

Driver's Handbook

Exhaust Aftertreatment System

B13R

VOLVO

Foreword

This manual contains information concerning the operation and function of the Exhaust Aftertreatment System. The information in this manual applies to vehicles complying with US10 Emissions Standard Please keep this manual in the vehicle at all times.

Note: Illustrations in this manual are used for reference only and may differ slightly from the actual vehicle. However, key components addressed in this document are represented as accurately as possible.

The National Highway Traffic Safety Administration (NHTSA) and Volvo Trucks North America should be informed immediately if you believe that the vehicle has a defect that could cause a crash, injury or death.

Contact NHTSA by calling the Auto Safety Hotline at 1 (888) 327-4236, by writing to NHTSA, U.S. Department of Transportation, Washington, DC 20590, by TTY at 1 (800) 424-9153, or visit their website at www.nhtsa.dot.gov.

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Order number: 89063156

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Safety Information

IMPORTANT: Before driving this vehicle, be certain that you have read and that you fully understand each and every step of the driving and handling information in this manual. Be certain that you fully understand and follow all safety warnings.

IT IS IMPORTANT THAT THE FOLLOWING INFORMATION BE READ, UNDERSTOOD AND ALWAYS FOLLOWED.

The following types of advisories are used throughout this manual:



DANGER

Danger indicates an unsafe practice that could result in serious personal injury or death. A danger advisory banner is in **white** type on a **black** background with a **black** border.



WARNING

Warning indicates an unsafe practice that could result in personal injury. A warning advisory banner is in **black** type on a **gray** background with a **black** border.



CAUTION

Caution indicates an unsafe practice that could result in damage to the product. A caution advisory is in **black** type on a **white** background with a **black** border.

Note: Note indicates a procedure, practice, or condition that must be followed in order for the vehicle or component to function in the manner intended.

General

USA

Emissions Control Compliance: The Federal Clean Air Act, Section 203 (a) (3), states the following concerning the removal of air pollution control devices or modification of a certified engine to a non-certified configuration:

“The following acts and the causing thereof are prohibited:

(3) For any person to remove or render inoperative any device or element of design installed on or in a motor vehicle engine in compliance with regulations under this part prior to its sale and delivery to the ultimate purchaser, or for any manufacturer or dealer knowingly to remove or render inoperative any such design after sale and delivery to the ultimate purchaser”

Specifically, please note that no person may make such changes prior to the sale and delivery of the vehicle to the ultimate purchaser, and, in addition, no manufacturer or dealer may take such action after sale and delivery of the vehicle to the ultimate purchaser. The law provides a penalty of up to \$10,000 for each violation.

Modifications, such as reprogramming of the fuel system so the engine will exceed the certified horsepower or torque, or removing the mufflers are examples of illegal changes.

Changes should not be made to a certified engine that would result in an engine that does not match the configuration of an engine model that is currently certified to meet Federal Standards

Canada

The same conditions that apply in the USA apply to Canada, with one exception. After the vehicle is sold to a retail customer, that is, the end user, the jurisdiction controlling the emissions control devices becomes the province in which the vehicle is licensed. No changes should be made that render any or all of the devices inoperative.

Should the owner/ operator wish to make any changes to the emissions control devices, check with the provincial authority before making any such changes

Mexico

The same conditions that apply in the USA apply to Mexico. Refer to Mexican Federal Law for Emissions Control which adheres to EPA regulations. No changes Should be made that render any or all of the emissions control devices inoperative.

If the owner/operator wishes to make changes to the emission control devices, check with state authority before changes are made.

2 Exhaust Aftertreatment System

System Overview

EPA 2010 requires 83% reduction in NO_x and 0% reduction in particulate relative to EPA 2007; then is retained the Diesel Particulate Filter (DPF) and is added another aftertreatment device called Selective Catalytic Reduction (SCR) catalyst.

The process for reducing NO_x via aftreatment is called Selective Catalytic Reduction (SCR). It requires a catalytic converter into which is injected Diesel Exhaust Fluid (DEF). The primary component of DEF is water; the active component is urea. Urea is a nitrogen compound that turns to ammonia when heated. When a urea-and-water solution is injected into the exhaust stream and passed over a catalyst, the urea reacts with the NO_x to form nitrogen and water vapor – two clean and harmless components of the air we breathe. The aftertreatment system primary function is to capture and oxidize (regenerate) the particulate matter (soot) in the engine exhaust gases and to reduce NO_x. To achieve this goal, the exhaust aftertreatment system is split into two main sections: the exhaust gases first enter the Diesel Oxidation Catalyst (DOC) and Diesel Particulate Filter (DPF)

assembly to capture and regenerate the soot on a regular or passive basis, then the exhaust gases flow through the catalytic converter to reduce NO_x to minimum level.

Vehicles equipped with a DPF require the use of EO-O Premium Plus (or VDS-4) specification high performance diesel engine oil and Ultra Low Sulfur Diesel (ULSD) fuel.



CAUTION

The use of Diesel fuel other than ULSD and engine oils other than EO-O Premium Plus (or VDS-4), will adversely affect performance, efficiency and durability of DPF system and the engine, to the point where the engine may not run at all. Manufacturer's warranties can also be rendered void due usage of improper fuel. None approved fuel additives (including engine oil) are NOT permitted. Blends of No. 1D and No. 2D grades of ULSD are recommended and allowable for cold weather operations.

Exhaust Aftertreatment System Description

The exhaust aftertreatment system consists of two units, the filtration and regeneration unit and the selective catalytic reduction SCR unit.

Filtration and Regeneration Unit

The main purpose of the filtration and regeneration unit is to capture and oxidize (regenerate) the particulate matter (soot) in the engine exhaust gas. The exhaust gas first enters the Diesel Oxidation Catalyst (DOC) and then flow through the Diesel Particulate

Filter (DPF); together they capture and regenerate the soot on a regular or passive basis. Through constant monitoring of the exhaust gas temperature and the system back pressure, the engine control module is able to manage regeneration.

Passive regeneration

Passive regeneration is the process by which the particulate matter is oxidized due to the heat generated by the engine internal combustion process. During normal highway

operation, exhaust temperatures alone are usually high enough to oxidize accumulating soot.

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Stationary (parked) regeneration

In a small number of specific engine duty cycles, engine control module may not be capable of completing an active regeneration. In these situations, the operator will be notified that a stationary or parked regeneration may be required. A DPF telltale light will illuminate indicating the need for user interaction. The lamp gives the operator a grace period to allow this process to take place at a time when most convenient for the

operator. This process requires the vehicle to be parked while a driver or maintenance technician initiates the regeneration process using the DID menus. Once initiated, the stationary regeneration process will be complete in about 45 minutes. The driver will be notified of the need for a stationary regeneration (parked) by illumination of the DPF REGENERATION telltale light.

Safety Information

The exhaust aftertreatment system utilizes technology that oxidizes trapped particles of unburned hydrocarbons thereby reducing emissions. This oxidation occurs during the regeneration process. While regeneration is occurring, very high exhaust gas temperatures will occur when the vehicle is stationary.



WARNING

Always ensure that the vehicle is in a safe and suitable location to withstand the high temperatures that occur during the generation process. Equipment damage or personal injury may occur if combustibles are too close to the exhaust pipe or outlet.



WARNING

The temperature of the exhaust system components during the regeneration process can exceed 500 degrees C (1000 degrees F). Various factors including ambient temperature and duration of the regeneration process, determine when these components will return to normal operating temperature after regeneration has completed. Be extremely careful around these hot components. Contact with these components can result in personal injury.

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Instrument Cluster Icons

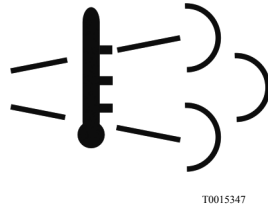
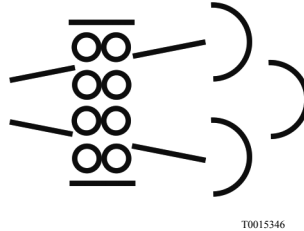
Aftertreatment icons are displayed on the instrument cluster. There are two aftertreatment icons.

- DPF Regeneration Required
- High Exhaust System Temperature (HEST)

The DPF Regeneration Required icon illuminates when the diesel particulate filter is becoming full and regeneration is needed.

The high Exhaust System Temperature icon illuminates when a parked regeneration is initiated. When the HEST icon is illuminated, do not park or operate the vehicle near people or any flammable materials, vapors and structures.

The icon flashes when the filter is full or overfull.

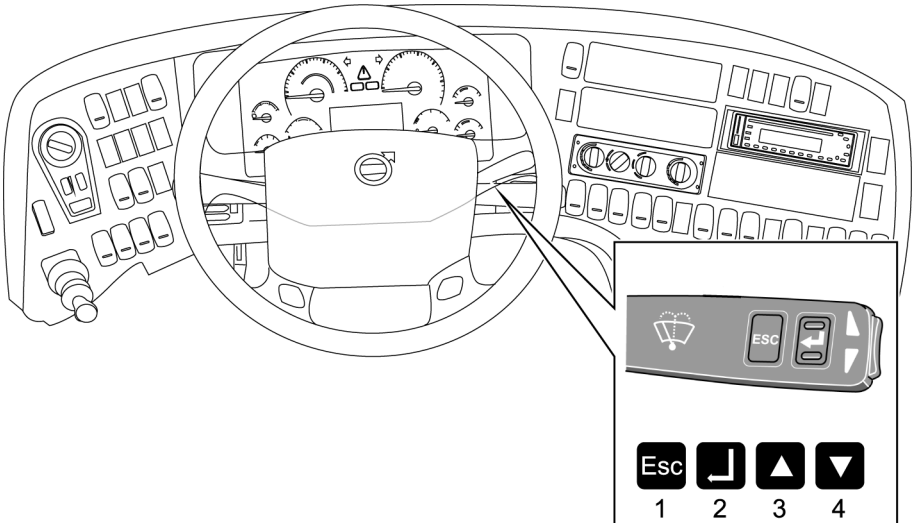


Operation

The stalk switch control lever is used to interact with the Driver Information Display (DID) in the center of the instrument cluster. The lever is located on the right-hand side of the steering wheel.

- 1 Esc or Escape button is used to return to the previous menu or display
- 2 ↵ or Enter button is used to display a list of menus, open a menu or select the highlighted area.

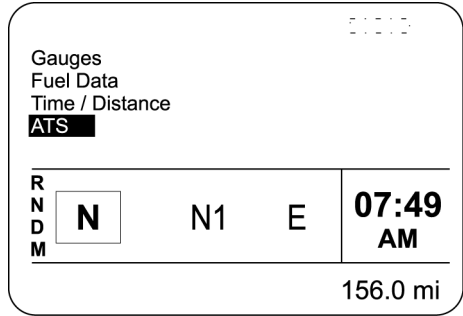
- 3 Up arrow button is used to scroll up through a menu
- 4 Down arrow button is used to scroll down through a menu.



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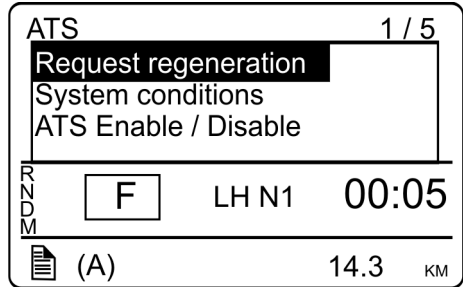
Aftertreatment Menu

- 1 The aftertreatment system menu is in the DID.
- 2 Use the up and down buttons on the stalk switch to scroll to the Aftertreatment menu.
- 3 Press the ↵ button to select the Aftertreatment menu



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The Aftertreatment menu has three submenus: request DPF regeneration, check aftertreatment status and cancel DPF regeneration.



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DPF Regeneration



WARNING

Always ensure that the vehicle is in a safe and suitable location to withstand the high temperatures that occur during the generation process. Equipment damage or personal injury may occur if combustibles are too close to the exhaust pipe or outlet.

Note: If the vehicle is in a location that may be hazardous when regeneration begins, the regeneration should be stopped. If the regeneration is stopped by vehicle operator, it should be initiated at a later time when the

There are two types of regeneration:

- Passived, and

vehicle is in a safer location. Regenerations that are stopped and never restarted at a later time however, will require that the vehicle be taken to an authorized Volvo workshop (or for Prevost supported vehicles, a Prevost service center/provider) to have the regeneration manually started.



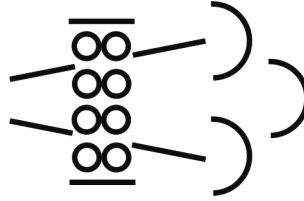
CAUTION

If the regeneration is cancelled by vehicle operator, it must be completed as soon as possible to avoid exhaust aftertreatment system damage.

- Parked

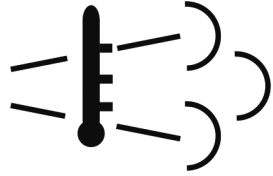
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Passive regeneration only occurs when the vehicle is moving at uninterrupted highway speed. Parked regeneration is manually initiated when the vehicle is stationary. This is the standard configuration. Other configurations are available.



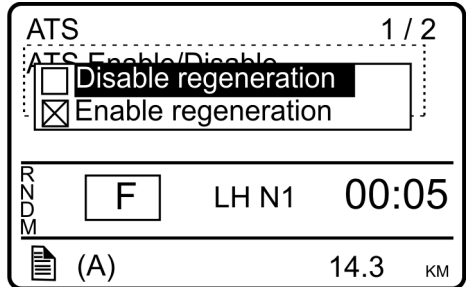
T0015346

If the regeneration process is not delayed, the regeneration process starts. The DPF Regeneration Required icon turns off and the High Exhaust System Temperature (HEST) icon may illuminate.



T0015347

To temporarily disable regeneration, scroll to the Aftertreatment menu in the DID, select “ATS enable/disable”. When regeneration is disabled, the letters ATS with X through them will be displayed in the DID. Enable regeneration by scrolling to the Aftertreatment menu, selecting “ATS enable/disable” and selecting “Enable REGEN”.



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12 Exhaust Aftertreatment System

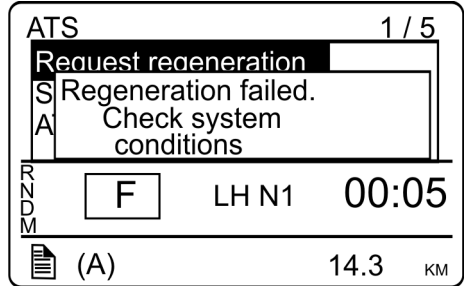
Note: It is important to enable regeneration as soon as possible to avoid engine problems. Long-term engine operation with regeneration disabled will result in a loss of engine performance including horsepower, torque and speed derates. Also, the DPF filter will become overloaded with soot and require service.

The regeneration process can be stopped at any time by turning the ignition key to OFF, scrolling to the Aftertreatment menu in the Driver Information Display (DID)

and selecting “ATS enable/disable”, or by pressing the ↵ button on the stalk switch. Regeneration cannot be initiated if it is not required. The following conditions must be met to perform a parked regeneration:

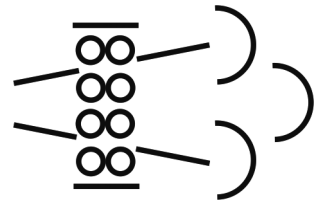
- Parking brake on and transmission in neutral
- Minimum 10 volts battery charge
- Engine running
- Accelerator and clutch pedal released
- PTO not active

If a request for parked regeneration fails, “Regeneration failed. Check system conditions” is displayed. Scroll to the Aftertreatment menu in the Driver Information Display (DID) and select “System conditions” to determine why the regeneration failed.



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If the DPF Regeneration icon is flashing, the diesel particulate filter is full. Maintain uninterrupted highway speed for an active or move the vehicle to a safe location and initiate a parked regeneration.



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If the Regeneration Required icon is flashing and the CHECK light illuminates, the diesel particulate filter is overfull. Engine performance will be limited. To avoid further engine derate, immediately move the vehicle to a safe location and initiate a parked regeneration, or take the vehicle to an authorized Volvo workshop (or for Prevest

support vehicles, to a Prevest service center/ provider).



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If the DPF Regeneration Required icon is flashing and the STOP light illuminates, a serious engine problem has occurred. The diesel particulate filter may be over its maximum capacity and the engine may shut down. The vehicle must be taken immediately to an authorized Volvo workshop (or for Prevest supported vehicles, to a Prevest service center/ provider) for service.






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Aftertreatment DEF Tank Level — Driver Warning & Inducement

Aftertreatment DEF tanks are sized to have no less than two times the diesel fuel tank mileage.

The vehicle instrument cluster has an aftertreatment DEF tank level gauge.

Triggers	Aftertreatment DEF Tank Low Level Indicator	Driver Information Display Screen
100% to 12% Aftertreatment DEF Tank Level Gauge	None	None
<=12% Aftertreatment DEF Tank Level Gauge	 <p style="text-align: center; font-size: small;">W2029416</p> <p>Solid indicator</p>	Low DEF level Refill to avoid Engine derate
0% Aftertreatment DEF Tank Level Gauge (~1% DEF Remaining)	 <p style="text-align: center; font-size: small;">W2029415</p> <p>Blinking indicator</p>	DEF Tank Empty Engine in derate Refill to avoid 5 Mph
0% Aftertreatment DEF Tank Level Gauge AND either: 1 Vehicle stationary for 20 minutes, or 2 Diesel fuel Refueling > 15% with parking brake engaged.	 <p style="text-align: center; font-size: small;">W2029415</p>	DEF tank empty Speed limited to 5 Mph

Aftertreatment DEF Quality — Driver Warning & Inducement

Triggers	Lamp Status	Driver Information Display Screen
Good DEF Quality	None	None
Poor DEF Quality DTC Initially Detected	 <small>W2029417</small>	SCR performance low Engine derate in < xxx mins
Poor DEF Quality DTC Initially Detected + 1 hour of operation	 <small>W2029417</small>	SCR performance low Engine derate in < xxx mins
Poor DEF Quality DTC Initially Detected +4 hours of operation	 <small>W2029417</small>	SCR performance low Engine in derate 5 Mph in < xxx mins
Poor DEF quality DTC initially detected + 4 hours of operation AND either: 1 Vehicle stationary for 20 minutes, or 2 Diesel Fuel Refueling > 15% with parking brake engaged	 <small>W2029417</small>	SCR Performance low Engine in derate 5 Mph at next stop
By means of 1 engine start or use of a service tool temporary exit from 8 Km/h (5 Mph) Inducement	 <small>W2029417</small>	SCR performance low Speed limited to 5 Mph
Ignition Key Cycle before DEF Quality Evaluation has been completed	 <small>W2029417</small>	SCR perf. check Engine in derate 5 Mph Limit removed

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Exit conditions for DEF Quality “8Km/h (5 mph) road speed limit” Inducement:






Next 1 Engine Starts: Return to 25% torque reduction until there is a proper DEF quality evaluation. If poor DEF quality is detected during the next monitoring cycle then 8 Km/h (5 mph) is resumed after the vehicle is stationary for 20 minutes. After one engine start has been exhausted then a Tech Tool is required to exit the 8 Km/h (5 mph) road speed limit.

With Tech Tool DTC Clearing: Invoke 25% torque reduction until there is a proper DEF quality evaluation. If poor DEF Quality is detected during the next monitoring cycle then 8 Km/h (5 mph) is resumed after de vehicle is stationary for 20 minutes.





Aftertreatment Tampering — Driver Warning & Inducement

When the SCR tampering fault is active for one or more hours a new Driver Information Display screen appears. The text changes for the Driver Information Display (DID) screen associated with this fault are listed in the table below.

Note: Repeated acts of tampering will result in more severe inducement.

Triggers	Lamp Status	Driver Information Display Screen
No fault	None	None
Tampering Fault Detect Note: For examples of various SCR sensor tampering types refer to the “SCR Tampering ” table below	 <p style="text-align: center; font-size: small;">W2029417</p>	SCR system fault Engine derate in < xxx mins
Second Drive Cycle with Active DTC.	 <p style="text-align: center; font-size: small;">W2029417</p>  <p style="text-align: center; font-size: small;">W3031200</p>	SCR System Fault Engine in derate 5Mph in <xxx mins
Driving with Active Fault for + 1 hour.	 <p style="text-align: center; font-size: small;">W2029417</p>  <p style="text-align: center; font-size: small;">W3031200</p>	SCR system fault Engine in derate 5 Mph in < mins

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<p>Driving with Active Fault for + 4 hours</p>	 <p style="text-align: center; font-size: small;">W2029417</p>  <p style="text-align: center; font-size: small;">W3031200</p>	<p>SCR system fault Engine in derate 5 Mph at next stop</p>
<p>Active tampering DTC initially detected + 4 hours of operation AND either:</p> <ol style="list-style-type: none"> 1 Vehicle stationary for 20 minutes, or 2 Diesel Fuel Refueling > 15% with parking brake engage 	 <p style="text-align: center; font-size: small;">W2029417</p>  <p style="text-align: center; font-size: small;">W3031200</p>	<p>SCR system fault Speed limited to 5 Mph.</p>

SCR Tampering
Aftertreatment Control Module (ACM) Disconnected
Aftertreatment Inlet NOx Sensor Disconnected
Aftertreatment Outlet NOx Sensor Disconnected
DEF Pump Disconnected
DEF Dosing Valve Disconnected
DEF Tank Lever Sensor Disconnected
DEF Dosing valve or line blocked
DEF Pump pressure build up failure
DEF Return Line Blocked or Plugged

Note: For additional DID information refer to the Driver Information Display Manual.

Misfilling Diesel or Aftertreatment DEF Tanks

Although diesel fuel and Aftertreatment DEF caps are clearly labeled and filler necks and nozzles are different accidents can happen.

Contamination of fluids by- misfilling of diesel or DEF in the wrong tank may result in vehicle malfunction

Results of misfilling DEF in Diesel Tank

- Engine may run poorly or not at all
- Injectors may be damaged
- Exhaust system corrosion may occur between turbocharger and Aftertreatment DPF
- On Board Diagnostic (OBD) Diagnostic Trouble Codes (DTC)
- Costly repair

Results of misfilling diesel en Aftertreatment DEF Tank

- Aftertreatment SCR system may be damaged by Diesel
- SCR Catalyst may be damage by diesel (chemical damage)
- Emissions may be non-compliant
- On Board Diagnostic (OBD) Diagnostic Trouble Codes (DTC)
- Costly repairs

Aftertreatment System Maintenance

The vehicle must be taken to an authorized Volvo workshop (or for Prevost supported vehicles, to a Prevost service center/provider) to remove the ash from the diesel particulate filter and clean the aftertreatment fuel injector.

- The ash cleaning interval is 400 000 km (250,000 miles) or 4,500 hours, which ever occurs first.
- The aftertreatment fuel injector cleaning interval is 240 000 km (150,000 miles) or 4500 hours, which ever occurs first.

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Aftertreatment System Status

When ATS Status is selected, the following submenus are available:

ATS		1 / 5
Inhibit switch	OK	
Clutch Status	N / A	
Service brakes	N / A	
<div style="border: 1px solid black; padding: 2px; display: inline-block;">F</div> LH N1 00:05		
<div style="border: 1px solid black; padding: 2px; display: inline-block;">(A)</div>		14.3 KM

W2075112

ATS		2 / 5
PTO Status	OK	
Acc. Pedal	OK	
Gear Status	OK	
<div style="border: 1px solid black; padding: 2px; display: inline-block;">F</div> LH N1 00:05		
<div style="border: 1px solid black; padding: 2px; display: inline-block;">(A)</div>		14.3 KM

W2075113

ATS		3 / 5
Veh. Speed High	OK	
Park Brake	OK	
Exh. gas temp	N / A	
<div style="border: 1px solid black; padding: 2px; display: inline-block;">F</div> LH N1 00:05		
<div style="border: 1px solid black; padding: 2px; display: inline-block;">(A)</div>		14.3 KM

W2075114

ATS		4 / 5
System Fault	OK	
System timeout	N / A	
Soot level low	Check	
<div style="border: 1px solid black; padding: 2px; display: inline-block;">F</div> LH N1 00:05		
<div style="border: 1px solid black; padding: 2px; display: inline-block;">(A)</div>		14.3 KM

W2075115

ATS		5 / 5
Soot level high	OK	
Engine Status	Check	
Veh. Speed Low	N / A	
<div style="border: 1px solid black; padding: 2px; display: inline-block;">F</div> LH N1 00:05		
<div style="border: 1px solid black; padding: 2px; display: inline-block;">(A)</div>		14.3 KM

W2075116

Selective Catalytic Reduction

Selective Catalytic Reduction is an emissions-reduction technology with the ability to deliver near-zero emissions of nitrogen oxides (NO_x), a smog-causing pollutant and greenhouse gas. SCR's performance has been proved in millions of miles of real-world operation in other countries, as well as in long-term field tests in U.S.

SCR reduces NO_x emissions to very low levels, while at the same time delivering excellent fuel economy and reliability. The system doesn't change the design or operation of the basic engine. Rather, SCR is an aftertreatment system which converts NO_x in

The VOLVO SCR system is simple and effective, with few components. It consists of a Aftertreatment DEF tank plus a Aftertreatment DEF pump, Aftertreatment DEF dosing unit and SCR catalyst. The advantage of using DEF is that it enables the engine to use less EGR —and higher oxygen levels- for better combustion, while meeting EPA near-zero NO_x emissions requirement of 0.2 g/hp-hr NO_x. By using DEF, we avoid the disadvantages of increasing EGR to massive levels. This results in better fuel economy from your VOLVO engine.

exhaust stream into harmless gases. Modern diesels already use exhaust aftertreatment systems, called diesel particulate filters, to control emissions of another pollutant, soot (also known as particulate matter or PM).

SCR works by injecting Diesel Exhaust Fluid (DEF) into the exhaust steam, after the DPF. DEF is a safe, simple solution of water and urea. DEF works with the heat of the exhaust and catalyst to convert NO_x into nitrogen and water vapor — two harmless and natural components of the air we breathe. The end result is cleaner air, excellent fuel efficiency and a reliable emissions control system for today's modern diesel engine.



W2055491



CAUTION

Do not put diesel fuel in the aftertreatment DEF tank. Diesel fuel, if sprayed into the hot exhaust along with the DEF, could ignite explosively causing a fire resulting in personal injury or damage to the exhaust system.

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Diesel Exhaust Fluid (DEF)

Diesel Exhaust Fluid (DEF) is a reactant that's key to the SCR process. It's nontoxic, aqueous solution of 32.5% urea and 67.5% water. Urea is a compound of nitrogen that turns to ammonia when heated. It is used in a variety of industries, perhaps most commonly

as fertilizer in agriculture. The fluid is not flammable, nor is it dangerous when handled normally. However, it is corrosive to metal, particularly copper and aluminium. Read the separate section concerning the handling of DEF solution.

Diesel Exhaust Fluid (DEF) Handling

When handling DEF solution, it is important that electrical connectors to be connected or well encapsulated. Otherwise there is a risk that the DEF will cause oxidation that cannot be removed. Water or compressed air do not help, since DEF quickly oxidizes metal.

If a connector comes into contact with the DEF solution it must be replaced immediately to prevent the DEF solution from creeping further into the copper wiring, which takes place at a speed of about 60 mm (2.4 in) per hour.



CAUTION

When detaching hoses and components, do not spill DEF on disconnected connectors. If DEF is spilled on a connector, the connector must be replaced immediately.

About spilled Diesel Exhaust Fluid (DEF)

Things to know about spilled Diesel Exhaust Fluid (DEF)

- If urea solution comes into contact with the skin, rinse with plenty of water and remove contaminated clothing.
- If urea solution comes into contact with eyes rinse for several minutes and call for medical help if necessary
- If inhaled breathe fresh air and call for medical help if necessary
- Do not allow the DEF solution to come into contact with other chemicals
- The DEF solution is not flammable. If the DEF solution is exposed to high temperatures for long periods of time, it breaks down into ammonia and carbon dioxide
- The DEF solution is corrosive to certain metals, including copper and aluminium. This is similar to the corrosion caused by salt water
- If the DEF solution is spilled onto the vehicle, wipe off the excess and rinse with water. Spilled DEF solution can form concentrated white crystals on the vehicle. Rinse off these crystals with water.

Note: Do not flush DEF into the normal drain system.



WARNING

DEF split onto hot components will quickly vaporize. Turn your face away!

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