

KOMATSU



**Diesel Exhaust
Fluid (DEF) What
you need to know**

Background

Starting in 2014, off-road engine emissions regulations in the U.S. and Canada require engine and equipment manufacturers to reduce nitrogen oxides (NOx) emissions. These regulations apply to construction and industrial equipment and engines produced on or after the effective dates of the regulations.

In order to achieve these mandated emissions reductions, Komatsu, and many off-road equipment manufacturers, will utilize a Selective Catalytic Reduction (SCR) system. The SCR system consists of a catalyst that reacts with a urea-based Diesel Exhaust Fluid (DEF) to reduce NOx emissions. This SCR technology is currently used globally in diesel on-road vehicles.

Selective Catalytic Reduction (SCR) System

SCR is a technology with which NOx is reduced outside of the combustion process. This enables the combustion process to be optimized, reducing particulates and ensuring maximum engine performance. NOx reduction takes place after combustion through the use of a urea solution (DEF) and a catalytic converter. The DEF is injected into the exhaust system just before the catalytic converter. When the mixture of exhaust gases and DEF passes through the catalytic converter, the nitrogen oxides are converted into nitrogen and water vapor. The more energy-efficient combustion process also has a positive effect on fuel consumption.

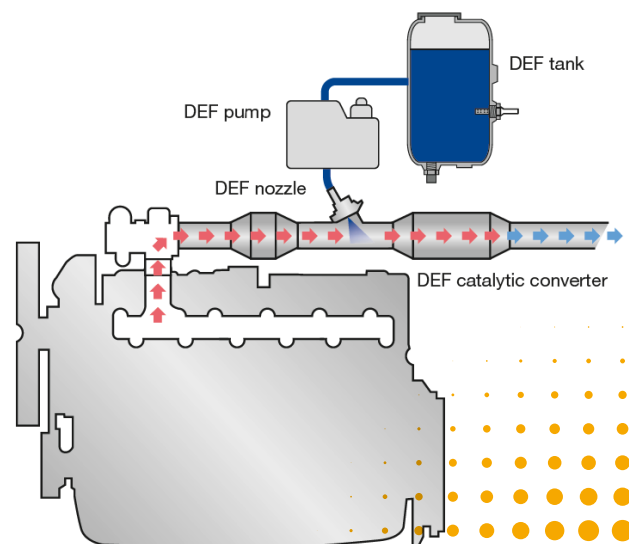
SCR Advantages

- Fulfills legal requirements for NOx and particulate reduction
- Reduces fuel consumption
- Lower fuel costs (cost of DEF included)
- Lower operating costs compared to Cooled Exhaust Gas Recirculation (CEGR)
- Requires no Exhaust Gas Recirculation (EGR) valve
- Requires no servicing of emission control
- Reduced sensitivity to lower quality diesel (sulfur)

SCR Disadvantages

- Requires the addition and handling of DEF
- More components outside the engine

Selective Catalytic Reduction (SCR) System



Diesel Exhaust Fluid

DEF is required in all SCR systems. During operation, engines with SCR systems consume a small amount of DEF, approximately 3% to 4% of diesel fuel consumption, by volume, depending on engine operation, duty cycle, terrain, load, etc. A small DEF tank, typically mounted in the engine compartment, must be refilled regularly, typically at every re-fueling.

Currently, a number of Komatsu Forestry machines have incorporated the SCR engine technology. Starting in 2014, you will begin to see other Komatsu equipment that will require DEF in order to meet emissions standards.

Komatsu's DEF

- Is ultrapure — formaldehyde-free, metals-free, and mineral-free
- Comes with a quality custody chain — one manufacturer, one supplier is lot traceable
- Provides a one micron purity standard
- Conforms to ISO 22241
- Includes a Certificate of Analysis on every shipment

DEF FAQ's

What is Diesel Exhaust Fluid?

Diesel Exhaust Fluid (DEF) is a high purity chemical solution containing 32.5% chemical-grade urea mixed with 67.5% high purity deionized water which is injected into the exhaust system to reduce NOx emissions in engines equipped with an SCR system.

What is urea?

Urea is the active ingredient of DEF. It is created from synthetic ammonia and carbon dioxide when subjected to high heat and pressure and can be produced as a liquid or solid. It is used in a variety of industries, often as a fertilizer in agriculture.

Is the 32.5% chemical-grade urea solution critical?

Komatsu SCR systems are calibrated to operate on a 32.5% urea solution, ensuring optimum NOx conversion. The 32.5% urea concentration provides the lowest freeze point and the best protection in cold ambient temperatures.

What are the benefits of using DEF?

Diesel engines equipped with SCR using DEF not only meet the 2014 tailpipe standard, they also deliver a significant fuel economy benefit.

Is DEF a fuel additive?

No. DEF should not be added to the fuel tank. Vehicles manufactured with SCR technology are designed with a separate tank, which has a blue cap, to hold DEF. The fluid is sprayed from this tank directly into the exhaust system.

Can DEF be mixed with anti-freeze, other additives, or water?

No. Additives and water will change DEF effectiveness, invalidate emissions certification, and result in possible catalyst damage.

How often will I need DEF?

DEF is used at about 3% - 4% of your diesel fuel consumption. So, for every 100 gallons of diesel fuel you will need approximately 3 to 4 gallons of DEF.

How large is the DEF tank on my machine?

Several tank sizes will be specified based on machine application and duty cycle. The specific size also ensures a diesel fuel to DEF fill ratio of 1:1 (that is, one DEF tank refill to each fuel tank refill) is met. Generally speaking, the size of the DEF tank is about 10% the size of the diesel fuel tank.

What happens if the DEF tank becomes empty?

When DEF drops below a set level the system alerts the operator, similar to a low fuel level situation. If the machine continues to run without filling the tank, sensors will indicate a high level of NOx and PM. The machine will run up to 40 minutes without DEF; continued operation beyond this limit without

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What happens if the DEF tank is filled with the wrong liquid, or water?

The system will get information from sensors in the exhaust pipe that the level of NOx and PM is too high. System will run for up to 40 minutes then de-rate to "reduced power mode". When running in the reduced power mode, the machine has enough power to move but at a low performance level.

What happens if DEF is contaminated with diesel?

The filler necks of DEF tanks are smaller than nozzles used to dispense diesel, making it difficult to accidentally put diesel into the DEF tank. In addition to having a smaller filler neck diameter, DEF tank caps are blue, marked 'Diesel Exhaust Fluid', and have the appropriate ISO standard number or other identifying marks.

If the DEF tank becomes contaminated, the system will need to be cleaned with deionized water. If contaminated and the machine is not operated before draining and flushing the DEF tank, there should be no permanent damage to the SCR catalysts. If the DEF tank is accidentally filled with diesel, diesel will float on top of the DEF in the tank, however even small amounts of diesel can damage your SCR system. Komatsu recommends contacting the local distributor immediately before operating the vehicle.

What special maintenance does the SCR system require?

No. Additives and water will change DEF effectiveness, invalidate emissions certification, and result in possible catalyst damage.

How often will I need DEF?

Apart from filling the DEF-tank each time the machine is refueled, no other actions need to be taken. The DEF and fuel tanks are sized to require refilling at the same time. Keeping the DEF tank full when machine is parked, and draining the tank at the end of the season or when parked for an extended period of time, helps prevent the risk of crystal formation, which can clog the tank.

Is DEF a hazardous material?

DEF is not considered to be hazardous. It is non-polluting, non-flammable solution, and non-explosive. It is, however, highly corrosive and has an ammonia odor.

What happens if DEF is spilled on the machine?

DEF is corrosive to aluminum and other materials. Small amounts of DEF should be washed away with water or wiped up. If left to dry, it will turn into white crystals which can be washed away with water. If large amounts of DEF are spilled, it is best to contact a DEF supplier for advice.

Does DEF have a shelf life?

Yes. The shelf life will depend on the temperature at which product is stored, however, use of product older than one year is not recommended.

Will changing DEF suppliers require cleaning out storage tanks or flushing the system?

No. Simply run the DEF as empty as possible before refilling with another brand. DEF is a pure chemical, so a bulk storage tank with a closed loop system should never need to be cleaned out unless it is contaminated by another substance.

DEF is manufactured to strict ISO 22241, AUS 32 and DIN 70070 standards. These standards ensure proper manufacturing, testing and handling procedures. DEF should only be purchased from companies that provide proof that they follow these standards, are ISO and API certified, with their own laboratories and testing equipment.

Is this product affected by temperature?

The ideal storage temperature for DEF is between 15 F and 77 F (-9 C and 25 C). Additionally DEF should be protected from direct sunlight. DEF will begin to crystallize at 12 F. It can also lose its potency if stored for prolonged periods over 86 F.

How long can DEF be stored?

The shelf life of DEF depends on storage temperature. DEF will degrade over time depending upon how long it is exposed to high temperatures and sunlight. ISO 22241-3 defines the minimum shelf life expectations when stored at constant temperatures and notes that if DEF is stored below 86 F (30 C), shelf life will be one year; below 77 F (25 C), shelf life will be 18 months.

How do I keep the DEF from freezing? What happens if DEF freezes while in the vehicle DEF tank?

Diesel equipment has heated tanks and supply lines that are designed to freeze and thaw with no performance issues. SCR systems are designed to prevent DEF from freezing in the tank and supply lines while the engine is being operated. Normal operation of the product will not be inhibited if DEF freezes when the engine is shut down. The SCR system is designed to quickly thaw frozen DEF ensuring that the operation of the engine will not be impacted. Freezing and unthawing of DEF will not cause degradation of the product.

How much does DEF cost?

Cost can depend on a variety of factors. Please talk to your local Komatsu distributor about DEF costs.

Can I buy DEF from my Komatsu distributor?

Komatsu distributors offer DEF in 2.5 gal bottles, for single use applications, 55 gallon drums, 330 gallon totes for multiple uses, and a variety of mini bulk and bulk deliveries (300 gallon minimum).

Does it matter what DEF brand I purchase?

Yes, it does. TerraCair, Komatsu's preferred DEF, is an API-certified, ultrapure, and formaldehyde-free. CF Industries, who manufactures TerraCair, is the largest North American producer of DEF and stands ready to meet your DEF demands. With unbroken supply chain oversight managing the entire process, CF Industries is able to provide a quality product that ensures the customer's peace of mind. Production, to pump, to the vehicle tank – they stand behind their product. DEF is manufactured to strict ISO 22241, AUS 32 and DIN 70070 standards. These standards ensure proper manufacturing, testing and handling procedures.

Can I make DEF myself?

No. Only a pre-mixed solution of DEF available from the supply base should be used. Use of any fluid which does not meet the requirements outlined in ISO 22241-1 may damage Komatsu's SCR systems and will void warranty.

Is any new maintenance required on the engine or SCR system?

A filter is installed in the DEF pump unit to ensure proper filtration of impurities such as dirt and debris. This filter must be replaced every 5,000 hours.

Will there be any special fuel or oil requirements for Komatsu SCR-equipped vehicles?

Fuel and oil requirements will be the same as Tier 4 Interim/EU Stage IIIB. Ultra low sulfur diesel (ULSD) and low ash oil will be required for use in SCR equipped products.

