines will add a catalyzed exhaust filter to meet emissions regulations.

Interim Tier 4 with selective catalytic reduction and a diesel oxidation catalyst



Selective catalytic reduction (SCR) systems require the use of diesel exhaust fluid (DEF, or more commonly referred to as urea). DEF is stored in a tank and then injected into the exhaust stream. The diesel oxidation catalyst (DOC) helps remove particulate matter to acceptable levels.

5. Why use cooled EGR and exhaust filters for Interim Tier 4 engines greater than 56 kW (75 hp)?

Based on customer input regarding the different technology options, John Deere will continue to utilize cooled EGR, combined with exhaust filter technology, to meet Interim Tier 4/Stage III B regulations. The EGR solution, for NOx control, requires less operator involvement and is simpler, proven, fuel-efficient and a less costly technology compared to alternative solutions. Like the cooled EGR system and the VGT, the exhaust filter was specifically designed to meet the demands of off-highway applications. The exhaust filter also has the benefit of replacing the muffler in most applications.

6. Why not SCR?

There are a number of reasons. First is the fact DEF is not widely available today. You may have to drive a distance to get to a DEF retailer. Its price also can be high and it can be difficult to store. For example, it will turn to a gel and even freeze in cold temperatures. Not only do you need to store diesel around your operation, you also have to store DEF and keep it from freezing. These IT4 regulations take effect in 2011, which is just around the corner, and we believe the infrastructure for the delivery and storage of DEF to our nonroad customers will not be adequate by that time.

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.

With SCR, you must also consider the total fluid consumption including diesel fuel and DEF additive. The single-fluid approach of cooled EGR is easier for operators to use and delivers better total fluid economy.

7. Is cooled EGR the right choice for IT4?

Cooled EGR is what our customers told us they want for IT4. It's a simple solution for the operator that leverages the proven fuel efficiency of our PowerTech Plus engines and is part of an integrated vehicle design. That's something John Deere excels at as we design, manufacture, and service the engine, drivetrain, hydraulics, exhaust filter, cooling system, and other vehicle systems as part of a complete package to improve performance, convenience, and value. Finally, cooled EGR is easy to maintain. If it needs service, our customers are backed by the most responsive dealer network in the industry. Our dealers and their service technicians will be highly trained on these new engines and can even help you improve total vehicle efficiency.

8. What are the Tier 3/Stage III A technologies that John Deere is currently using?

The Tier 2 regulation required a 50 percent reduction in PM and 20 percent reduction in NOx from Tier 1.

The Tier 3/Stage III A technologies required a 40 percent reduction in NOx from Tier 2. There was no requirement to reduce PM.

John Deere used a variety of technologies to meet Tier 3/Stage III A emissions regulations. Below are descriptions of all of our Tier 3/Stage III A technology platforms.

PowerTech M engines have mechanical fuel injection systems, 2-valve cylinder heads, fixed-geometry turbochargers and mechanical controls. PowerTech M engines feature mechanical unit pump (2.4L) or mechanical rotary pump (4.5L) fuel systems, and turbocharged or air-to-air aftercooled aspirations. John Deere chose to move straight from Tier 2 to Interim Tier 4 regulations in 2008 with its PowerTech M 2.4L engines, so they are Interim Tier 4 and Stage III A compliant without the use of exhaust filters.

PowerTech E engines have full-authority electronic controls, 2-valve cylinder heads, high-pressure fuel systems, fixed-geometry turbochargers with turbocharged or air-to-air aftercooled aspirations. PowerTech E 2.4L and 3.0L engines feature electronic unit pump fuel systems, and PowerTech E 4.5L and 6.8L engines feature high-pressure common-rail fuel systems. John Deere chose to move straight from Tier 2 to Interim Tier 4 regulations in 2008 with its PowerTech E 2.4L engines under 56 kW (75 hp), so they are Interim Tier 4 and Stage III A compliant today, and do not require exhaust filters.

PowerTech Plus engines feature improved engine efficiency and performance with cooled exhaust gas recirculation (EGR) and variable geometry turbocharger (VGT) technologies, electronically controlled high-pressure fuel systems, 4-valve cylinder heads and full-authority electronic controls. With cooled EGR, precise amounts of exhaust gas are recirculated into the combustion chamber, lowering combustion temperatures. This reduces the formation of NOx. VGT helps drive the amount of recirculated exhaust gas that mixes with fresh air. The amount of cooled EGR required is determined by load and speed. PowerTech Plus engines also feature an air-to-air aftercooled aspiration and high-pressure common-rail (4.5L, 6.8L and 9.0L) or electronic unit injector (13.5L) fuel systems. PowerTech Plus technologies are the foundation John Deere has built upon for its Interim Tier 4/Stage III B and Final Tier 4/Stage IV.

9. What drives the size of an exhaust filter?

There are several design considerations affecting the final configuration of the exhaust filters, one being the accumulation of ash which is a by-product of combustion and comes from inorganic solids found in engine oils. Ash is not created during the exhaust filter cleaning or regeneration process. The exhaust filter size is also based on other factors such as engine displacement, power level and mandated ash service intervals shown below. The final exhaust filter design represents the best balance of all factors.

EPA regulations require that exhaust filters must have a minimum ash service interval of:

- For engines above 130 kW, the service interval is 4,500 hours. John Deere optimizes exhaust filter design for 5,000-hour service intervals.
- For engines below 129 kW, the service interval is 3,000 hours and John Deere optimizes exhaust filter design for 3,000-service intervals.

10. Does cooled EGR add more complexity than other technologies?

While cooled EGR engines require additional sensors and actuators, the control logic is designed into the engine control unit, which allows the complexity to be transparent. The technology may appear complex to the average individual, but it is the key to the product's function, performance, and reliability. Cooled EGR is a proven technology that is used to control NOx emissions by most on-road diesel engine manufacturers, as well as millions of gasoline and diesel passenger cars.

11. Does use of cooled EGR decrease power density?

With cooled EGR and the VGT, John Deere has maintained or increased the power density for each engine platform. With PowerTech engines, you will never be forced to go up in platform size. In fact, using John Deere PowerTech engines may allow customers to go down in platform size, if they choose to do so, and lower their installed cost.

12. When will the John Deere Interim Tier 4/Stage III B engines be available?

OEM engines greater than 130 kW (174 hp) will be available in limited production quantities starting in early 2010. As with earlier tiers and other Interim Tier 4/Stage III B models, John Deere is targeting the start of limited production for engines less than 130 kW (174 hp) to be available six to 12 months ahead of the January 2012 regulation date. Availability of Interim Tier 4/Stage III B engines in Deere equipment will be announced via normal product launch processes in late 2010. Interim Tier 4-compliant engines less than 56 kW (74 hp) are available and in production today.

13. What John Deere engines are included in the 130 kW (174 hp) and above category?

Our product line for 130 kW (174 hp) and above includes the 6.8L, 9.0L and 13.5L engine displacements.

14. What technologies will John Deere use to meet emissions regulations for Interim Tier 4/Stage III B engines?

John Deere Power Systems will achieve compliance with Interim Tier 4/Stage III B emissions regulations for our 56 kW (75 hp) and above product line by starting with our proven Tier 3/Stage III A PowerTech Plus engine platform that includes cooled exhaust gas recirculation (EGR) for NOx control with the addition of an exhaust filter for reducing particulates. The lineup will continue to include the 4.5L, 6.8L, 9.0L, and 13.5L in-line, 4- and 6-cylinder engines, all of which feature a four-valve cylinder head, high-pressure fuel system, variable geometry turbocharger (VGT), and air-to-air aftercooling. The PowerTech PWX 4.5L engine [56 -91 kW (75-122 hp)] will use a wastegated turbocharger instead of a VGT. As always, John Deere will offer the appropriate level of technology and performance to meet customer and equipment needs.

Five ratings greater than 19 kW (25 hp) and less than 56 kW (75 hp) from the John Deere PowerTech M and PowerTech E 2.4L engine models already meet Interim Tier 4 and Stage III A emissions regulations. PowerTech M 2.4L engines feature 2-valve cylinder heads, mechanical unit pump fuel systems, and fixed-geometry turbochargers. PowerTech E 2.4L engines feature similar 2-valve cylinder heads and fixed-geometry turbochargers, but add full-authority electronic engine controls, electronic unit pump fuel systems, and air-to-air-aftercooling. Neither requires the use of cooled EGR or an exhaust filter.

15. What are the differences between the technologies used on Interim Tier 4/Stage III B engines that are rated 56 to 130 kW (74 to 174 hp) versus 130 kW (174 hp) and above?

John Deere will apply the proven cooled EGR and exhaust filter technology to its 56 to 130 kW (74 to 174 hp) engines, similar to engine models greater than 130 kW (174 hp). However, the size of the exhaust filter, size of the cooled EGR components, type of exhaust filter media, form of dosing and different turbocharger technologies will be applied based on engine power levels. By applying the appropriate level of technology, John Deere will be positioned to meet OEM equipment needs, provide world-class engine performance and do so with a cost-effective solution.

PowerTech PWX and PVX engines below 130 kW use an in-cylinder dosing strategy to achieve active regeneration, while our higher horsepower engines utilize an external dosing system integrated into the exhaust system. Dosing utilizes a small amount of fuel injected into the exhaust stream to create the heat needed to oxidize the particulate matter (PM) trapped in the exhaust filter.

16. What engine ratings will be available for Interim Tier 4/ Stage III B?

OEM engine models and ratings for the John Deere Interim Tier 4/Stage III B lineup include:

PowerTech M 2.4L	36 kW (48 hp)
PowerTech E 2.4L	45 – 49 kW (60 – 66 hp)
PowerTech M 4.5L	55 kW (74 hp)
PowerTech PWX 4.5L	56 – 91 kW (75 – 122 hp)
PowerTech PVX 4.5L	93 – 129 kW (125 – 173 hp)
PowerTech PVX 6.8L	104 – 129 kW (140 – 173 hp)
PowerTech PVX 6.8L	138 – 187 kW (185 – 250 hp)
PowerTech PSX 6.8L	168 – 224 kW (225 – 300 hp)
PowerTech PVX 9.0L	187 – 224 kW (250 – 300 hp)
PowerTech PSX 9.0L	242 – 317 kW (325 – 425 hp)
PowerTech PSX 13.5L	298 – 448 kW (400 – 600 hp)

17. Will John Deere offer a mechanical injection engine for Interim Tier 4/Stage III B?

PowerTech M 2.4L and 4.5L engines are the simplest of the PowerTech family. These engines have 2-valve heads, fixed geometry turbochargers, and mechanical fuel systems. PowerTech M engines are perfect for less demanding applications. Their mechanical controls are simple to operate and maintain.

The PowerTech M 2.4L meets Interim Tier 4 and Stage III A emissions regulations and the PowerTech M 4.5L meets Interim Tier 4 emissions regulations without the addition of cooled EGR or an exhaust filter.

The EU does not require compliance with Stage III B emissions regulations for engines less than 19 kW (25 hp). Stage III B regulations for engines 37 to 56 kW (50 to 74 hp) do not take effect until 2013.

John Deere does not currently plan to offer a mechanical solution for Interim Tier 4/Stage III B engines greater than 56 kW (75 hp).

18. What will John Deere do to meet Final Tier 4/Stage IV regulations?

John Deere is developing and testing the technologies it will adopt to achieve Final Tier 4/Stage IV emissions regulations. The purpose of Final Tier 4/Stage IV emissions regulations is to further reduce NOx by an additional 80 percent for engines 130 kW (174 hp) and greater beginning in January 2014. Technologies such as cooled EGR and VGT with an exhaust filter will likely be the foundation for meeting Final Tier 4/Stage IV regulations. We are constantly evaluating emerging technologies for their effectiveness and for their ability to provide reliable and durable products in off-highway applications. And as with engine configurations that meet previous emissions tiers, we'll continue to tailor our Final Tier 4/Stage IV engine solutions to fit the variety of off-highway applications customers use them in.

19. Please describe the naming convention for Interim Tier 4/Stage III B engines.

The three letters define the engine's technology platform, turbocharger and exhaust filter. All of the John Deere Interim Tier 4/Stage III B engines with ratings 56 kW (75 hp) and above are designated "P," indicating the Tier 3/Stage III A PowerTech Plus technology platform that features 4-valve cylinder heads, cooled exhaust gas recirculation, full-authority electronic engine controls, high-pressure fuel systems and air-to-air aftercooling. These engines use either a variable geometry turbocharger (designated "V"), wastegated turbocharger (designated "W") or series turbochargers (designated "S"), and they also feature an exhaust filter (designated "X").

Examples:

- PowerTech PWX 4.5L
- PowerTech PVX 4.5L
- PowerTech PSX 6.8L

The primary difference between the PowerTech PWX and PVX when compared to the PSX engine models is the wastegated or variable geometry turbocharger (VGT) versus series turbochargers, consisting of a VGT and a fixed-geometry turbocharger. The 13.5L model is available only with series turbochargers while the 6.8L and 9.0L engines, depending on power level, have both single and series turbo configurations available. The 4.5L engines, depending on power level, will have a variable geometry turbo or a wastegated turbo. The PowerTech PVX engine models deliver similar power, transient response, peak torque and fuel economy as the Tier 3/Stage III A engine models they replace. The same performance benefits are extended to the PowerTech PSX engine models and will also provide improved low-speed torque and enhanced high-altitude operation.

20. Does the exhaust filter technology for off-highway engines typically mirror that used in on-highway engines?

The exhaust filter technology John Deere will use to meet Interim Tier 4/Stage III B emissions regulations is similar to the technology being used in on-highway applications today to meet emissions regulations, which started in 2007. However, the exhaust filters are designed to accommodate the more rugged conditions and varied packaging needs encountered in off-highway applications.

21. Will we continue to see the same emissions technologies trickle down from the on-highway market to the off-highway market, or will there be a divergence?

It is anticipated that the same technologies used in on-highway engines will continue to trickle down into off-highway products. However, one of the biggest challenges is the rate at which these technologies — originally developed for on-highway use — must be adapted for off-highway use.

The time between adoption of a new technology for on-highway engines and its use in off-highway applications has continued to decrease. Off-highway equipment often works in harsher and more varied environments. Additional development time is required to make on-highway technologies suitable for off-highway applications. Ensuring the robustness of these technologies for off-highway use will continue to be a challenge through Final Tier 4/Stage IV.

John Deere Power Systems is one of the few companies that manufacture engines exclusively for off-highway applications. 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 off-highway conditions. This benefits John Deere machine owners as well as OEM customers. Due to the fact that John Deere designs engines as well as construction, forestry and agricultural machines, it has unique expertise in integrating the engine, drivetrain, cooling package and controls for optimized performance, efficiency and cost.

Performance

▶ 1. What performance changes will John Deere Interim Tier 4/Stage III B engines have compared to our Tier 3/Stage III A engines?

▶ 2. How significant is the change in heat rejection from Tier 3/ Stage III A to Interim Tier 4/ Stage III B?

▶ 3. What is the maximum rated speed for Interim Tier 4/Stage III B engines?

▶ 4. Is John Deere adopting new turbocharger technologies for IT4?

1. What performance changes will John Deere Interim Tier 4/Stage III B engines have compared to our Tier 3/Stage III A engines?

Our PowerTech Plus Tier 3/Stage III A engines demonstrate best-in-class fuel economy. These engines also offer excellent performance characteristics, such as cold-weather starting, transient response time, power bulge, peak torque and low-speed torque. Because John Deere Interim Tier 4/Stage III B engines continue to use the same technologies as our Tier 3/Stage III A engines, our Interim Tier 4/Stage III B engines will maintain or improve upon today's performance and total fuel economy leadership in the off-highway industry.

2. How significant is the change in heat rejection from Tier 3/ Stage III A to Interim Tier 4/ Stage III B?

The increased cooled EGR flow rates will increase specific heat rejection values for Interim Tier 4/Stage III B engines. In an effort to minimize the effects on any application, coolant flows, top tank temperatures, new radiator designs and new variable speed fan drives are being adopted to better manage the increased heat rejection.

3. What is the maximum rated speed for Interim Tier 4/Stage III B engines?

Displacement	**Max rpm**
2.4L	2800
4.5L	2400
6.8L	2400
9.0L	2200
13.5L	2100

4. Is John Deere adopting new turbocharger technologies for IT4?

John Deere Interim Tier 4/Stage III B engines above 130 kW (174 hp) will use either a variable geometry turbocharger (VGT) or series turbochargers (combination of VGT and a fixed-geometry turbo) to increase performance and maximize fuel efficiency. Depending on the power level of engines between 56 to 130 kW (75 to 174 hp), engines will use either a variable geometry turbocharger (VGT) or a wastegated (WGT) turbocharger.
John Deere PowerTech M 2.4L engines and PowerTech E 2.4L engines under 56 kW (75 hp) use a fixed-geometry turbocharger.

The Interim Tier 4 PowerTech PVX and PowerTech PSX 9.0L engine platforms will utilize a new VGT turbocharger which is electronically controlled and hydraulically actuated. The PowerTech PVX 4.5L and 6.8L and PowerTech PSX 13.5L engines will utilize the same proven VGT as used on our PowerTech Plus Tier 3 engine models, which are electronically controlled and actuated. The PowerTech PWX 4.5L will utilize the a new wastegated (WGT) turbo on ratings equal to or less than 91 kW (122 hp).

Exhaust Filter Operation

▶ 1. What is regeneration?

▶ 2. How does the regeneration process work?

▶ 3. Does the operator have to stop the machine for it to regenerate?

▶ 4. How does ETM work?

▶ 5. What temperature must the exhaust reach to achieve passive regeneration? At what temperature must the exhaust run for active regeneration?

▶ 6. What happens to the ash created during the engine's normal combustion process?

▶ 7. How much fuel is injected into the exhaust system during an active regeneration?

▶ 8. What is the derating strategy related to regeneration?

▶ 9. If exhaust temperature is critical in achieving passive regeneration of the DPF, can light load applications achieve the necessary exhaust temperatures? Will lightly loaded applications require active regeneration more often?

▶ 10. How long does it take to complete the active regeneration process?

▶ 11. Does active regeneration only begin when the exhaust filter is completely restricted, or can this process be initiated gradually when the filter is partially restricted?

▶ 12. Is the DOC/DPF separate or combined?

▶ 13. Does the exhaust filter replace the muffler?

▶ 14. What types of materials are used inside exhaust filters?

▶ 15. Will the exhaust filter need to be replaced? What is the expected operational life of the exhaust filter?

▶ 16. What is the required ash service interval?

▶ 17. What is the expected operational life of the various sensors used in the exhaust system? How reliable will these components be in off-highway applications?

▶ 18. Is the ash capacity in the exhaust filter identical between SiC and Cordierite filters?

▶ 19. Because the exhaust filter captures particulate matter, is a spark arrestor still needed?

1. 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.

2. How does the regeneration process work?

Interim Tier 4/Stage III B PowerTech engines 130 kW (174 hp) and above will utilize a catalyzed exhaust filter that contains a diesel oxidation catalyst (DOC) and a diesel particulate filter (DPF). Under normal operating conditions, the DOC reacts with exhaust gases to reduce carbon monoxide, hydrocarbons and some PM. The downstream DPF forces exhaust gases to flow through porous channel walls, trapping and holding the remaining PM. Trapped particles are eventually oxidized within the DPF through a continuous cleaning process called passive regeneration, utilizing exhaust heat created under normal operating conditions.

If normal operating conditions cannot be achieved and filter loading begins to occur, John Deere’s exhaust temperature management (ETM) system manages the initiation and duration of a process called active regeneration. To achieve needed temperatures within the exhaust filter during an active regeneration, a small quantity of fuel is injected into the exhaust system. This automatic process creates the heat needed to oxidize the PM under operating conditions when passive conditions cannot be achieved.

3. Does the operator have to stop the machine for it to regenerate?

In most cases the regeneration process uses exhaust heat created under normal engine operating conditions. When necessary, the engine's control system can raise exhaust temperature to regenerate the filter. In either case, regeneration does not impact machine operation.

4. 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 above 572°F (300°C) 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 intake air throttle valve, include a later post injection (after main injection event), retard engine timing for the main injection event, vary the VGT vane position and elevate low idle speed. When 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.

5. What load factor must the vehicle reach to achieve passive regeneration? At what temperature must the exhaust run for active regeneration?

Passive regeneration is a continuous process and utilizes exhaust heat created under normal operating conditions — greater than 30 percent load factor — to oxidize particulate matter trapped in the filter.

Active regeneration occurs when conditions (load, speed and ambient temperatures) for passive regeneration cannot be achieved. Under these conditions, John Deere's exhaust temperature management (ETM) system manages the initiation and duration of a process called active regeneration. To achieve needed temperatures within the exhaust filter during an active regeneration, a small quantity of fuel is injected into the exhaust system. This process is initiated when the exhaust temperature in the DOC reaches approximately 600 degrees F.

6. What happens to the ash created by an engine's normal combustion process?

Ash is a by-product of inorganic solids found in lower-grade engine oil. Ash is not created during the cleaning, or regeneration process. As a result, the exhaust filter must be periodically — every 3,000 or 5,000 hours depending on engine power — serviced to remove accumulated ash. This service requires advanced equipment and should only be done by an authorized John Deere service provider.

7. How much fuel must be injected into the exhaust system to allow active regeneration?

The quantity of fuel consumed during an active regeneration is very minimal — less than 1 percent of a machine's total fuel consumption. Operators can reduce the number of active regenerations by avoiding light-load and lower-speed conditions, which reduce an engine's exhaust temperatures and its ability to regenerate passively.

8. What is the derating strategy related to active regeneration?

Derating does not occur under normal operating conditions. However, to ensure emissions compliance and prevent damage to the engine and exhaust filter, the engine control unit has the capability to derate a machine under certain exhaust filter conditions. Operators will receive different levels of notification regarding filter loading. If active regeneration is not inhibited, engine derating should not take place under normal operating conditions. More detailed information can be found in the engine operator's manual.

9. Can light load applications achieve the necessary exhaust temperatures to complete an active regeneration?

Yes, lightly loaded applications — less than 30 percent load factor — can achieve active regeneration as a result of the John Deere exhaust temperature management (ETM) system. The ETM system is able to adjust different engine parameters to elevate exhaust temps under these light-load conditions. Light-load applications will require active regeneration more often.

10. How long does it take to complete the active regeneration process?

The regeneration process, from start to finish, will take approximately 25 to 50 minutes. If normal operating conditions cannot be achieved and filter loading begins to occur, John Deere's exhaust temperature management (ETM) system manages the initiation and duration of the active regeneration. Actual cleaning process takes approximately 20 to 30 minutes.

11. Does active regeneration only begin when the exhaust filter is completely restricted, or can this process be initiated gradually when the filter is partially restricted?

Active regeneration begins when the filter is partially restricted. When regeneration is delayed to a point where it will affect performance, stationary/parked regeneration is required. If the operator continues to delay regeneration past the warning messages and engine derating, the filter will become restricted and exhaust filter service will be required.

12. Is the DOC/DPF separate or combined?

John Deere uses a combined DOC/DPF exhaust filter.

13. Does the exhaust filter replace the muffler?

Test results indicate that a muffler will not be required in most applications. Our experience has been that noise attenuation provided with the exhaust filter meets or exceeds that of a conventional muffler. However, each application is different, and actual results may vary.

14. What types of materials are used inside exhaust filters?

The two common ceramic honeycomb materials are SiC (silicon carbide) and Cordierite. We have chosen to use both, and which is used will depend on the size of the exhaust filter.

15. Will the exhaust filter need to be replaced? What is the expected useful life of the exhaust filter?

The catalyst, filter media and associated materials within the exhaust filter lose their effectiveness over time and will need to be replaced. EPA mandates a useful life of 8,000 hours or 10 years, whichever comes first. John Deere's exhaust filters are designed with a 10,000 hour life.

16. What is the required ash service interval?

John Deere exhaust filters are designed with a 5,000 hour ash service interval for engine power levels greater than 130 kW (175 hp). For power levels below 130 kW (175 hp) our exhaust filters are designed with a 3,000 hour ash service interval.

17. What is the expected operational life of the various sensors used in the exhaust system? How reliable will these components be in off-highway applications?

John Deere's exhaust filters and sensors are designed with a 10,000-hour life. Emissions-control-related parts and components are warranted by John Deere for 3,000 hours or five years, whichever comes first.

All engine and exhaust filter components have been designed and tested for use in off-highway applications.

18. Is the ash capacity in the exhaust filter identical between SiC and Cordierite filters?

The ash capacity of SiC and Cordierite materials are comparable. The key to remember is that regardless of the materials utilized in the exhaust filter the EPA mandates a minimal service interval for ash removal. (see question #15)

19. Because the exhaust filter captures particulates, is a spark arrestor still needed?

The need for a spark arrestor component is typically application dependent. While the exhaust filter may capture smaller particulates there still may be a requirement for spark arrestors on John Deere Interim Tier 4/Stage III B engines. Consult with local regulating authorities to determine actual needs.

Installation Impact

▶ 1. Will John Deere put its Interim Tier 4/Stage III B engines into production earlier to enable its customers to re-engineer their machines to fit the new engines?

▶ 2. How is John Deere working with its distributors and customers to integrate Interim Tier 4/Stage III B engines into their machines?

▶ 3. How will these Interim Tier 4/Stage III B technologies affect the overall design of the engine? Will the engine change size?

▶ 4. How involved is an engine repower for a Tier 2/Stage II or Tier 3/Stage III A engine?

▶ 5. Should the exhaust filter be horizontal? Could it be vertical?

▶ 6. What services does John Deere offer to help end users meet the new California Air Resources Board (CARB) regulations (or states that adopt similar legislation that requires end users to bring their existing fleets up to regulation)?

1. Will John Deere put its Interim Tier 4/Stage III B engines into production earlier to enable its customers to re-engineer their machines to fit the new engines?

John Deere Power Systems has communicated our technology choices earlier than ever before and well in advance of the regulation compliance date. Select models will be available prior to the emissions regulation date in order for our OEM customers to have sufficient time to design the engines into their machines.

2. How is John Deere working with its distributors and customers to integrate Interim Tier 4/Stage III B engines into their machines?

John Deere took customer input into consideration when making our technology choice and product development plans. Their inclusion drives considerations that improve the ease with which these new engines can be applied. Further, to keep our customers informed, John Deere is providing product development information substantially earlier than with previous engine versions. We are in an excellent position to integrate and optimize all the components and vehicle systems for best performance, fit and value for the customer. We manufacture the engines and ECUs and have design control of the exhaust filters.

John Deere is also an equipment manufacturer which enables us to share significant experience on optimizing cooling systems, engine/transmission interfaces, passive and active regeneration management, packaging for sight lines and maintenance, etc., and our customers benefit from that experience.

John Deere Power Systems already has significant laboratory and real-world experience with our new exhaust filter technologies. We have been researching exhaust filter technologies for 15 years, and we have machines that have been operating in the field with prototype Interim Tier 4 engines and exhaust filters since early 2007. In 2008, we placed 20 machines in operation from the John Deere agricultural and construction divisions. Our application engineers are working closely with the John Deere engine distributors and OEMs to achieve integration of Interim Tier 4/Stage III B engines into their applications. Our distributors are well versed in the requirements for these changes and will be able to implement them quickly and effectively. Even though these latest emissions requirements result in significant changes to the complete engine package, we are making every effort to simplify the engine installation process for our OEM customers. Our application engineers work closely with the OEMs to match the right engine to their machine, ensuring that the integration of Interim Tier 4/Stage III B engines goes as smoothly as possible.

3. How will these Interim Tier 4/ Stage III B technologies affect the overall design of the engine? Will the engine change size?

The overall design of the Interim Tier 4 engines is very similar to the Tier 3 models they replace. We will continue to utilize the 4.5L, 6.8L, 9.0L and 13.5L engine platforms.

John Deere's engines with cooled EGR and exhaust filtration will require similar space as the Tier 3/Stage III A engine and muffler they typically replace.

4. How involved is an engine repower for a Tier 2/Stage II or Tier 3/Stage III A engine?

Repowering an existing machine can require extensive equipment modification and requires a strong level of machine and engine application engineering knowledge.

Challenges to repower include:

- Upgrading a mechanically controlled machine with an electronically controlled engine
- The addition of critical engine emissions/performance systems such as charge air cooling must be accommodated
- Increased heat rejection of the new engine may require a cooling system redesign
- Engine torque curve differences may affect vehicle performance
- In the case of repowering with an IT4 engine, these opportunities will be very difficult due to the higher level of electronic integration of the engine and the real estate needed to mount the exhaust filter. There are some applications where an IT4 engine may be used for repower but most likely it will be a machine that utilizes a skid-mounted power unit.

Before considering the repower of any older machine a thorough application review should be performed to ensure that the engine and supporting systems can meet engine application guidelines for the replacement engine.

5. Should the exhaust filter be horizontal? Could it be vertical?

These devices can be mounted either vertically, horizontally or other orientations as long as the pressure sensor lines are properly oriented. Our application engineers and John Deere Power Systems distributors will work closely with our OEM customers to ensure proper placement of the exhaust filter.

6. What services does John Deere offer to help end users meet the new California Air Resources Board (CARB) regulations (or states that adopt similar legislation that requires end users to bring their existing fleets up to regulation)?

John Deere Power Systems distributors are working with customers to determine the most cost-effective compliance strategy for their fleets. This can include retrofitting with third-party exhaust filter systems, repowering with a newer certified engine or retiring/replacing an older machine from their fleets.

There are many challenges to retrofitting, including:

- Installation costs
- Matching the device (technology) to the machine operation/load cycle
- Installation integrity
- Engine envelope issues such as operator line of sight
- Operator training
- Product support (filter cleaning)

Contact your local John Deere Engine Distributor for additional details.

Operator Impact

▶ 1. Can the exhaust filter be cleaned manually?

▶ 2. Is there a need to remove the exhaust filter from the machine for any other maintenance, and can this be done by the operator?

1. Can the exhaust filter be cleaned manually?

The operator cannot manually clean particulate matter from the exhaust filter. The exhaust filter system has been designed to properly maintain itself without operator intervention through the process of passive and active regeneration. The regeneration process occurs during normal engine operation.

2. Is there a need to remove the exhaust filter from the machine for any other maintenance, and can this be done by the operator?

For service intervals to remove the ash, the exhaust filter will need to be removed and serviced by an authorized service dealer.

Competition

▶ 1. How will John Deere Interim Tier 4/Stage III B engines stand out from the competition?

▶ 2. Will John Deere competitors use SCR?

▶ 3. The SCR system has been adopted by several manufacturers. Why is John Deere choosing EGR first?

1. How will John Deere Interim Tier 4/Stage III B engines stand out from the competition?

John Deere is an innovator in the commercial application of cooled EGR and variable geometry turbocharger (VGT) technologies for off-highway use. Throughout Tier 3/Stage III A, John Deere has gained experience with these technologies over a wide range of applications and has established a proven record of reliability; other engine manufacturers are just now considering adopting these technologies for off-highway applications. John Deere engines have a strong reputation of performance, durability and reliability, and we are designing our new engines to exceed those expectations. These new engines will also feature more power and increased performance, world-class fuel economy, reduced noise, and low overall operating costs.

2. Will John Deere competitors use SCR for Interim Tier 4/Stage III B?

Some manufacturers have selected SCR to achieve Interim Tier 4/Stage III B emissions regulations. Deutz, Fiat Powertrain (FPT), Sisu, MTU and Volvo have announced that they will utilize SCR to meet Interim Tier 4.

3. The SCR system has been adopted by several manufacturers. Why is John Deere choosing EGR first?

For Interim Tier 4/Stage III B, 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 Interim Tier 4/Stage III B 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.

John Deere has researched both of the different technologies, and from a global perspective, believes that cooled EGR with the addition of an exhaust filter is the best approach for meeting Interim Tier 4/Stage III B emissions regulations. John Deere remains confident that our world-class fuel economy position attained with Tier 3/Stage III A engines utilizing cooled EGR will be maintained with the use of only one fluid (diesel). 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.

Fuel Economy

▶ 1. What is the fuel economy versus engine load and can users still gear up and throttle back?

▶ 2. Will fuel consumption increase with cooled EGR because of high fan power requirements?

▶ 3. How does the total fluid consumption with a SCR system compare to conventional EGR diesel engine?

▶ 4. Does the John Deere solution require urea?

1. What is the fuel economy versus engine load? Can users still gear up and throttle back?

Information pertaining to fuel economy data at rated speed (100 percent load) will be available when the product is launched. Machine users will still be able to gear up and throttle back with Interim Tier 4/Stage III B engines.

2. Will fuel consumption increase with cooled EGR because of high fan power requirements?

Heat rejection for Interim Tier 4/Stage III B engines will increase. This is why John Deere is now offering variable speed fan drives which will actually improve fuel economy. With a properly designed cooling package and variable speed fan drive, the average fan power will decrease.

3. How does the total fluid consumption with a SCR system compare to conventional EGR diesel engine?

The claim that engines designed to operate on selective catalytic reduction (SCR) consume less fuel is not accurate.

Regarding engines utilizing SCR we must consider the total fluid consumption — that is, the consumption of diesel fuel and the diesel exhaust fluid (DEF) additive. Competitive engine manufacturers who utilize SCR have stated their engines could provide up to 5 percent better fuel economy compared to their non-SCR engines. When you consider that urea consumption is approximately 3 to 5 percent of diesel fuel consumption and the fact that urea cost is similar or higher than diesel fuel, there is no advantage for engines utilizing SCR from a total fluid consumption and cost perspective.

Depending on the engine model, John Deere Interim Tier 4/Stage III B bare engine fuel consumption will be similar to Tier 3/Stage III A. Overall fuel economy will improve in some vehicles/applications due to drivetrain optimization and engine/vehicle integration.

John Deere Tier 3/Stage III A engines currently hold a 5 to 10 percent fuel economy advantage when compared to most competitive engines. As a result, John Deere Interim Tier 4/Stage III B engines will continue to maintain their fuel-economy leadership without utilizing SCR for Interim Tier 4.

In regards to decreased system cost, research shows that Interim Tier 4/Stage III B engines with SCR systems are comparable in total installed engine cost compared to engines utilizing cooled EGR and exhaust filters. When considering SCR system cost, end users will need to consider sourcing, inventory and distribution costs associated with SCR. John Deere engines/vehicles will continue to provide the best value with a simple (one fluid) and proven technology (cooled EGR and variable geometry turbochargers).

4. Does the John Deere solution require urea?

John Deere's Interim Tier 4/Stage III B technology platform does not require the use of urea. Injecting a liquid urea-based additive (also referred to as DEF — Diesel Exhaust Fluid) is required in an alternative NOx reduction system called selective catalytic reduction (SCR). The SCR system injects urea into the exhaust stream to reduce NOx within the SCR catalyst. It requires that the machine be fitted with an SCR catalyst, separate tank, a sophisticated liquid additive injection system, a tamper-proof diagnostic system and, since urea freezes, heating systems for the tank and delivery lines. Currently, the additive may not be conveniently available in many parts of the world, especially for off-highway applications. With John Deere's EGR solution the operator doesn't have to purchase or maintain a second fluid.

SCR may be an appropriate technology for the future when it is more commercially available for off-highway applications; however, for Interim Tier 4/Stage III B, the cooled EGR and exhaust filter technology approach provides a simple and proven solution requested by our customers. Since the John Deere Interim Tier 4/Stage III B solution does not use SCR, urea is not required.

Service

▶ 1. Will serviceability and service intervals change with Interim Tier 4/Stage III B engines?

▶ 2. Are the types of engine oil and diesel fuel quality going to become more important factors with the newer emissions technologies?

▶ 3. Can I use biodiesel with Interim Tier 4/Stage III B applications?

1. Will serviceability and service intervals change with Interim Tier 4/Stage III B engines?

Current engine maintenance intervals remain unchanged or are improved upon depending on the application/machine type. The oil change interval will be the same interval offered for Tier 3/Stage III A engines at either 500 hours or 250 hours. One noticeable difference will come with the addition of the exhaust filter. While the regulations require an exhaust filter ash service interval of 4,500 hours minimum for engines 130 kW (174 hp) and greater and 3,000 hours for engines less than 130 kW (174 hp), John Deere will provide a 5,000-hour and 3,000-hour ash service interval respectively.

2. Are the types of engine oil and diesel fuel going to become more important factors with the newer emissions technologies?

Engine oil type and diesel fuel have always played a role in emissions. But products used and technologies needed to meet Interim Tier 4/Stage III B and Final Tier 4/Stage IV emissions regulations make them even more important.

With the introduction of exhaust filters, the type of engine oil used can have a significant impact on the proper functioning and ash service life of these devices. Ash, a byproduct of inorganic solids, will collect in the exhaust filter over time as a result of the combustion process. The use of oils meeting API CJ-4 and ACEA E9 standards, both with reduced trace metals content, are required to reduce ash accumulation and increase exhaust filter service life for Interim Tier 4/Stage III B engines. John Deere has developed new engine oils, which are formulated to ensure optimum running performance and longevity of Interim Tier 4/Stage III B engines. The John Deere engine oils are 100 percent backward compatible and suitable for engines with and without emissions control devices. It is important to always follow the manufacturer's oil-type and service-interval recommendations.

Similar to oils, the type of diesel fuel used can also have a significant impact on emission control devices. Sulfur content levels of typical off-highway diesel fuels vary geographically — ranging from >5000 parts per million (ppm) to 500 ppm (low sulfur diesel). The use of exhaust filters on Interim Tier 4/Stage III B engines will require using diesel fuel with a sulfur content of less than 15 ppm (ultra-low sulfur diesel or ULSD). Using diesel fuels with a higher sulfur content (greater than 15 ppm) can damage the exhaust filter or catalyst, creating the need for an increased number of regenerations and leading to early replacement of the exhaust filter. See page 9 for fuel sulfur regulations.

3. Can I use biodiesel with Interim Tier 4/Stage III B applications?

The increased interest in and use of biofuels demands strict adherence to applicable fuel quality standards. John Deere Power Systems recently clarified its position on biodiesel. While 5 percent blends (B5) are preferred, biodiesel concentrations up to a 20 percent blend (B20) in petroleum diesel fuel can be used in John Deere engines through Tier 3/Stage III A models, including all non-emissions-certified engines. Biodiesel blends up to B20 can be used only if the biodiesel (100 percent biodiesel or B100) meets ASTM D6751 (U.S.), EN 14214 (EU) or equivalent specification. Biodiesel users are strongly encouraged to purchase biodiesel blends from a BQ-9000 Certified Marketer and to source from a BQ-9000 Accredited Producer, as certified by the National Biodiesel Board. Certified Marketers and Accredited Producers can be found at www.bq-9000.org. For additional information, visit www.JohnDeere.com/biodiesel.

References

Where can I get more information?

More information can be found on our Web site, or you can call or e-mail us.

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