

# PACCAR ENGINES

All PACCAR Engines will utilize SCR technology to meet 2010 emissions requirements and provide customers increased reliability and fuel economy.



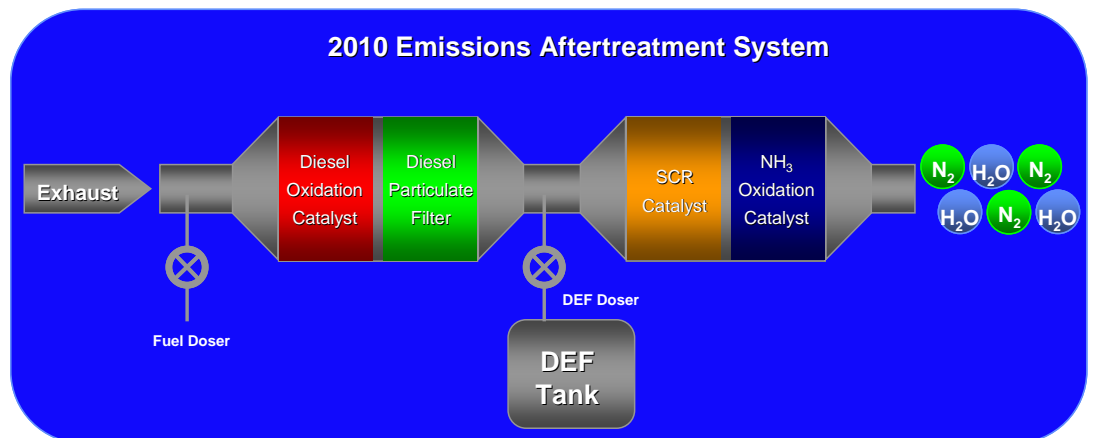
## Selective Catalytic Reduction: Technology for the Environment & Business

Environmental regulations and concerns about clean air impacts all of us. Protecting and preserving the environment is a core value at PACCAR. By 2010 all PACCAR engines will achieve near-zero emissions of NOx, a greenhouse gas and smog causing compound.

Two emissions technologies will be available, Selective Catalytic Reduction (SCR) and in-cylinder, Exhaust Gas Recirculation (EGR). PACCAR has carefully evaluated each technology and concluded that SCR will provide the most fuel efficient and cost-effective solution to 2010 regulations. The SCR system operates downstream from the engine, removing much of the stress and heat rejection related to EGR-only engines to improve reliability and increase fuel economy.

### How Does SCR Work?

SCR is very simple. There are four major components to the SCR system: a Diesel Exhaust Fluid (DEF) tank, a DEF doser, the SCR catalyst, and an ammonia (NH<sub>3</sub>) catalyst. These components are all integrated into the exhaust system. Small amounts of DEF are injected into the catalyst where it is mixed and reacts with the NOx found in the exhaust to produce nitrogen gas and water vapor, both of which are harmlessly released into the atmosphere through the vehicle's tailpipe.



### What Are the Benefits of SCR?

Simply stated, SCR improves engine fuel economy and increases engine reliability. Compared to 2007 emissions technology, engines using SCR aftertreatment do not require significant increases in EGR flow rates to meet EPA 2010 NOx limits. Because the pollutants are reduced to near-zero levels within the exhaust stream, an engine with SCR aftertreatment will operate cooler, cleaner and more efficient than engines with higher EGR levels. PACCAR engines with SCR technology will provide up to 5% fuel economy improvement compared to today's engines, and even greater when compared to a 2010 non-SCR engine. Also, a cooler engine provides greater reliability.

## ***Diesel Exhaust Fluid:***

### Solution

67% - Purified Water

33% - Urea

### Weight

9.1 lbs/gallon

### Availability

Peterbilt & Kenworth  
Dealerships

Truck Stops

### Reference Websites

[www.factsaboutscr.com](http://www.factsaboutscr.com)

[www.truckscr.com](http://www.truckscr.com)

## **Is This Technology Proven?**

SCR technology has been proven globally for a number of years in some of the harshest climates and industries including trucking, marine and stationary power applications. Over 500,000 vehicles are successfully performing with SCR technology, including over 100,000 PACCAR engines.

Engines utilizing high EGR flow rates are in fact unproven, as this is a new concept not yet in use by any engine manufacturer. The high output EGR engines in 2010 will require significantly higher heat rejection to deal with the increased EGR levels, resulting in potentially lower fuel economy than today's designs.

## **What is DEF?**

DEF is a non-toxic solution of purified water (67%) and Urea (33%). Urea is a non-hazardous, natural compound which is produced from natural gas and commonly used in everyday products such as fertilizer. DEF can be stored, dispensed and handled in bulk and smaller quantities.

## **How Much DEF Will I Use?**

DEF is used in a low volume, approximately 2 gallons for every 100 gallons of diesel fuel. Consequently, the DEF on-vehicle tank will be substantially smaller than the fuel tanks. A variety of DEF tanks will be available, matched to fuel volume and vehicle application.

## **Where Will DEF be Sold?**

PACCAR is working with DEF distributors to ensure a nationwide availability. DEF will be widely available at truck stops and other fueling outlets, as well as truck OEM dealerships. The North American industry will also likely follow European practice where many fleets purchase bulk tanks for additional availability. In addition to a range of bulk volumes, DEF will also be available in small containers of approximately 2 ½ gallons to easily carry on the vehicle.



## **How Does DEF Perform in Extreme Temperatures?**

DEF has proven to be very reliable throughout the world in a wide range of climates. DEF will freeze at approximately 12°F (-11°C) and thaws quickly with no degradation. During normal vehicle use, DEF remains operational at 5°F (-15°C) without requiring a heating element within the system. PACCAR products will utilize heat generated from the engine to ensure the solution remains at operational consistency at the coldest temperature extremes.

DEF stored at high temperatures for an extended period of time will slowly degrade. However, product quality is easily maintained at virtually all temperatures by simply ensuring DEF stock is rotated within a year.

## Glossary of Terms:

SCR – Selective Catalytic Reduction is an exhaust aftertreatment technology that utilizes a reductant (DEF) to convert NOx to harmless nitrogen and water.

DEF – A solution of urea and purified water used to reduce NOx in the SCR process.

EGR – Exhaust Gas Recirculation is a NOx reduction where a portion of the exhaust gases are used to reduce the combustion temperature in the engine cylinders.

NOx – Oxides of Nitrogen are compounds that contribute to smog and pollution.

DPF – The Diesel Particulate Filter removes small particles, “soot,” from diesel engine exhaust.

Doser – An injection process in which DEF and/or fuel is provided at timed intervals within engine aftertreatment systems.

## How Will the Operator be Affected?

The SCR system includes sensors to monitor operational performance. Warning indicators will inform the driver of items requiring attention. For example, as the DEF tank approaches empty, the driver will receive a number of indications, providing ample time to refill the tank before it becomes empty. When the tank is almost empty or an unapproved fluid is used in the DEF tank, the engine will automatically derate.

The DEF tank is easy to refill. When filling from bulk storage tanks, a unique nozzle fits directly into the tank, which is clearly identified with a blue cap. The DEF tank filler neck is smaller than that used on the diesel fuel tank, preventing accidental contamination. Smaller, transportable containers of DEF use flexible filler hoses and funnels with spill-free nozzles.

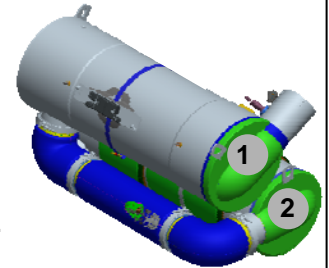
## How Does SCR Affect My Vehicle's Configuration?



The SCR system components are integrated with the vehicle chassis. Vehicle packaging for these components is dependent upon exhaust configurations specified and the application. For example, in a typical vehicle, the DPF and SCR catalysts will most likely be positioned within the toolbox mounted under the cab as illustrated in blue in the rendering at left.

The catalysts, shown in the drawing at right, each perform a specific function in the aftertreatment process:

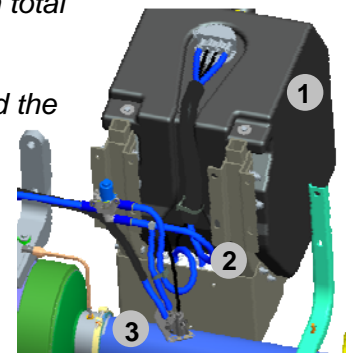
1. Diesel Particulate Filter – The DPF is used in all diesel engines to reduce particulate matter (engine soot).
2. SCR Catalyst – The SCR catalyst facilitates the chemical conversion of NOx to Nitrogen gas and water vapor.



The DEF tank, noted in green in the rendering at left, will be mounted on the chassis in front of the fuel tanks in most configurations where refilling is simple and there is no interference with aftermarket-related modifications that occur behind the cab and/or sleeper.

The tank and injection components, illustrated in the rendering below, each perform a specific function in the aftertreatment process:

1. DEF Tank – The tanks will store the DEF solution on the vehicle and be available in a range of sizes dependent upon total vehicle diesel fuel volume.
2. Dosing Pump – The pump provides pressure to send the DEF solution from the tank to the doser.
3. DEF Doser – The doser delivers the DEF into a mixing pipe where it is combined with the exhaust gas exiting the Diesel Particulate Filter (DPF).



Visit our websites for  
more information about  
PACCAR Engines

PACCAR Inc  
[www.paccar.com](http://www.paccar.com)

Kenworth  
[www.kenworth.com](http://www.kenworth.com)

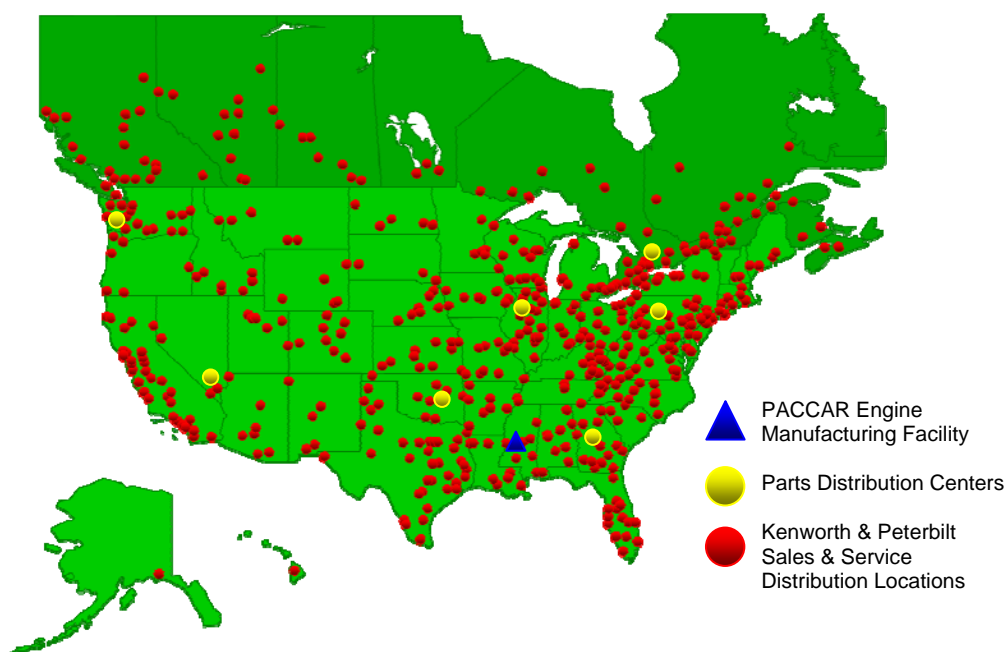
Peterbilt  
[www.peterbilt.com](http://www.peterbilt.com)

## Which Vehicles Will Have an SCR System?

The Environmental Protection Agency stipulates that all engines manufactured after December 31, 2009 and used in light, medium and heavy duty trucks must comply with the new regulations. All engine options for PACCAR customers will utilize SCR technology to meet 2010 emissions regulations.

## How Will PACCAR Support this Technology?

PACCAR has made significant investments in Peterbilt and Kenworth distribution networks, parts distribution centers, product testing facilities, and the new state-of-the-art engine production facility in Columbus, Mississippi. From comprehensive training courses to advanced diagnostic tools, the PACCAR organization has incorporated the experience gained from having successfully implemented and supported SCR technology through its European nameplate, DAF, into its North America support network.



In addition to these locations, PACCAR's support network includes:

- Four engine training centers
- Two product technical centers, including a technologically advanced engineering test lab at the engine production facility in Columbus, MS.
- A customer support center and engine support center
- Ten regional service support centers across North America

## Where can I find more information about PACCAR engines?

Additional information may be obtained by visiting the PACCAR, Kenworth or Peterbilt websites. Or, stop in at one of the nearly 600 Kenworth and Peterbilt dealership locations found throughout the U.S. and Canada.

## The PACCAR Emissions Solution

Safe. Efficient. Reliable. And good for the Environment.

**PACCAR** ENGINES