

## Diesel Exhaust Fluid (DEF) Frequently Asked Questions

### Diesel Exhaust Fluid (DEF) – What it is and how it should be handled

#### **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<sub>x</sub> into nitrogen gas and water vapor. It is stable, colorless, odorless, and meets accepted international standards for purity and composition.

#### **What is the purpose of DEF?**

DEF is used in Selective Catalytic Reduction (SCR) systems to change the oxides of nitrogen (NO<sub>x</sub>) emissions in diesel exhaust to nitrogen and water. Nitrogen makes up about 78% of the air we breathe every day.

#### **What are the benefits of using DEF?**

Diesel engines equipped with SCR using DEF not only meet the 2010 tailpipe standard, they also deliver significant fuel economy.

#### **What does DEF look like?**

DEF is clear like water.

#### **What does DEF smell like?**

DEF can have a slight ammonia smell.

#### **Why not use a 100% urea solution?**

DEF provides the highest degree of practical NO<sub>x</sub> 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.

**Are there any storage considerations/limitations for DEF?**

Yes, since DEF can degrade over long periods of time (>1 year), and at temperatures over 90°F, long term storage should be limited, if possible. Product should be stored in temperatures between 12° F and 86° F.

**What is the DEF shelf life and storage?**

When stored between 12 and 86 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.

**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 include:

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

**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.

## **DEF and Trucks – Vehicle Operations & DEF Handling**

### **Why is it necessary to use DEF now?**

Diesel engines purchased after January 1, 2010, require the use of DEF in vehicles using SCR technology to reduce emissions and meet the EPA 2010 tailpipe standards.

### **How does DEF work within an SCR system?**

The goal of an SCR system is to reduce levels of NO<sub>x</sub> (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<sub>x</sub> changes into harmless nitrogen and water.

### **How often will I have to refill my DEF tank?**

That depends upon the size of your DEF tank and the dosing rate chosen by your automobile/truck manufacturer. DEF tanks range in size from 6 gallons to 30 gallons. For most truck applications, DEF refills often coincide with a regular oil change schedule. DEF Refills are also quite convenient with nearly 10,000 retail locations now offering DEF either at the pump or in pre-packaged containers.

### **What will occur with my truck if I do not refill the DEF tank?**

Performance degradation will be followed by an inability to start your vehicle if you do not fill the tank.

### **Should my DEF tank be emptied if my truck is placed in storage?**

Not required. Vehicle on-board controls are designed to store and handle DEF.

### **Will my vehicle sustain any damage if I accidentally spill the DEF on the engine or other surface?**

DEF can be mildly corrosive to some materials, particularly aluminum, copper and other alloys. It should be washed off with water. DEF vehicle tanks, fluid lines, storage tanks and dispensing equipment will be made of appropriate, heavy-duty and tamper-free forms of durable plastic.

### **What if DEF gets on my hands or in my eyes?**

According to OSHA, DEF is mildly irritating to the eyes and skin. If the liquid should contact either, the DEF should be flushed out/washed off with plenty of clean water.

### **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.

## **With a freezing level at 12 degrees Fahrenheit, should drivers in very cold temperatures be concerned?**

While freezing may be one of the biggest concerns with SCR, there have been no issues with DEF based on winter reliability and growth testing in Canada, nor has this been an issue among Northern European fleets in areas like Norway. 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.

## **Purchasing & Planning for DEF Supplies**

### **Where can I purchase DEF?**

Car and truck dealers, truck stops, and eventually retail and convenience stores. For more information on where to find DEF for sale, log on to [www.discoverDEF.com](http://www.discoverDEF.com).

### **How do I know what DEF to buy?**

High quality DEF will be produced and distributed by companies that have demonstrated their domestic expertise in production and distribution and will bear the API Certified symbol. This designation implies that the fluid meets the stringent product quality standards established by ISO 22241. Look for this logo on DEF packaging:



### **In what volumes can I buy DEF?**

In addition to large above and below ground bulk storage units for truckstops and truck terminal refilling, DEF is currently available in a variety of different volumes, including:

- 2.5 & 5 gallon prepackaged supplies
- 55 gallon drum
- 275 gallon Intermediate Bulk Container (IBC)
- 330 gallon plastic totes

On January 1, 2010, DEF began to be installed at fuel islands a select Pilot Travel Centers and other truckstops. Many new stations at Pilot and other truckstops are being equipped with fuel island DEF dispensing technologies. Also, carrying DEF now are Loves Travel Stops and TA Travel Centers.

### **Where can I buy DEF filling equipment and how much does it cost?**

The petroleum equipment institute (PEI) has published guidelines for handling, transporting, storing and dispensing DEF under RP1100. You may also seek guidance from the ISO standard 22241 which also addresses the use and handling of DEF. Several manufacturers have solutions now available from manually, air or electrically operated pumps to dispense DEF from jugs, drums, IBC's and Mini-bulk containers.

A system can be as simple and economically purchased as a hand operated pump; while other systems can be as sophisticated as having overhead hose reels and will be able to operate with your existing inventory control systems that can monitor the use of the DEF. For retail sites it will be necessary to have and

use weights and measure approved equipment. But for a large segment of the DEF users weights and measure will not be required and a much more economical solution for dispensing DEF is available now.

**Do DEF producers or distributors lease or sell the dispensing 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.

**Where can I get more information on DEF?**

The International Organization for Standardization, or ISO, has developed a document detailing the specification, testing methodology, storage, handling, transportation requirements, and the refilling interface for DEF. That document is ISO 22241 parts 1, 2, 3, and 4. This copyrighted document is available for purchase at the International Organization for Standardization web site at:

[http://www.iso.org/iso/iso\\_catalogue/catalogue\\_tc/catalogue\\_detail.htm?csnumber=42941](http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=42941)

AUS 32 Quality Assurance Guidance Document (version 2.1 - August 2008) - this document was developed in order to safeguard the integrity of the urea solution in production, storage and distribution. It provides very useful background information. It can be accessed for free download at: <http://www.petrochemistry.net/?HID=113>