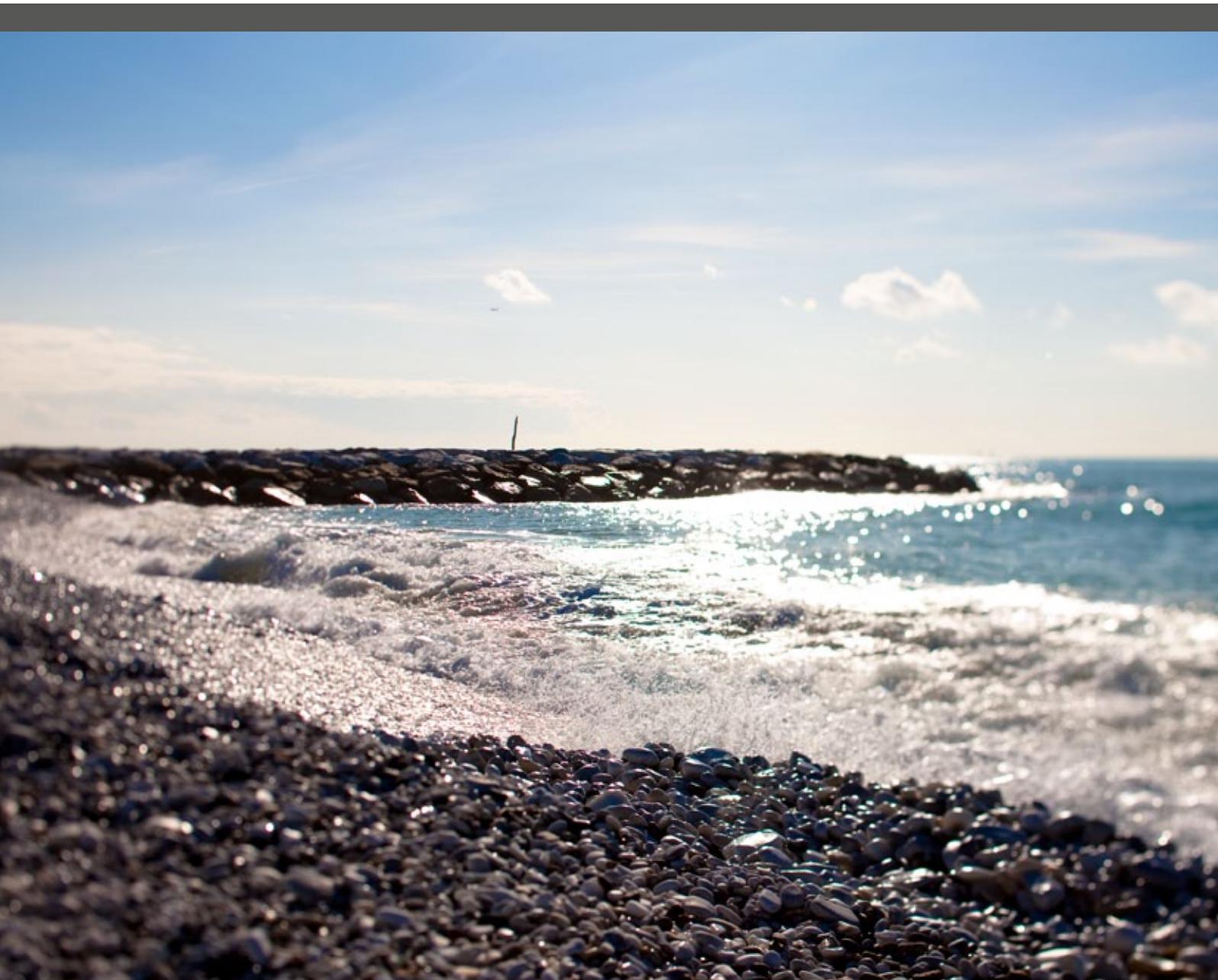


# Introduction to Stage IIIB and Tier 4i



# New technology

By the start of 2011, Stage IIIB compliance in EU and Tier 4i compliance in the U.S. will be required for all off-road equipment powered by engines over 129 kW. The legal requirements are the same for EU Stage IIIB and EPA Tier 4i. The regulations are set to minimize the emission of NOx (Nitrogen oxide) and harmful particulates.



## Technologies

Due to the new legalizations two main types of solutions have emerged at the market, the Selective catalytic reduction (SCR) technology used by Volvo, AGCO Sisu and the Exhaust gas recirculation (EGR) technology used by e.g. Cummins. The SCR technology is more common in Europe and the EGR technology is mostly used in North America.

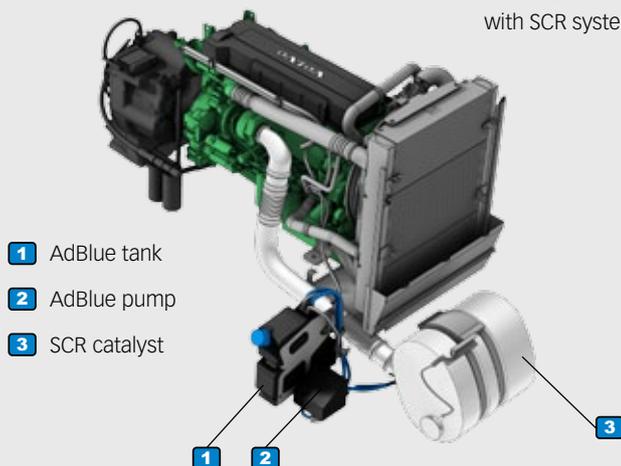
## SCR

The SCR (Selective Catalytic Reduction) process: When the emissions leave the engine they are directed to catalyst where they are mixed with an injection of AdBlue (urea) from the AdBlue tank. The injection of up to 5% AdBlue starts at chemical reaction and the emission gases are transformed into harmless nitrogen gas and water vapor.

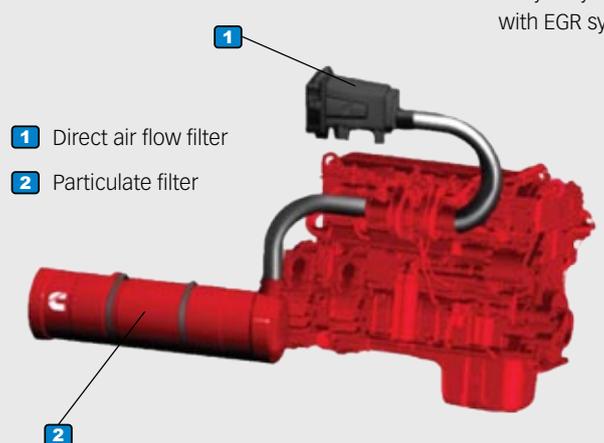
## EGR

The EGR (Exhaust Gas Recirculation) process: The EGR engine works at a lower combustion temperature which generates a lower level of NOx than the SCR system. On the other hand the EGR engine generates a higher level of particles. To take care of these particles the EGR engine has an extra added particulate filter.

Volvo TAD 1360VE with SCR system.



Cummins heavy duty engine with EGR system.



# Kalmar products affected by Stage IIIB/Tier 4i

All Kalmar products sold after January 1st 2011 with engines over 129 kW operating in EU and the U.S. are required to meet the regulations of Stage IIIB/Tier 4i. The regulations will affect the following products.

Product	Engine	Transmission
Kalmar DRF450	Volvo TAD1360	ZF 5WG261
Kalmar DRF100	Volvo TAD762	Dana TE17311
Kalmar DCE90-180	Volvo TAD761	ZF 3WG171
Kalmar DCF180-250	Volvo TAD761	ZF 3WG171
Kalmar DCF370-520	Volvo TAD1360	Dana TE32418
Kalmar DCF360-410CSG	Volvo TAD1360	Dana TE32418
Kalmar DCF280-330	Volvo TAD762	Dana TE17312
Kalmar DCF80-100	Volvo TAD762	Dana TE17311
Kalmar Logstacker	Volvo TAD 1360	ZF 5WG261
Kalmar TR618i	Volvo TAD762VE / SisuDiesel 74 AWI	Dana RTE15822
Kalmar TRL618i	Volvo TAD762VE / SisuDiesel 74 AWI	Dana RTE15822
Kalmar TT618i	Volvo TAD762VE / SisuDiesel 74 AWI	Dana RTE15822

## Benefits and disadvantages

### SCR

- + Increased power and torque.
- + Efficient fuel consumption.
- + No additional service for the SCR system.
- + No additional cooling system.
- + Proven technology, used by Volvo since 2006.
- Requires a second fuel to handle, AdBlue.
- Availability of AdBlue.
- Unknown price stability of AdBlue.
- AdBlue must be heated during cold conditions to avoid freezing (-11 °C).

### EGR

- + No additional fuel or tank
- + Common in the U.S
- + No extra logistic for handling a second fuel
- + No extra installation for catalysator and extra pump.
- Requires an extra particular filter
- More cooling capacity is needed, this requires larger fans and radiator.

**AdBlue** consists of 32,5% Urea solved in water. Urea is a chemical that is produced in a synthetic way. The low concentration of urea makes almost harmless. Urea has been used for many years as a fertilizer within the agriculture sector. The liquid is transparent and odorless. AdBlue is Non-toxic and Non-flammable which makes it safe to handle. AdBlue has a freezing point of -11 °C, which can make it freeze during cold conditions. However AdBlue can always be heated up to liquid status again. The filling of AdBlue when indicated low in the machine, is usually done together with the filling of diesel. AdBlue is a commercial product available in lots of different cans and bulk sizes.

**AdBlue**<sup>®</sup>

## Meeting the customer; FAQ

### - Where can I buy AdBlue?

*Answer: AdBlue can be purchased at truckstops, service station or manufacturer dealership. It is also possible to arrange for a supply of AdBlue direct to the base of operations.*

*Visit [www.findAdBlue.com](http://www.findAdBlue.com) to find your nearest dealer.*

### - What happens to the AdBlue when the temperature drops below -11 °C?

*Answer: AdBlue freezes at -11 °C. However, all Kalmar machines have integrated heating systems to keep the AdBlue liquid at all times.*

### - How much AdBlue will I need and what is the price of AdBlue?

*Answer: The average AdBlue consumption is about 4% of the diesel consumption. The price for AdBlue is approximately 1/2 of the price for diesel.*

### - Do I need to replace or service the SCR system after a while?

*Answer: No, the SCR system is built to last for the engines entire life time and there is no increase in service intervals.*

### - What happens if I run out of AdBlue while driving?

*Answer: The machine will indicate that the AdBlue level is low. After that the engine effect will gradually decrease until the engine has reach 50 % of effect, then the machine is more or less unusable, but this will not harm the engine in any way.*

### - Is AdBlue hazardous?

*Answer: No, AdBlue consists of 2/3 of water and the remaining 1/3 is an organic compound. You do not need any protective clothing and if you spill just rinse it off with water.*

### - What happens in the future, after Stage IIIB and Tier 4i?

*Answer: Stage IV will be launched in 2014 in Europe and the U.S. According to Volvo Penta there will be no major installations needed to meet the new requirements. The EGR System will require more adaption to meet the future requirements.*

Global presence and local service bring  
our products and solutions closer to our customer.



*Cargotec improves the efficiency of cargo flows on land and at sea – wherever cargo is on the move.  
Cargotec's daughter brands Hiab, Kalmar and MacGregor are recognised leaders in cargo and load handling  
solutions around the world. Cargotec's global network is positioned close to customers and offers extensive  
services that ensure the continuous, reliable and sustainable performance of equipment.  
Cargotec's class B shares are quoted on the NASDAQ OMX Helsinki. [www.cargotec.com](http://www.cargotec.com)*



**Cargotec Sweden AB**  
Torggatan 3  
SE-340 10, Lidhult, Sweden  
tel. +46 372 260 00  
fax +46 372 263 90  
[www.cargotec.com](http://www.cargotec.com)