

Portable Power Service News | Engine

Diesel Exhaust Fluid (Adblue)

What is Diesel Exhaust Fluid (DEF)?

DEF is the main reactant and a critical element of any Tier 4 Final Selective Catalytic Reduction (SCR) aftertreatment system. DEF decomposes into ammonia and water within the SCR system where it reacts with and simplifies oxides of nitrogen (NOx) into nitrogen, carbon dioxide and water vapor.

DEF has a uniform composition of 32.5% urea and 67.5% pure water. This composition makes DEF:

Non-toxic

Non-flammable

Non-polluting

Consistent in low temperatures

DEF's urea to water ratio is preferred for use with most SCR systems worldwide due to its optimum cold weather performance. The 32.5% DEF concentration has the lowest freezing point of all possible concentrations (down to 12° F or -11° C) and enables the urea and water to freeze and thaw with a consistent concentration.

DEF consumption will vary depending on the environment, operation and duty cycle of equipment. On average, DEF consumption is 3% to 5% of fuel consumption. As fuel consumption increases, DEF consumption also increases, so it is important to consider the highest fuel consumption rates of the equipment when planning DEF delivery and storage.

Due to its wide availability throughout both North America and Europe, DEF is subject to multiple international quality standards.

Quality DEF should meet and display certification from the American Petroleum Institute (API), German Institute of Standardization

DIN70700 or the International Organization of Standardization (ISO) 22241.

DEF Purity & Cleanliness

Maintaining Diesel Exhaust Fluid (DEF) purity and cleanliness according to the specifications defined by ISO 22241 and is essential in preventing damage to the Selective Catalytic Reduction (SCR) aftertreatment system. If DEF is delivered or stored improperly hard particle contamination, chemical contamination, or urea concentration issues may occur, damaging the system and reducing equipment performance.

Hard particle contamination can damage DEF pumps and dosers but it can be prevented through proper filtration during delivery and storage. DEF pumps and dosers include filters to remove hard particle contaminants.

Chemical contamination, which can lead to SCR catalyst damage, is more difficult to detect and impossible to remove. Contaminated DEF must be replaced with clean and pure DEF for proper machine operation.

Urea concentration in DEF can be adversely affected if DEF is delivered or stored improperly. If the water within the DEF evaporates, an increase in urea concentration will occur which may damage the aftertreatment system. DEF may also become improperly diluted by outside contamination and/or condensation which may reduce aftertreatment performance and possibly lead to aftertreatment system damage. Cummins SCR aftertreatment systems have built in DEF quality sensors that can recognize urea concentration and notify the operator.

DEF Equipment Delivery & Storage

DEF is available today through existing distribution channels, specifically through fuel, lube, or chemical supply chains and other dedicated DEF suppliers. If a site uses diesel, it will also use DEF very soon. The availability of bulk DEF delivery equipment is growing. Currently, existing fuel service vehicles, designated DEF delivery trucks, and tote systems make large volumes of DEF portable and easier to deliver to industrial consumers.

On-Site Storage/Filling Equipment

There are an ever increasing number of ways to easily store large volumes of DEF onsite, ranging from bulk storage tanks to equipment mounted containers. Large volume storage tanks can hold up to 30,000 gallons of DEF in vertical or horizontal above-ground containers and there are also versions suitable for underground storage. Integrated DEF dispensing systems that are pre-piped and fitted with the unit and pump are also available. All of these tanks can be made of fiberglass or epoxy-lined steel.

In addition to large scale bulk DEF storage and delivery, there are a number of smaller bulk containers for intra-site delivery of DEF including drum and tote containers. Both of these container types make use of either attached or vehicle-mounted DEF pumps and tanks with electric DEF pump drives. Electrically heated DEF transfer hoses are also available from major manufacturers.

The hoses are designed to operate intemperatures ranging from -40°F to 248°F (-40°C to 120°C) and are available in both pressure and suction designs. Electrically heated tote and drum blankets are also available in insulated wrap designs with adjustable thermostat control (as seen below). Standard ratings range to -23C/-10F with some Arctic ratings ranging to -40C/-40F. All are UL/CSA rated for safety.

DEF system components

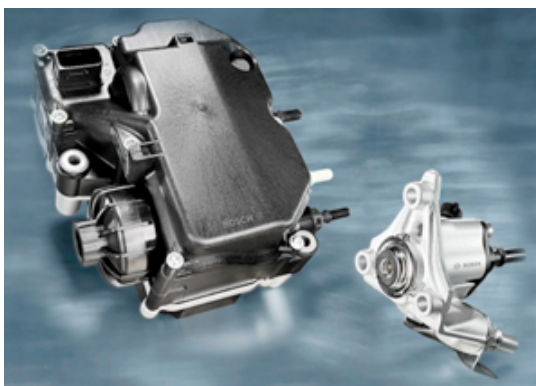


DEF tank with Multi Function Head Unit and easily identifiable blue, ¼ turn cap with 19mm ISO 22241 magnetic resistor to prevent miss-fils.

Multi Function Head Unit with integrated level - temperature and quality sensors ,DEF strainer, connections for Bosch dosing unit and coolant lines.



Heated DEF suction and return lines will thaw the DEF fluid and ensure it is in fluid form ready for injection by the pump unit.



The Bosch pump will deliver DEF fluid to the dosing unit fitted on the Decomposition Tube (DRT) between the DOC and SCR.

DEF System Operation

Priming State

Once the SCR reaches a temperature of 190°C [375°F] the ECM will command the aftertreatment DEF dosing unit to start its priming process. The aftertreatment DEF dosing unit will draw DEF from the DEF tank, pressurize and filter the DEF before sending to the aftertreatment DEF dosing valve. The aftertreatment DEF dosing valve will open and close to rid any air from the system. Once the system is able to build up pressure and has removed most of the air bubbles from the DEF lines, the aftertreatment DEF dosing system is capable of dosing.

Dosing State

The aftertreatment DEF dosing valve will open and spray DEF in the exhaust stream when the engine ECM aftertreatment calibration limits are met. The DEF will then be chemically altered by the aftertreatment SCR catalyst to clean the exhaust gases. As long as the dosing system is in the dosing state, the aftertreatment DEF dosing unit will continue to run regardless if the aftertreatment DEF dosing valve is or is not spraying DEF. DEF dosing rates are dependent on engine duty cycle. The dosing rates are not necessarily constant under most duty cycles. The aftertreatment DEF dosing valve will pulse the demanded amount of DEF into the exhaust stream. Any DEF that is not used by the aftertreatment DEF dosing valve is returned to the DEF tank.

Purging State

When a driver keys OFF, the dosing system will shut itself down with a purge cycle to prevent DEF from being left in the system, and in cold climates, potentially freezing. An audible click and pumping sound will be heard from the DEF dosing unit when it is in a purge cycle. The DEF dosing unit will slide its internal reverting valve and cause a change in the flow direction of the DEF. The DEF dosing unit will pull all of the DEF out of the aftertreatment DEF dosing valve and pressure line, and then return the unused DEF to the DEF tank. In this process the aftertreatment DEF dosing valve will open, eliminating the vacuum created in the lines for a more complete purge process. After a complete purge the majority of the system will be free of any remaining DEF. If the main power to the ECM is removed, via battery cut off or other means before the purging state is completed, an internal fault will be logged in the ECM.

Heating State

DEF freezes at -11°C [12°F]. If the operator starts the engine in a cold climate the dosing heating state will be activated. If the ambient conditions are below -4°C [25°F] the ECM will command the dosing system to go into the defrost state.

The aftertreatment dosing unit will turn on its internal heater to defrost any remaining DEF that still may be inside it. The heated DEF lines will also be commanded on. If the DEF tank temperature drops below -5°C [23°F], the DEF Tank coolant valve will be commanded open by the ECU. Engine coolant will flow through the tank multi function head unit to defrost the frozen DEF. The DEF dosing system will not prime until every component is completely defrosted. If ambient conditions continue to be cold after the system has primed, the ECM will command a maintenance heating feature to prevent the DEF dosing system from refreezing. This feature will cycle the heating on and off to the DEF lines, DEF tank, and aftertreatment DEF dosing unit.

DEF System Lamps

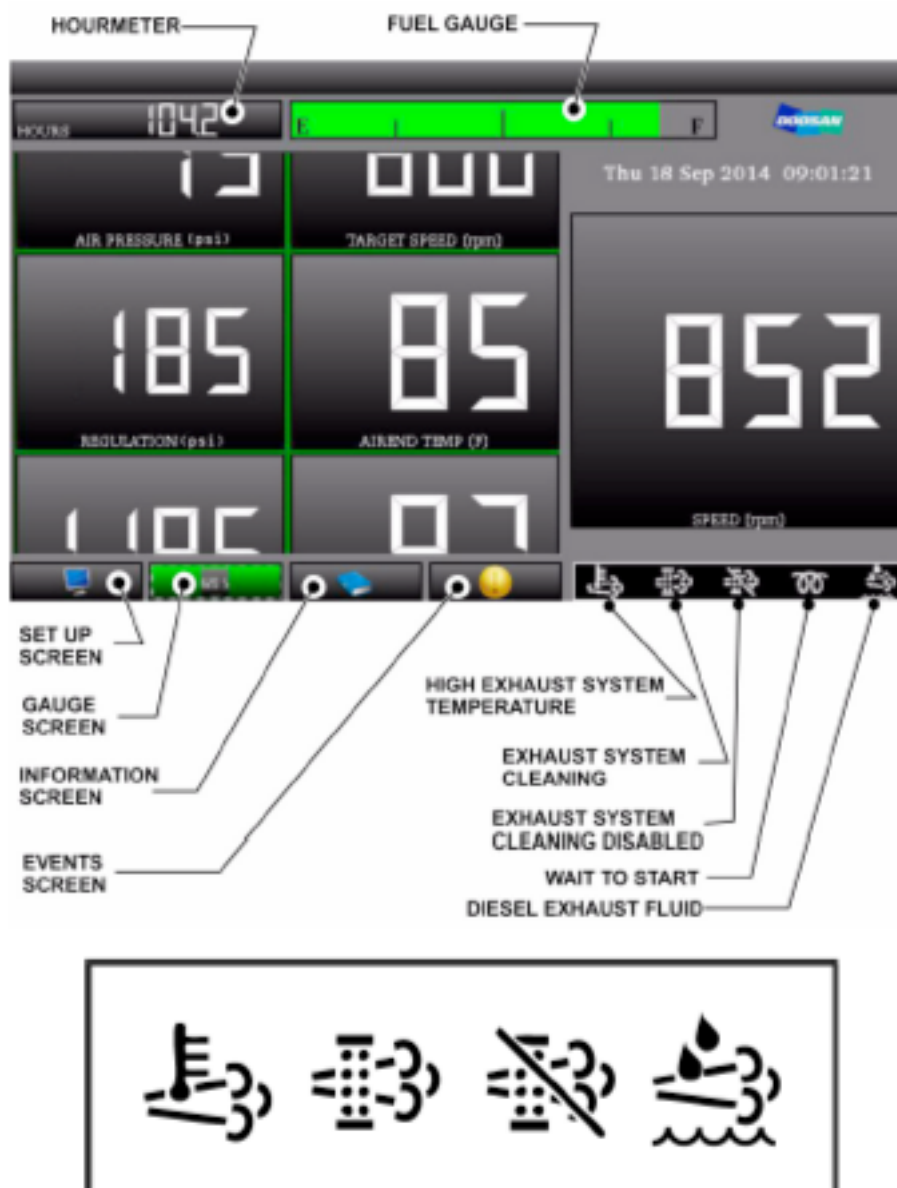
Independent of the type of control system your DIPP compressor has, this warning light will be used to signal a low DEF fluid level to the operator.

Diesel Exhaust Fluid (DEF) Level Lamp

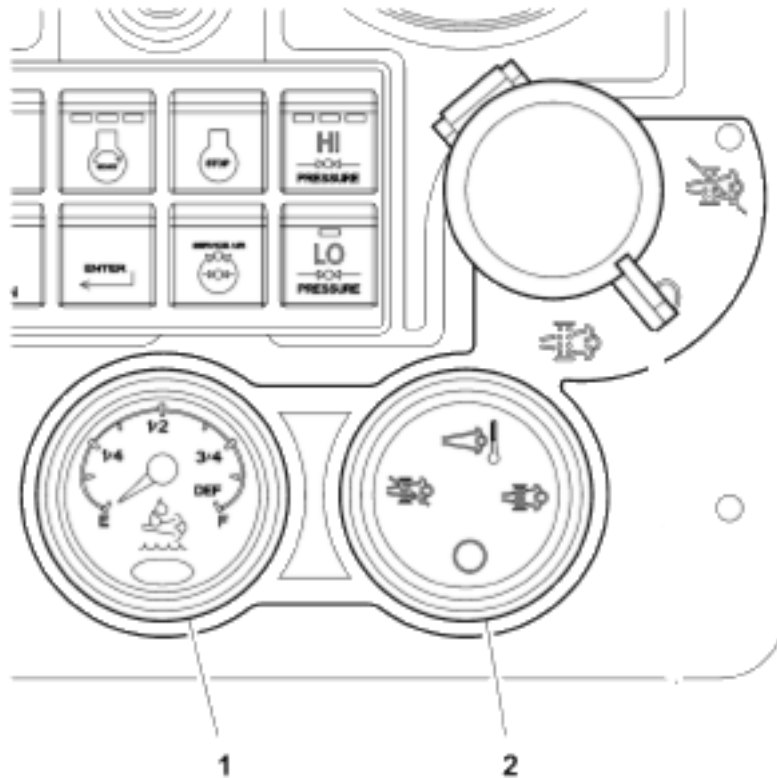


- Lights when the DEF fluid is low.

Compressors equipped with the Viewport



Compressors equipped with the Midport



1. DEF tank fluid level gauge
2. Aftertreatment system warning lights

Aftertreatment protection affecting compressor operation

DEF Quality

Adequate DEF quality is essential to meet emission targets. If an issue with the DEF quality is detected the system will warn the operator by the use of warning lights and engine codes. If the warnings are ignored the engine derate will apply, resulting in lower compressor flow output.

DEF Equipment Tampering

When any hardware or performance issues cause the NOx emissions to exceed the legislated limits, the operator is warned with the respective engine fault codes. If the warnings are ignored, the inducements will start.

Tampering/Malfunction events include, but are not limited to:

- Disconnected tank level and/or quality sensor
- Blocked DEF line or dosing unit
- Disconnected DEF dosing unit
- Disconnected DEF pump
- Disconnected SCR Wiring Harness
- Disconnected NOx Sensor
- EGR Valve malfunction
- Disconnected coolant level sensor
- Any hardware or performance issues that will cause the NOx emission exceeding a legislated threshold.

WARNING:

The ultimate engine protection level will be activated after several restarts with tampering or low DEF level uncorrected and requires a Cummins technician to reset protection parameters to allow engine restart.

NOTE:

DEF or Diesel Exhaust Fluid is also known as

-UREA

-Adblue

www.doosanportablepower.com  FSC
Mixed Sources
Controlled
Forest

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