

1.0 Introduction:

To meet EPA final Industry emission standards (Tier 4 final) for on-highway and off-highway diesel engine exhaust emissions in the U.S., diesel engine manufacturers have had to adopt various emission control technologies. Diesel engines for off-highway equipment above 75hp, including generator sets, use selective catalytic reduction (SCR) systems to meet the latest exhaust emission levels. Within a SCR system small quantities of diesel exhaust fluid (DEF) are injected into the exhaust downstream of the engine to reduce the nitrogen oxide (NOx) levels in the engine's exhaust. NOx is one of the emissions contributing to atmospheric pollution.

This Information Sheet discusses the application of Diesel Exhaust Fluid (DEF) to reduce Exhaust Emissions and maintenance issues that should be incorporated into a planned maintenance program when a diesel with SCR is the power source. (Continued over)

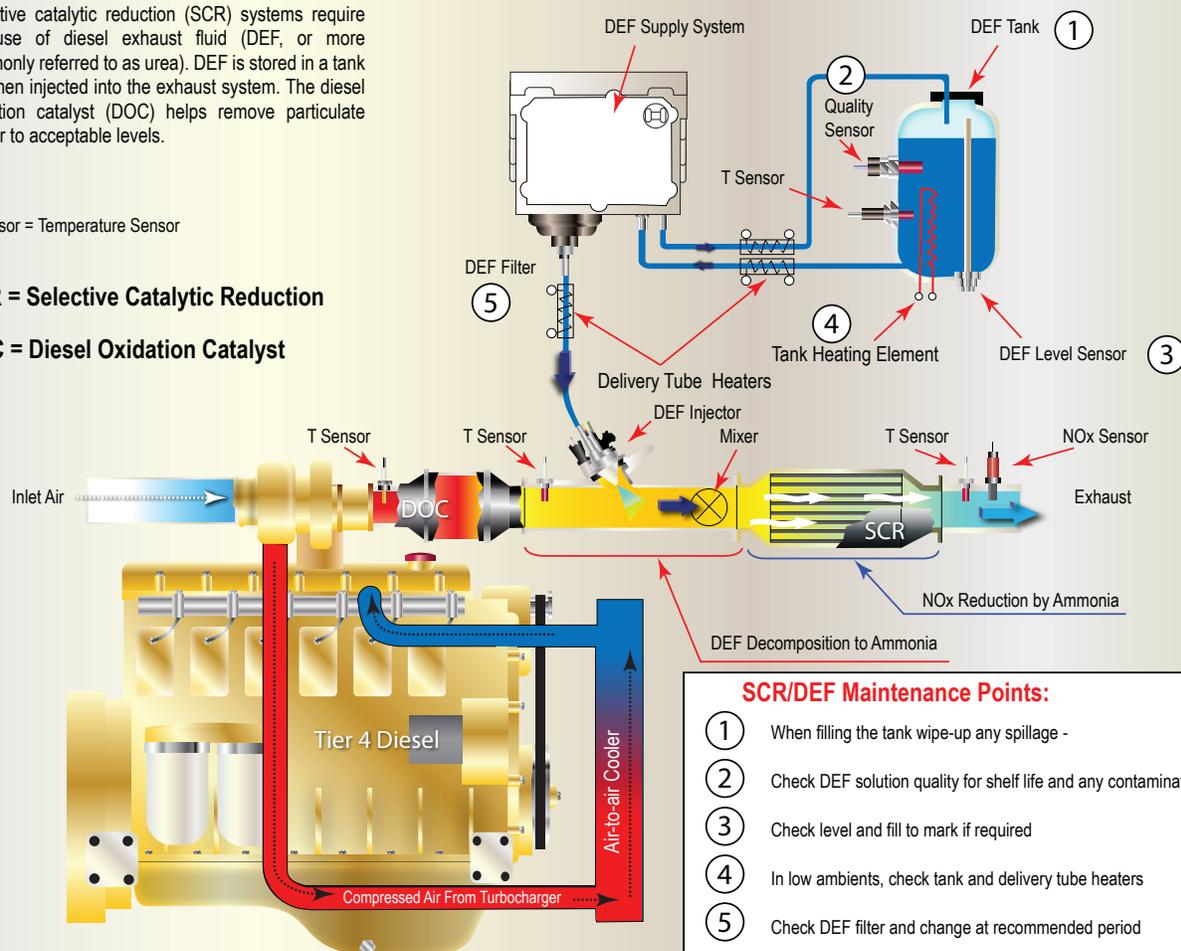
Diesel Engine DEF Emission Technologies to Meet Tier 4 (Final) Emission Levels

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 system. The diesel oxidation catalyst (DOC) helps remove particulate matter to acceptable levels.

T Sensor = Temperature Sensor

SCR = Selective Catalytic Reduction

DOC = Diesel Oxidation Catalyst



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2.0 Diesel Exhaust Fluid (DEF):

In a SCR system, the DEF reactant is necessary for the activation of a catalytic reaction. DEF is a carefully blended aqueous urea solution that consists of 32.5% high purity urea and 67.5% deionized water by weight. It is a nontoxic, nonhazardous, and nonflammable liquid. DEF quality standards are covered by ISO 322241 standards.

3.0 Urea:

Urea is a compound of nitrogen that turns to ammonia gas when heated. It is used extensively in a variety of industries, most commonly as a fertilizer in agriculture.

4.0 Deionized Water:

Deionized water, sometimes known as demineralized water, has almost all of its mineral ions removed by a chemical process. This is very similar to distilled water. For a complete catalytic reaction it is essential the urea is in solution with very clean, uncontaminated water.

5.0 Other Names:

DEF is commonly referred to as AdBlue in Europe. This is a trademark controlled by the German Association of the Automotive Industry (VDA).

6.0 Sources:

This can be purchased at truck stops and retail locations across the country (see listings on www.discoverDEF.com). It can be purchased pre-packaged in 1, 2.5, and 4 gallon jugs (the most expensive way) or 55-gallon drums and 275 or 330 gallon totes. Many larger truck stops receive bulk supplies and it can be purchased at the pump at lower price levels. DEF must be stored in a separate and dedicated tank. We recommend that your purchase always be made from a reputable API-certified supplier. SCR systems have been employed with great success by the road transport industry on their all trucks in the USA. It is well proven and trouble free.

7.0 Selective Catalytic Reduction (SCR):

This catalytic system uses the DEF to break down the dangerous NOx emissions produced during combustion into nitrogen (N) and water (H₂O). DEF fluid is sprayed into the exhaust stream by an advanced injection system, then converted into ammonia and carbon dioxide at the catalyst. Most systems use an average of 2.0% (doses can range between 1 and 3%) or slightly more (up to 5%) of the diesel fuel consumption as the treating rate. The rate depends on the NOx level produced by the particular engine model. Internal changes to the engine have resulted in improved fuel economy so the total consumption of Tier 4 final engines is still lower than previous versions.

8.0 DEF Management During Generator Maintenance:

Care needs to be taken when handling this DEF solution. Protective clothing is not required, but any spills should be washed away with water or wiped up. DEF will form white crystals as it dries out which also should be washed away with water. The following should be noted when maintaining a diesel generator system with DEF:

- **Corrosion** - DEF is corrosive to some metals such as carbon steel, aluminum, copper and zinc, so these materials should not be used for storage. ISO322241 lists both recommended and non-recommended material.
- **Cold Ambients** - DEF freezes into a crystalline slush at 12°F (minus 11°C) so heating method solutions are necessary and have to be added to tanks, supply lines and tubes for cold weather operation.
- **Fluid Expansion** - When frozen, DEF expands by some 7%. Fluid containers should allow for expansion and not be filled beyond a pre-determined level to allow for expansion.
- **Operator Protection** - DEF should not be swallowed. A physician should be consulted immediately if it is ingested accidentally.
- **Odor** - DEF has a slight pungent smell like that of ammonia but is completely harmless.
- **Transferring DEF to the Generators DEF Container** - Operators may consider the use of a packaged dispensing unit (e.g. with a 12-volt motor) to pump the DEF from storage to the DEF tank mounted on the equipment. Care should be taken to prevent dedicated hoses and nozzles from being contaminated with any debris or any other fluid when being transferred to the system's DEF tank.
- **Change and Top-off Periods** - The recommendations of the manufacturer should be followed and checked and be incorporated into a planned maintenance program.

9.0 Shelf Life:

DEF has a normal shelf life of two (2) years. However, this can be shortened if the fluid is exposed to direct sunlight or if it is stored at above 86°F (30°C). All DEF packaging should have an expiry date label. Evaporation will occur over time so it is important to keep the cap of the DEF tank and any storage containers securely closed.

10.0 Contamination:

Contaminated DEF may cause the SCR system to malfunction. This means that any pump and container should only be used for the DEF and no other fluids like diesel fuel and lube oil. It is important to maintain the purity.