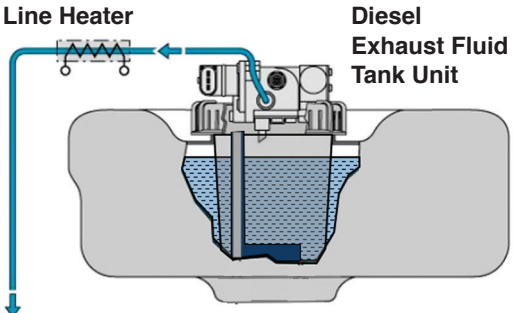
Diesel Engine Aftertreatment: How Ford Knocks Out the NO_x

Ford's new 6.7-liter Power Stroke® V-8 turbocharged diesel engine employs a multifaceted aftertreatment process to meet 2010 federal emissions standards that call for a reduction of nitrogen oxide (NO_x) levels by more than 80 percent compared with previous regulations. Ford's solution incorporates industry-proven technology, world-class supply partners and Ford-developed strategies to create an efficient, seamless system.

Cleaner In Means Cleaner Out

Ford's multi-step process begins by optimizing the new 6.7-liter Power Stroke turbocharged diesel engine for efficient combustion, which helps reduce harmful emissions from the start. Customers benefit from a more efficient system, which uses less fuel, and in turn the efficiency leads to an exhaust stream that does not overly burden the aftertreatment system. The system is a three-step process with each subsystem fully integrated so it operates as one unit.



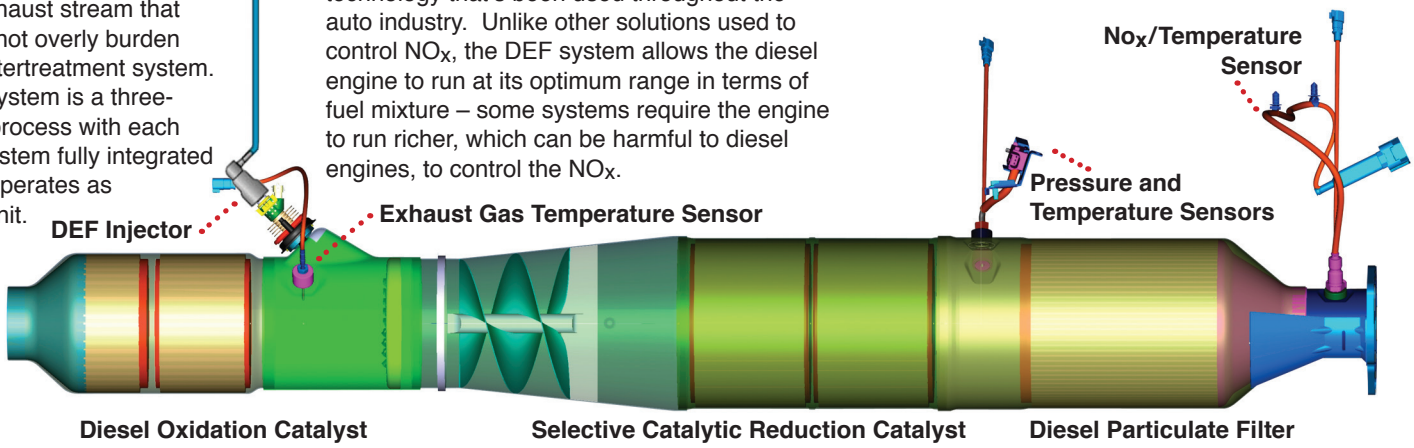
Why Ford Uses the Diesel Exhaust Fluid (DEF) Method

Injection of DEF to reduce NO_x is a proven technology that's been used throughout the auto industry. Unlike other solutions used to control NO_x, the DEF system allows the diesel engine to run at its optimum range in terms of fuel mixture – some systems require the engine to run richer, which can be harmful to diesel engines, to control the NO_x.

DEF Replenishment Facts

The Ford system is designed so that DEF is replenished approximately every 7,500 miles, depending on customer use. The message center will alert the customer if the DEF needs to be replenished. The first message comes when the customer has about 800 miles worth of DEF remaining.

The fill nozzle for the DEF is located next to the fuel cap. It has a blue cap. Ford-approved DEF will be available in 1- and 2-1/2-gallon bottles with nozzles and can be purchased from Ford dealers and other retailers.



Step One: Cleaning and Heating

The first step in cleaning the diesel exhaust occurs when the exhaust stream enters the Diesel Oxidation Catalyst (DOC). The role of the DOC is twofold. First, it converts and oxidizes hydrocarbons – at about 250 degrees Celsius – into water and carbon dioxide.

Second, the DOC is used to provide and promote heat, using specific engine management strategies, into the exhaust system. Through appropriate thermal management, this heat increases the conversion efficiency of the downstream subsystem(s) in reducing emissions.

Step Two: Knocking Out the NO_x

The second step in the process is known as Selective Catalytic Reduction (SCR). In this process, the NO_x in the exhaust stream is converted into water and inert nitrogen, which is present in the atmosphere and harmless. Before the exhaust gas enters the SCR chamber, it is dosed with Diesel Exhaust Fluid (DEF), also known as urea, an aqueous solution that is approximately 67.5 percent water and 32.5 percent pure urea.

When heated, the DEF splits into ammonia and carbon dioxide. These molecules are atomized, broken up and vaporized, then enter a mixer that resembles a corkscrew. This twist mixer evenly distributes the ammonia within the exhaust flow. The ammonia enters the SCR module, which contains a catalyzed substrate, and through chemical reactions combines and converts the NO_x and ammonia into the harmless inert nitrogen and water. Dosing typically occurs between 200 and 500 degrees Celsius.

Step Three: Scrubbing Away the Soot

The final step of the cleansing system for the diesel exhaust gas involves the Diesel Particulate Filter (DPF). The DPF traps any remaining soot, which is then periodically burned away, known as regenerating, when sensors detect the trap is full. The regeneration process sees temperatures in excess of 600 degrees Celsius to burn away soot.