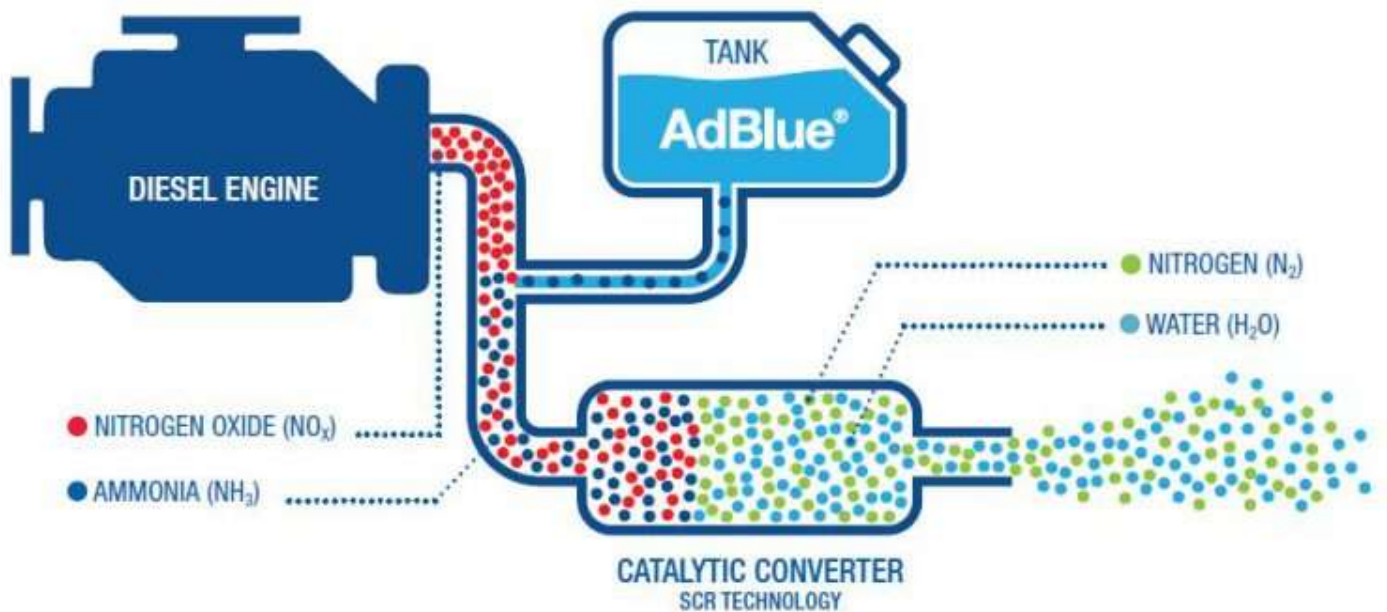


## WHAT IS SCR

Selective Catalytic Reduction (SCR) is an advanced active emissions control technology system used in diesel engines.

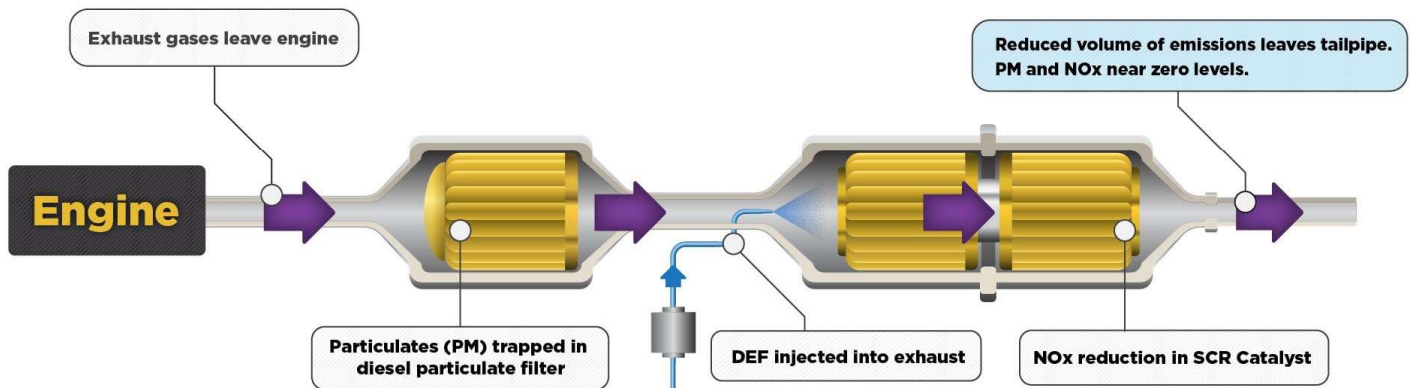


### What is Selective Catalytic Reduction

Selective Catalytic Reduction (SCR) is an advanced active emissions control technology system that injects a liquid-reductant agent through a special catalyst into the exhaust stream of a diesel engine. The reductant source is usually automotive-grade urea, otherwise known as Diesel Exhaust Fluid (DEF). The DEF sets off a chemical reaction that converts nitrogen oxides into nitrogen, water and tiny amounts of carbon dioxide (CO<sub>2</sub>), natural components of the air we breathe, which is then expelled through the vehicle tailpipe.

SCR technology is designed to permit nitrogen oxide (NO<sub>x</sub>) reduction reactions to take place in an oxidizing atmosphere. It is called "selective" because it reduces levels of NO<sub>x</sub> using ammonia as a reductant within a catalyst system. The chemical reaction is known as "reduction" where the DEF is the reducing agent that reacts with NO<sub>x</sub> to convert the pollutants into nitrogen, water and tiny amounts of CO<sub>2</sub>. The DEF can be rapidly broken down to produce the oxidizing ammonia in the exhaust stream. SCR technology alone can achieve NO<sub>x</sub> reductions up to 90 percent.

## Diesel Emissions Control System



**\*Schematic is not representative of all manufacturers' approach to achieve near zero emissions**

### Why is SCR important

SCR technology is one of the most cost-effective and fuel-efficient technologies available to help reduce diesel engine emissions. All heavy-duty diesel truck engines produced after January 1, 2010 must meet the latest EPA emissions standards, among the most stringent in the world, reducing particulate matter (PM) and nitrogen oxides (NOx) to near zero levels. SCR can reduce NOx emissions up to 90 percent while simultaneously reducing HC and CO emissions by 50-90 percent, and PM emissions by 30-50 percent. SCR systems can also be combined with a diesel particulate filter to achieve even greater emission reductions for PM. In the commercial trucking industry, some SCR-equipped truck operators are reporting fuel economy gains of 3-4 percent. Additionally, off-road equipment, including construction and agricultural equipment, must meet EPA's Tier 4 emissions standards requiring similar reductions in NOx, PM and other pollutants. SCR is one technology that can help off-road equipment meet these stringent emissions standards.

### Where is SCR used

SCR has been used for decades to reduce stationary source emissions. In addition, marine vessels worldwide have been equipped with SCR technology, including cargo vessels, ferries and tugboats. With its superior return in both economic and environmental benefits, SCR is also being recognized as the emissions control technology particularly helpful in meeting the U.S. EPA 2010 diesel engine emission standards for heavy-duty vehicles and the Tier 4 emissions standard for engines found in off-road equipment. SCR systems are also found in the growing number of diesel passenger vehicles.

## What are the special considerations of using SCR

One unique aspect of a vehicle or machine with an SCR system is the need for replenishing Diesel Exhaust Fluid (DEF) on a periodic basis. DEF is carried in an onboard tank which must be periodically replenished by the operator based on vehicle operation. For light-duty vehicles, DEF refill intervals typically occur around the time of a recommended oil change, while DEF replenishment for heavy-duty vehicles and off-road machines and equipment will vary depending on the operating conditions, hours used, miles traveled, load factors and other considerations.

DEF is an integral part of the emissions control system and must be present in the tank at all times to assure continued operation of the vehicle or equipment. Low DEF supply triggers a series of escalating visual and audible indicators to the driver or operator. Once the tank reaches a certain level near empty, the starting system may be locked out the next time the vehicle is used, preventing the vehicle from being started without adequate DEF. A nationwide DEF distribution infrastructure has rapidly expanded to meet the needs of a growing SCR technology marketplace.

On-board tanks to store DEF are typically located in the spare tire area of passenger vehicles, while tractor trailers typically have a DEF tank alongside the diesel fuel saddle tank. Proper storage of DEF is required to prevent the liquid from freezing at temperatures below 12 degrees Fahrenheit, and most vehicle DEF dispensing systems have warming devices.

## What is the Future for SCR Technology

The U.S. Environmental Protection Agency (EPA) announced efforts to develop more stringent tailpipe emission standards for commercial vehicles close to zero through the “**Cleaner Trucks Initiative**”. Refinements and improvements to SCR systems will be a critical technology to deliver closer-to-zero emissions. Dosing events, compact designs and placement of SCR systems integrated into commercial vehicles will play an important role in reducing emissions.

## What is DEF

Diesel Exhaust Fluid (DEF) is a non-toxic fluid composed of purified water and automotive grade aqueous urea. DEF is available with a variety of storage and dispensing methods. Storage options consist of various size containers such as bulk, totes and bottles or jugs. The American Petroleum Institute rigorously tests DEF to ensure that it meets industry-wide quality standards.

DEF is available for purchasing at various locations like truck stops, truck dealerships and engine distributors which can be located using one of the below links. DEF tanks range in size from 5 to 22 gallons depending on the truck's application. The DEF tank fill opening is designed to accommodate a DEF fill nozzle to ensure only DEF is put into the tank. A diesel fuel nozzle will not fit into the DEF tank opening. In addition, the DEF tank has a blue lid to differentiate it from the diesel tank.



## Why do I need DEF

In order to meet stringent NOx emission standards beginning in 2010 for commercial truck engines and beginning in 2014 for most off-road engines, most engine makers are employing selective catalytic reduction (SCR), which requires DEF to operate. SCR-equipped engines have demonstrated a fuel efficiency increase of at least five percent. Typically you need about three percent as much DEF as you do fuel.

## Need DEF

DEF is widely available in bulk dispensers and in smaller portable containers in truck stops, auto part stores and other retail locations across the country. DEF is also distributed via bulk tanker to individual garages or to pumps at fuel stations.



Product: MUGA AdBlue<sup>®</sup> Solution

Application: Used in automotive Selective Catalytic Reduction (SCR) system to reduce Nitrogen Oxides (NOx) in diesel engine exhaust gas.

PARAMETERS	UNIT	VALUES
Urea content	% (m/m)	31.8 - 33.2
Refractive index at 20°C		1.3814 - 1.3843
Alkalinity as NH3	% (m/m)	< 0.2
Biuret	% (m/m)	< 0.3
Aldehydes	mg/kg	< 5.0
Insoluble matter	mg/kg	< 20.0
Phosphate(PO4)	mg/kg	< 0.5
Aluminium	mg/kg	< 0.5
Calcium	mg/kg	< 0.5
Chromium	mg/kg	< 0.2
Copper	mg/kg	< 0.2
Iron	mg/kg	< 0.5
Potassium	mg/kg	< 0.5
Magnesium	mg/kg	< 0.5
Sodium	mg/kg	< 0.5
Nickel	mg/kg	< 0.2
Zinc	mg/kg	< 0.2

The analytical methods are defined in ISO22241-2 (version 2019).  
Manufactured and quality controlled in Singapore