



# Tech Tip

DIESELS 153

## DIESEL EXHAUST FLUID

### The Required Fluid for the Selective Catalytic Reduction System

**T**here is much chatter going on in the repair industry concerning diesel powered vehicles and a fluid referred to as Diesel Exhaust Fluid (DEF). Some are wondering what the mysterious fluid is for and how it functions in the system, and some are wondering if the system can be by-passed, or what happens if the tank runs empty. The government has mandated that the system must be designed to be tamper proof. The Selective Catalytic Reduction system (SCR) will be found on 2010 and newer applications. The diesel engines must meet some stringent EPA NOx standards, and this system has gained popularity among the vehicle manufacturers. It is imperative that we familiarize ourselves with the system, as it will be a part of our diesel vehicle service. This article will focus on the SCR system, how it functions, and some common concerns of the vehicle owner and those technicians who service the diesel applications.

The purpose of the SCR system is to reduce oxides of nitrogen (NOx) emitted to the atmosphere during the combustion process. This is especially a problem with the high compression pressures generated by the diesel engine. The system injects a mist of DEF fluid into the exhaust upstream of the SCR catalyst where it vaporizes, forming ammonia and carbon dioxide. The ammonia in conjunction with the SCR catalyst converts the NOx into harmless nitrogen and water vapor. The vehicles that are equipped with the SCR system also incorporate a Diesel Particulate Filter (DPF). The purpose of this system is to capture soot from the exhaust and incinerate it during a regeneration (burn-off) cycle. The SCR system has increased the range the vehicle can be driven between regeneration cycles, which improves the fuel economy, since less diesel is required to clean the DPF.

#### WHAT IS DEF FLUID?

DEF fluid is a non-toxic solution comprised of 67.5% deionized water and 32.5% high purity urea. Urea is a compound of nitrogen, and when it is exposed to

heat it turns to ammonia. Urea is commonly used in industries such as agriculture fertilizer, waste water treatment and the manufacture of some pharmaceuticals. It is estimated that 90% of the world production of urea is used in agriculture as a fertilizer. It is abundant, naturally occurring, and can be made from natural gas. Urea is the same organic compound found in urine. Don't even think about it...urinating in the DEF tank will not work. Do not try to blend your own urea, as the agricultural urea is not suitable for this system. Sensors are in place to protect the system from improper fluids being introduced into the system. Doing so will only leave you stranded or the vehicle performance impaired. The system cannot be bypassed and the system cannot be fooled into accepting alternate chemicals.

#### DEF CONSUMPTION

Some diesel truck owners or potential buyers become alarmed when they determine there is a second tank to fill. The DEF tank capacities vary from 5 to 8 gallons, depending on the vehicle manufacturer. The heavy duty vehicles carry larger tank capacities. The tank fill cap will be easily recognized by its blue color. The location of the tank will vary depending on the vehicle design. The DEF usage rate will vary from 2 to 3% of the diesel fuel consumed. The average consumption is one gallon of DEF fluid for every 50 gallons of diesel fuel consumed. The vehicle manufacturers claim a fuel savings of 2 to 3% in systems fitted with this technology. This is possible due to the engine being fully optimized in terms of fuel mixture. Engines not fitted with this system may require a richer fuel mixture to control the NOx. Also, with this system less frequent DPF regeneration (burn-off) cycles are necessary, which reduces diesel fuel consumption.

#### RUNNING LOW ON DEF

If the system is allowed to run out of DEF, engine power will be reduced. Initially, the power will be restricted, resulting in a maximum speed of approximately 55

mph. Continued driving will result in the speed being reduced to 5 mph. This is referred to as a limp mode. Eventually the engine will fail to start following engine shut-down. For safety reasons the engine will not quit while the vehicle is being driven. If the DEF tank is empty, a minimum of one gallon of DEF fluid will be required to restore power to the engine.

## **ON-BOARD WARNING SYSTEM**

The system features an on-board warning system and instruments mounted in the dash to keep the driver aware of the level of DEF in the tank and how many miles are left until the tank is empty. In addition, special sensors in the DEF tank will alert the driver about the quality of the fluid. The warning system will advise the driver when poor quality DEF is present in the tank. If the fluid is not replaced within 200 miles, the vehicle speed may be limited to 55 mph, and ultimately reduced to 5 mph until the quality of the DEF is restored.

## **FREEZE PROTECTION**

DEF will freeze at 12 degrees F. Normally the fluid will become slushy instead of freezing as a solid. The DEF thaws quickly without a degradation of the fluid. Even if the fluid is frozen, the vehicle will start and the vehicle is driveable. This feature is programmed into the system. The tank and lines are heated and the fluid will quickly revert to a liquid, insuring DEF delivery in an acceptable time limit authorized by the EPA. Some systems utilize electric heaters and others use engine coolant routed through the DEF tanks. Some systems are fitted with a pump that pulls the fluid from the lines and back into the tank during engine shut-down to prevent freezing. Chemicals designed to prevent freezing should not be added to the DEF tank, as they will dilute the DEF, making the system inoperative and possibly damaging the SCR components.

## **DEF SHELF LIFE**

When stored at temperatures between 10 and 90 degrees F and out of direct sunlight, the shelf life of the DEF is typically 12 months. If the maximum temperature does not exceed 75 degrees F for an extended period of time, shelf life may be extended to 24 months. The DEF containers should contain a date code reflecting the date the product was made.

## **EXTREME HEAT**

Vehicles operated in ambient temperatures of approximately 120 degrees F may require replacement of the DEF fluid before the tank capacity is consumed, especially vehicles that are not driven for extended periods of time. DEF slowly converts to ammonia during extremely hot ambient temperatures. This can really be a concern for facilities that store the DEF, as the life of the fluid is drastically reduced. Imagine having a few hundred gallons of degraded DEF in your storage tanks.

## **EXHAUST MODIFICATION**

For all you truck owners who like to modify the exhaust system...no modifications should be made to the exhaust system between the engine and the diesel particulate filter (DPF). Further, most vehicle manufacturers do not recommend removing the exhaust cooler, as the exhaust components get really hot during the DPF regeneration (burn-off) cycle. Those precautions basically eliminate exhaust system modifications.

## **DEF SKIN CONTACT**

While it is advisable to prevent prolonged contact with the skin, DEF is non-toxic, non-hazardous and non-flammable. Should you come in contact with the fluid, it is advisable to wash the exposed area thoroughly with soap and water. If the skin becomes irritated, flush the exposed area with water for ten minutes, followed by washing the area with soap and water. If the fluid comes in contact with the eyes, flush the eyes with water for ten minutes. If eye irritation persists, seek medical attention.

Make an inspection of the Diesel Exhaust Fluid reservoir fluid level a part of your routine inspection or service procedure. Your customer will appreciate knowing that you have the required fluid available. His diesel engine will not run without it.

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