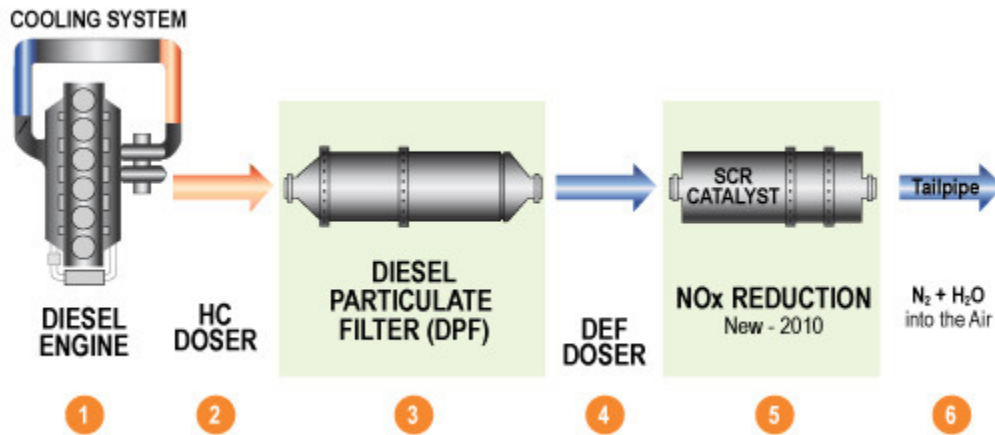


Understanding DEF & SCR



Diesel Exhaust Fluid (DEF) Frequently Asked Questions

What is DEF?

Diesel Exhaust Fluid (DEF) is one of the key elements involved in the SCR process. It is a nontoxic solution of 67.5% water and 32.5% automotive grade urea. DEF helps to convert NO_x into nitrogen gas and water vapor. It is stable, colorless, odorless, and meets accepted international standards for purity and composition.

What is urea?

Urea is a compound of nitrogen that turns to ammonia when heated. It is used in a variety of industries, including as a fertilizer in agriculture. Urea is naturally occurring, but is also commonly made from natural gas.

Why not use a 100% urea solution?

DEF provides the highest degree of practical NO_x reduction in real life automotive conditions. Using DEF at a 32.5% solution in water is cost-effective. Also, it allows the engine to perform at the highest levels of efficiency and at the widest range of climatic temperatures – anything above 12 degrees Fahrenheit.

How is DEF quality defined and guaranteed?

DEF is defined by AUS-32 specifications and the specifications meet or exceed the DIN 70070 August 2005 quality standard, the DIN V 70071 June 2005 analytical standard and the ISO 22141-1 2006 standard. The American Petroleum Institute has developed a quality certification program that ensures North American supplies of DEF will meet these standards at the pump and across the nationwide supply chain, including standards of product manufacturing, handling, quality assurance, safety and environmental protection.

What is the chemical process of producing urea and what is the energy balance of this process?

The production of urea involves the raw materials of ammonia and carbon dioxide. Two principle reactions take place in the formation of urea. The first is an exothermic (heat releasing) reaction in which ammonia + carbon dioxide creates ammonium carbamate. The second reaction is an endothermic (absorbing energy within heat) reaction in which ammonium carbamate is converted into water + urea.

How does DEF work within an SCR system?

The goal of an SCR system is to reduce levels of NO_x (oxides of nitrogen emitted from engines) that are harmful to our health and the environment. SCR is an aftertreatment technology that treats exhaust gas downstream of the engine. Small quantities of DEF (automotive grade urea solution) are injected into the exhaust stream and when mixed with the NO_x changes into harmless nitrogen and water.

What other industries use urea?

Urea solutions have a wide range of industrial and agricultural uses. More than 90% of world urea production is destined for use in agriculture as a fertilizer. Other industry uses included:

- Nutrient source in plants.
- Nutrient for effluent waste water treatment.
- Nutrient for fermentation processes.
- Reducing agent in SCR and SNCR processes.
- Chemical intermediate for the manufacture of derivatives of ammonia, pharmaceuticals, and catalysts.

With a freezing level at 12 degrees Fahrenheit, should drivers in very cold temperatures be concerned? Is there anything you could add to the DEF to keep it from freezing?

While freezing may be one of the biggest concerns with SCR, we have seen no issues with it based on our winter reliability and growth testing in Canada, nor has this been an issue among Northern European fleets in areas like Norway. We know DEF thaws quickly without changing its efficacy, and the EPA sees no problem in allowing for the short time it takes to warm up using the heat of the engine when you start the truck.

What is the DEF shelf life and storage?

When stored between 10 and 90 degrees Fahrenheit, DEF shelf life will be greater than one year. Big bulk dispensers (1,000 gallon) have climate control systems. However, Intermediate Bulk Container's (IBC) do not have climate control systems. Therefore, in cold temperature regions it is recommended to store DEF-IBC's in a storage unit. In warm temperature regions it is recommended to store DEF-IBC's in a shaded area to avoid potential water evaporation. Information about handling and storing DEF can be found at: http://tet.terraindustries.com/pdfs/urea_tech_manual_2006.pdf

Is DEF toxic compared to other automotive fluids?

No. By comparison, other automotive fluids such as diesel fuel, brake fluid, coolant fluid, engine, transmission, and axle lube are more toxic. The Environmental Protection Agency classifies DEF as "non-hazardous." Urea is naturally occurring and is biodegradable.

DEF is corrosive to aluminum. What will storage tanks be made of?

As DEF is corrosive to certain sensitive metals, DEF vehicle tanks, storage tanks, dispensing equipment, etc. will be made of an appropriate, heavy-duty and tamper-free form of durable plastic.

Does the trucking industry compete with other industries in purchasing urea?

If all trucks on the road today would be converted to SCR, they would account for only 10% of the urea consumption world wide. More than 90% of today's urea is used in agricultural applications. Also, when DEF is used for automotive and commercial vehicle use it differs from other urea solutions in purity, liquidity and concentration; therefore, it is not in direct competition with urea solutions as used in other industries.

Where and in what volumes can I buy DEF?

Today you can go and purchase DEF from bulk producers, blenders and distributors like Excelda, Cummins, Colonial Chemical, Yara, CDI Chemical Distributors and Brenntag. By the end of 2009, you will also find DEF at SCR car and light truck dealerships. DEF is currently available in a variety of different volumes, including:

- 10 liter emergency jug
- 55 gallon container
- 275 gallon Intermediate Bulk Container (IBC)
- 330 gallon plastic totes

In January 1, 2010, the goal is to have DEF available in bulk at all truck stops. By then, DEF will be available in 1,000 gallon bulk filling stations using new and existing dispensing technologies.

Where can I buy DEF filling equipment and how much does that cost?

You can purchase a DEF filling equipment through the two current equipment manufacturers, Dresser Wayne and Gilbarco, and Benecor. Dispensers for selling DEF at retail need three certifications: UL certified, weights/measures approved, and point of sale compliant. Filling station equipment that meets these requirements, such as a truck stop, will cost approximately \$33,000. Filling station equipment that is not point of sale compliant, such as dealership supply, will cost substantially less than \$33,000.

Do DEF producers or distributors lease or sell the dispensing containers and systems?

DEF producers and chemical distributors often team up with dispenser manufacturers to provide information and offer recommendations and programs on dispensing units. This approach makes implementation easier. Ask for details from your choice of provider.

What are the major truck stop chains in North America?

1. Pilot: 358 locations
2. Travel Centers of America (incl. Petro): 238 locations
3. Flying J: 192 locations of which 64 in Canada
4. Love's: 219 locations