



Diesel's Guide For Going Green



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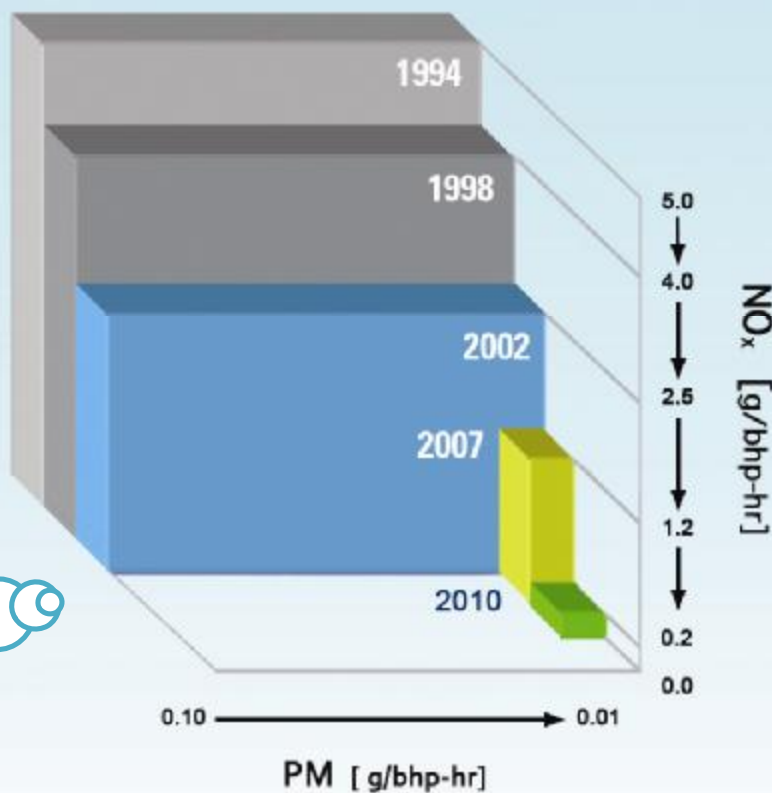
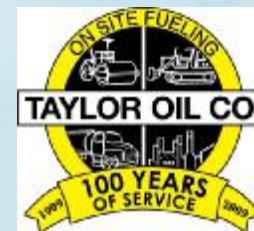
EPA Standards



- Effective January 1, 2010, the U.S. Environmental Protection Agency (EPA) mandated that all diesel-powered passenger and commercial vehicles produced must have an 83% reduction in NO_x emissions from the EPA 2007 emission requirement.
 - EPA 2010 engine emissions must meet a NO_x level of 0.2 g/bhp-hr.
- The EPA has formally approved Selective Catalytic Reduction (SCR) technology to meet its 2010 emission standard.



EPA Emissions Standards (1994 to 2010)



90% Less PM.
The EPA 2010 standard lowered PM emissions to 0.01 g/hp-hr.

83% Less NO_x Than 2007.
The EPA 2010 standard requires engine emissions to meet a NO_x level of 0.2 g/bhp-hr.

Overall, 96% Less NO_x Than 1994!

What is SCR?



- **S**elective **C**atalytic **R**eduction (**SCR**) is an emission control technology designed to inject **D**iesel **E**xhaust **F**luid (**DEF**) into the exhaust stream that will convert nitrogen oxides (NO_x), with an aid of a catalyst, into nitrogen (N_2) and water (H_2O). It is the after-treatment technology that treats exhaust gas downstream of the engine.
- **SCR** is a system that uses **DEF** to reduce NO_x to near zero levels to meet the **E**nvironmental **P**rotection **A**gency (**EPA**) 2010 emission regulations.



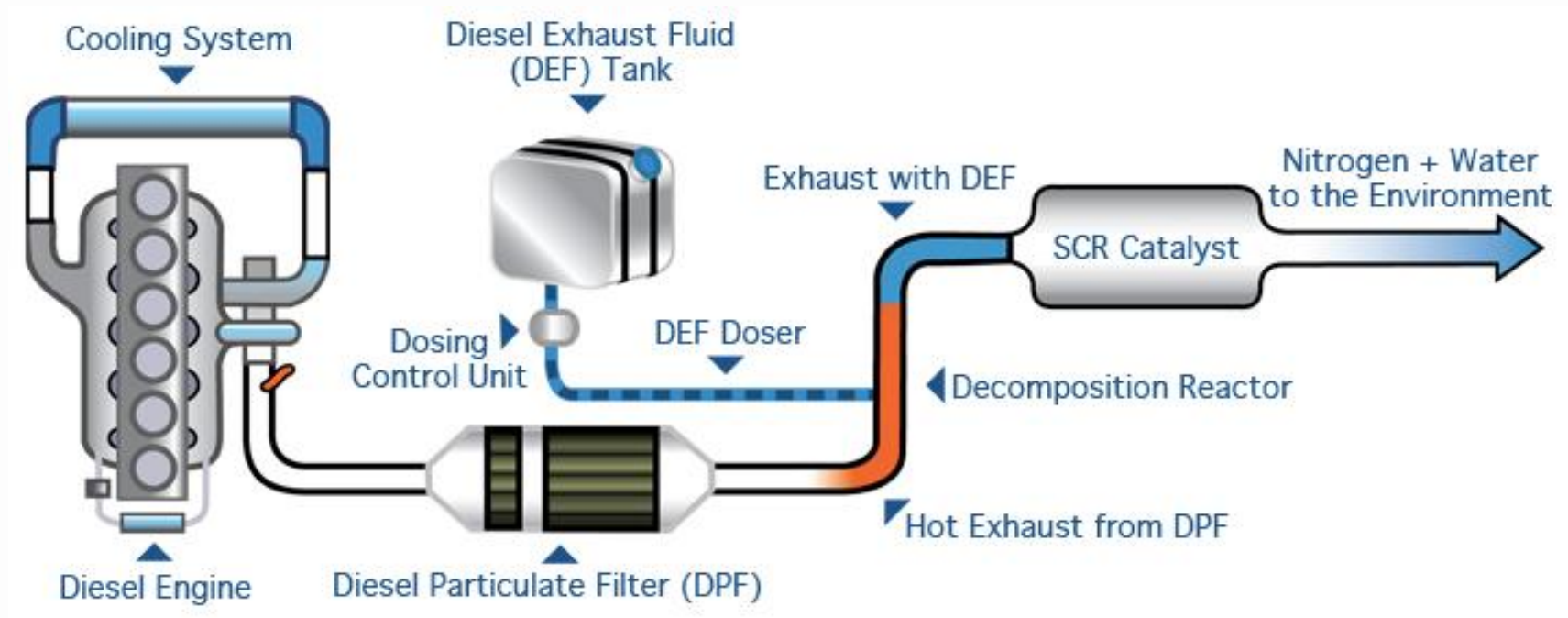


SCR Process



1. Diesel engine recycles the exhaust.
 - a) NO_x and Particulate Matter travel to DPF
2. Diesel Particulate Filter (DPF) traps the particulate matter and burns off the matter with a low grade heat. (The Filters do need frequent maintenance.)
 - a) DEF is sprayed into the exhaust stream as the NO_x travels down to the SCR Catalyst.
3. DEF and NO_x enter the SCR Catalyst together where they react and are converted to nitrogen and water vapor.
4. Nitrogen and water vapor are then released from the tailpipe.

SCR Process





A-EGR Technology

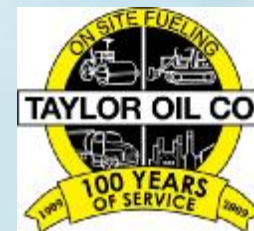
(Temporary Competitive Solution)



- **A**dvanced **E**xhaust **G**as **R**ecirculation (**A-EGR**) is a temporary competitive solution against **SCR**.
- **A-EGR** attempts to reduce NO_x and **P**articulate **M**atter (**PM**) by significantly raising fuel injection pressure at low engine speeds. **EGR** is currently used in diesel engines which re-introduces cooled exhaust air from the diesel engine's combustion chamber back into the engine to reduce the formation of NO_x and burn off **PM**.
- Navistar/International Truck is the only U.S. engine manufacturer using the **EGR** solution, combined with EPA carbon credits, to comply with EPA's 2010 NO_x emissions requirement .



Supporters of SCR

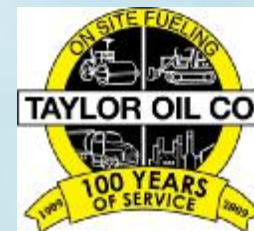


OEM Diesel Engine Manufacturer using SCR:

- Cummins
- Detroit Diesel
- Hino
- Mack
- PACCAR
- Volvo



Car Dealerships Using DEF



2010

- Audi
- BMW
- Chrysler
- Dodge
- Ford
- Mercedes Benz
- Volkswagen



2011

- Chevrolet
- GMC





What is DEF?

- Diesel Exhaust Fluid (DEF) is an ULTRA-PURE UREA solution that acts as a reductant. It is carried in a separate tank, and is then injected into the hot exhaust stream and absorbed onto a catalyst.
- DEF is an aqueous urea solution whose specifications are regulated by standard ISO 22241 70070. It is a non-toxic, non-flammable, non-hazardous and non-explosive substance.
 - might have a slightly pungent odor similar to ammonia.
- DEF is compounded of 32.5% urea and 67.5% deionized water.
 - Urea is a compound of nitrogen that turns to ammonia when heated.



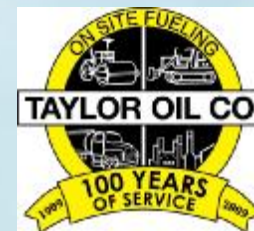
DEF Process



- The **ULTRA-PURE UREA** used to make Premium **ULTRA-PURE DEF** is made from liquefied Natural Gas that is refined into the size of pellets, or dry prill, in Germany.
- The prill is then liquefied in a strict process with deionized water, into a very precise and exact **DEF** solution under the guidelines of the ISO, the API, and the EPA.



DEF Specifications I

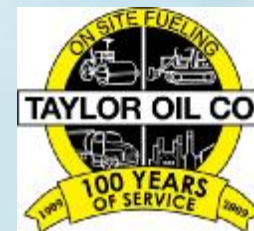


Specification-No.: ISO 22241

| Parameter | Value | Unit |
|-------------------------------|---------------|----------|
| Urea | 32,5 ± 0,7 | Weight % |
| Density (@ 77°F) | 9.05-9.09 | lbs/gals |
| Refractive Index (@ 77°F) | 1.2814-1.3843 | |
| Alkalinity as NH ₃ | < 0,1 | Weight % |
| Biuret | < 0,3 | Weight % |
| Aldehyd | < 5 | mg/kg |
| Insolubles | < 20 | mg/kg |
| Phosphate (PO ₄) | < 0,5 | mg/kg |
| Calcium | < 0,5 | mg/kg |
| Iron | < 0,5 | mg/kg |
| Copper | < 0,2 | mg/kg |
| Zinc | < 0,2 | mg/kg |



DEF Specifications II



| Parameter | Value | Unit |
|----------------------------|-----------------|-------------------|
| Chromium | < 0,2 | mg/kg |
| Nickel | < 0,2 | mg/kg |
| Aluminium | < 0,5 | mg/kg |
| Magnesium | < 0,5 | mg/kg |
| Sodium | < 0,5 | mg/kg |
| Potassium | < 0,5 | mg/kg |
| Density at 20°C (= +69° F) | 1,0870 – 1,0930 | g/cm ³ |
| Refractive index at 20°C | 1,3814 – 1,3843 | |

Appearance: colorless, clear liquid



DEF Impurities

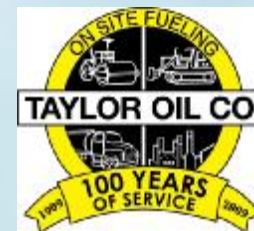


Impurities can come from:

- Urea manufacturer
- DEF blending, mixing, packaging process and packaging
 - Adding any type of additive during mixing process
 - For example, adding an additive to improve DEF's freezing point
- Transportation and handling of DEF product
- Customer storage of DEF product
- Customer dispensing DEF out of container
- Customer transferring of DEF product into secondary container
 - From secondary container into DEF tank
- Contamination of DEF tank on vehicle



DEF Consumption



- **DEF** consumption will be approximately 2% of the diesel fuel consumed. **DEF** will be consumed on a 50:1 ration with diesel. (For every 50 gallons of diesel fuel burned, you will use 1 gallon of **DEF**.)
 - Actual usage will vary with driving conditions and engine performance.

Heavy Duty:

| Annual Mile/Vehicle | Annual Total Miles | Avg. MPG/Truck | Average DEF Tank Size (on Vehicle) | Annual Fuel Usage (gallons) | Consumption/Gallon of fuel | Est. Annual DEF Consumption | DEF Fill-Ups/year |
|---------------------|--------------------|----------------|------------------------------------|-----------------------------|----------------------------|-----------------------------|-------------------|
| 120,000 | 120,000 | 6 | 20 | 20,000 | 2% | 400 | 20 |

Medium Duty:

| Annual Mile/Vehicle | Annual Total Miles | Avg. MPG/Truck | Average DEF Tank Size (on Vehicle) | Annual Fuel Usage (gallons) | Consumption/Gallon of fuel | Est. Annual DEF Consumption | DEF Fill-Ups/year |
|---------------------|--------------------|----------------|------------------------------------|-----------------------------|----------------------------|-----------------------------|-------------------|
| 50,000 | 50,000 | 8 | 10 | 6,250 | 2% | 125 | 13 |

DEF Gauge



- A **DEF** gauge, similar to a fuel gauge, will indicate the level of **DEF** remaining in the tank. There are indicators on the dash that will illuminate and alert the driver that the vehicle is low on **DEF**.
- If a vehicle is operated such that one would completely run out of **DEF**, the vehicle will be reduced to 55 MPH, if the tank is not replenished after a certain period of time, the speed will be again reduced, to 5 MPH.



DEF Fuel Tank

(Pick Up Trucks)



Ford Pick Up Truck DEF Tank



GM Passenger Van DEF Tank

(Picture courtesy of: <http://news.pickuptrucks.com/2009/08/first-look-2011-duramax-diesel-v8-engine.html>)



DEF Fuel Tank

(Freightliner Trucks)



Pictures courtesy of Campbell Freightliner

SCR Catalyst



Picture courtesy of Campbell Freightliner

DEF Thawing Process

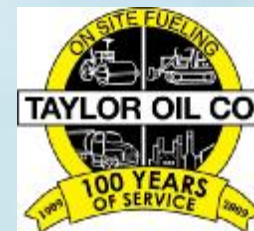


- **DEF** truck tanks and lines are equipped with heater systems so start up and normal operations of the vehicle will not be impacted.
 - The **DEF** tank is warmed by the engine coolant, so while the engine idles during warm-up, the fluid will start to thaw enabling the engine to idle without **DEF**.

| Thawing Pace | | |
|--------------|-----------|------------|
| 1 minute | 5 minutes | 10 minutes |
| | | |



DEF Package Availability



1/2 Gallon OEM



2.5 Gallon Jugs



55 Gallon Drums



275 Gallon Tote

For Bulk Storage and Dispensing Systems, contact your Prime Lube Representative.



½ Gallon OEM Bottles

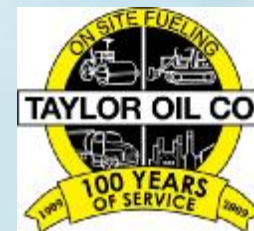


- Coupling to filler neck non-destructive and threaded for secure fit
- After threading onto filler pipe simple pressure on bottles bottom as inverted, opens to top seal to empty.
- 18 - 20 seconds to empty.
- Overflow protected
- Tamperproof
- Mercedes **BLUETEC**





2.5 Gallon Bottles



- 2.5 gallon easy pour container
- Attachable flex spout
- Available 72 bottles per pallet
- DOT approved





55 Gallon Drum



- Available 4 drums per pallet
- Easy dispensing of DEF with Poly or Stainless steel hand pump
- Easy dispensing of DEF with electric pump, hose and filling pistol (valve)



IBC Totes



- Available in 275 gallons.
- IBC containers are stackable to 3 high.
- IBC is available with either an “open” or “closed” system.
- Container is sealed –access caps secured with nylon plastics to expose any possible tampering of product.
- Easy assembly of Pump, Hose and Filling-pistol (valve).



Drum Dispensing Pumps



365 DEF Pump – Nylon and stainless steel DEF dispensing pump w/o house. Fits 15 through 55 gallon drums with 2" bung opening. Includes bung adapter and discharge spout. Spout can be removed and hose attached. Dispenses 8oz. Per stroke.



1014 DEF Rotary Pump – Plastic Rotary DEF dispensing pump with telescopic down tube. Polypropylene and stainless steel construction. Dispenses 1 gallon per 16 revolutions.



375 DEF Lever Pump – Lever style polypropylene and stainless steel DEF dispensing pump. Fits 15 through 55 gallon drums with 2" bung opening. Dispenses 12 oz. per stroke.



Drum Pump System (Auto Nozzle)



DRUM

Flow rate 8 gpm

Available with automatic nozzle



TROLL

Troll

Cod. R12068010

+
Basic





Tote Dispensing System



PRO Flow rate 7 ÷ 8 gpm
Accuracy +/- 1%



Flow Meter



BASIC

Flow rate 7 ÷ 8 gpm



DEF Storage

- **DEF** should be stored in a cool, dry, well-ventilated area, out of direct sunlight.
- **DEF** is a 32.5% solution and will begin to crystallize and freeze at 12°F (-11°C); which will cause **DEF** to expand 7% when frozen. So it should be stored between 23°F (-5°C) and 77°F (25°C).
 - At 32.5%, both the urea and water will freeze at the same rate, ensuring that as it thaws, the fluid does not become diluted, or over concentrated. The freezing and unthawing of the **DEF** will not cause degradation of the product.
- Prolonged **DEF** storage above 75°F will reduce the shelf life



DEF Material Storage



Compatible Storage Materials

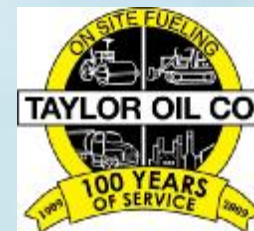
- Stainless Steel
- Titanium
- Durable Plastic
- Rubber

Incompatible Storage Materials

- Aluminum
- Magnesium
- Steel



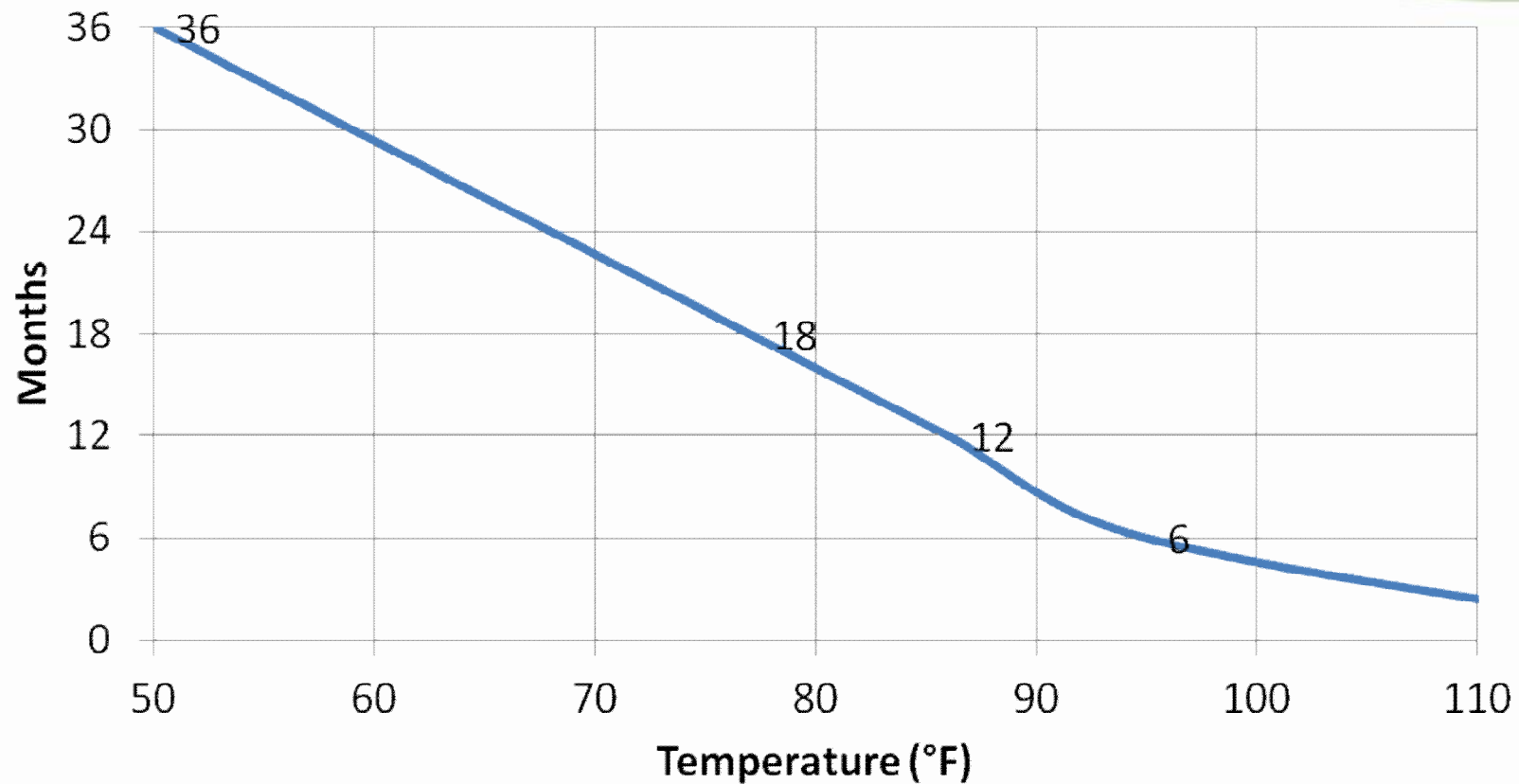
DEF Shelf Life



| Constant Storage Temperature | Shelf Life (Months) |
|--|-----------------------------|
| $\leq 10^{\circ}\text{C}$ or $\leq 50^{\circ}\text{F}$ | 36 |
| $\leq 25^{\circ}\text{C}$ or $\leq 77^{\circ}\text{F}$ | 18 |
| $\leq 30^{\circ}\text{C}$ or $\leq 86^{\circ}\text{F}$ | 12 |
| $\leq 35^{\circ}\text{C}$ or $\leq 95^{\circ}\text{F}$ | 6 |
| $> 35^{\circ}\text{C}$ or $> 95^{\circ}\text{F}$ | Check DEF before use |



DEF Shelf Life vs Temperature



Each increment in temperature that DEF is exposed to, for prolonged periods of time, decrements the shelf life.