

USE AND MAINTENANCE
USO E MANUTENZIONE
UTILISATION ET ENTRETIEN
BETRIEB UND WARTUNG
USOY MANTENIMIENTO

NEF₁SERIES

G-DRIVE ENGINES

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NEF SERIES

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USE AND MAINTENANCE

INTRODUCTION

We would like to thank you for buying an FPT product, and compliment you on your choice of engine.

Before you carry out any operation involving the engine or its fittings, please read the contents of this manual carefully; compliance with the instructions provided in the manual is the best way to guarantee trouble-free, long term operation of the engine.

The contents of this manual refer to the standard configuration of the engine, and the illustrations are purely indicative.

Some instructions are provided by giving the sequence of operations to be carried out in order to allow the engine and/or its fittings to perform in a certain way. In some cases they will be dependent on the configuration of the commands and the set-up of the generator set on which the engine is installed; for any points that differ from the contents of this manual, please consult the instructions provided by the generator set Manufacturer or a specific manual.

The information provided below was current at the date of publication.

The Manufacturer reserves the right to make modifications at any time without prior notice, for technical or commercial reasons or to update the engines to comply with legal requirements in the various Countries.

The Manufacturer declines all liability for any errors or omissions.

Please remember that the FPT Technical Service Network is available to offer you its experience and professional skills, wherever you may be.

TABLE OF CONTENTS

	Page		Page
■ GENERAL INFORMATION	3	■ CHECKS AND MAINTENANCE	29
Guarantee	3	Maintenance personnel	29
Spare parts	3	Accident prevention	29
Liability	3	Maintenance schedule	30
Warnings and safety requirements	3	Frequency	30
Safety warning symbols	15	Checks (in period of use) – how to proceed	33
Engine technical data	16	Periodic maintenance - how to proceed	41
Exhaust gas after-treatment system (ATS)	20	Extraordinary maintenance - how to proceed	58
■ NAMEPLATES	21	Engine handling	62
Identification plate	21	Disposal of waste	62
Type-approval plate	21	Scheduled maintenance for the ATS system - how to proceed	63
"Delegated assembly" plate	21	■ LONG PERIODS OF INACTIVITY	66
■ USE	22	Preparing the engine for a long period of inactivity	66
Preliminary checks	22	Restarting the engine after a long period of inactivity	67
For proper engine use	23	■ ENGINE MALFUNCTIONS	68
Special warnings	24	■ BEHAVIOUR IN EMERGENCY	69
Run-in	25		
Refilling	26		

■ GENERAL INFORMATION

GUARANTEE

In order to ensure that your engine gives the best possible performance and to take advantage of the FPT guarantee, you must follow the indications provided in this publication with great care; failure to do so may result in invalidation of the guarantee.

SPARE PARTS

Always use Original FPT Spare parts. This is essential to keep the engine in original running order.

The use of non-original spare parts will not only invalidate the guarantee, but will mean that FPT will not be considered liable in any way during the whole working life of the engine.

LIABILITY

The Manufacturer will only be considered liable subject to performance of the control and maintenance operations indicated and described in this manual; to this effect, proof that these operations have been performed must be provided. Any extraordinary maintenance operations that may be necessary must be carried out by qualified technicians from Workshops in the FPT Network, using the instruments and equipment provided for the purpose.

WARNINGS AND SAFETY REQUIREMENTS

The following information is intended to encourage caution when using the engine, so as to avoid damage to persons or property as a result of improper or incorrect behaviour.

1) Risk of personal injury. Warnings - safety instructions for the operator and maintenance personnel

The main sources of risk to the health and safety of the operator and maintenance personnel are related to: the environment in which the 'finished' machine operates, the temperatures reached by the engine surfaces, the liquid-fluid toxicity and exhaust gas emission.

Possible sources of risk are also: the presence of guards and sharp-edged surfaces, the use of solvents and cleaning powders, high pressure of liquids-fluids in the engine circuits, the methods used for handling the engine and components.

It is therefore essential to observe the following safety instructions.



Risk of injury.

Use appropriate personal protective equipment (gloves, safety shoes, goggles, etc.) Failure to do so could result in serious health risks.



Risk of injury.

Use suitable clothing, preferably tight-fitting; do not wear chains, rings, etc. Failure to observe these instructions could cause serious health risks.



Risk of intoxication or poisoning.

Make sure that no combustible vapours or gasses are present in the area in which the engine is to operate. Provide adequate ventilation and a suitable exhaust gas extraction system in enclosed environments. Failure to observe these instructions could cause serious health risks.



Risk of intoxication or poisoning.

Do not breathe fumes from liquids, fluids or solvents. Do not breathe in engine exhaust gas. Failure to observe these instructions could cause serious health risks.



Risk of burns.

The engine and the exhaust heat up during operation. Before working on the inside of the engine compartment, and to prevent the risk of burns, open the engine compartment and let the components cool down to a temperature which allows them to be touched. Failure to observe these instructions could cause serious health risks.



Risk of injury.

Avoid contact with liquids and fluids when the engine is hot: risk of burns. Failure to observe these instructions could cause serious health risks.



Risk of injury.

All flammable fluids and liquids must be handled with care, in accordance with the product safety data sheets. In case of accidental contact, consult the product safety data sheets. Store fluids and liquids in containers that comply with current regulations. Failure to observe these instructions could cause serious health risks.



Risk of injury.

The engine oil is highly pollutant and toxic. In case of contact with the skin, wash thoroughly with soap and water. Protect skin and eyes appropriately; work in accordance with accident prevention regulations. Failure to observe these instructions could cause serious health risks.



Fire hazard.

Pay the utmost attention to parts glowing with heat and guards with warning pictograms.

Failure to observe these instructions could cause serious health risks.



Fire risk!

Fire hazard: pay the utmost attention to flammable liquids, dusts and vapours.

Failure to comply with these indications could result in death or serious injury.



Risk of explosion.

Engine with CNG - LNG fuel systems: make the fuel system safe (LOTO) before working on it; accidental leakage of gas from the system can cause it to explode.

Failure to comply with these indications could result in death or serious injury.



Risk of injury.

During maintenance work on the engine, pay attention to sharp parts and/or edges and/or surfaces such as guards and heat shields (if present).

Failure to observe these instructions could cause serious health risks.



Risk of injury.

Due to the high pressure in the pipes which go from the high pressure pump to the rail and from the rail to the electro-injectors, do not under any circumstances:

- disconnect the pipes with the engine running;*
- reuse the disassembled pipes.*

Failure to observe these instructions could cause serious health risks.



Risk of injury.

When the engine is hot, the pressure inside cooling circuits is such that it may expel the hot liquid in an extremely violent manner with the risk of burns. Only open the coolant tank filler cap when the engine is cold.

Failure to observe these instructions could cause serious health risks.



Health risk when lifting and carrying loads!

Use suitable lifting equipment and load securing devices.

Failure to comply with these indications could result in death or serious injury.



*Risk of injury and accidents if used incorrectly!
Observe the maintenance instructions. If in any doubt,
contact the service network before proceeding.
Failure to comply with these indications could result in
death or serious injury.*

2) Risk of serious damage to the engine. Warnings - instructions for the correct use and maintenance of the engine

The main warnings - instructions to be followed when working on the engine in order to correctly carry out component replacement and/or engine maintenance operations are provided.

Compliance with the following instructions will protect the engine from potential damage.



*General instructions.
For correct engine operation, only use recommended oils
or oils with the required characteristics. In the case of
refilling, do not mix oils with different characteristics.
Failure to observe these indications will void the warranty.
Partial or total non-compliance with these instructions
may cause serious engine damage and may also, at times,
invalidate the warranty.*



*General instructions.
Before pressure washing mechanical parts, protect
electrical connectors and any control units. Do not use
excessive washing pressures < 2 bar; keep the lance more
than 20 cm away from the engine.
Partial or total non-compliance with these instructions
may cause serious engine damage and may also, at times,
invalidate the warranty.*



*General instructions.
Extraordinary maintenance operations are only to be
carried out by qualified personnel with the appropriate
technical knowledge and equipped with suitable tools and
means of protection. All the technical instructions are
provided in the FPT repair and technical manuals.
Partial or total non-compliance with these instructions
may cause serious engine damage and may also, at times,
invalidate the warranty.*



*General instructions.
Worn, damaged or consumable parts must be replaced
with original FPT parts.
Partial or total non-compliance with these instructions
may cause serious engine damage and may also, at times,
invalidate the warranty.*



General instructions.

Always keep the work area clean during workshop operations; immediately clean the surfaces of the work area from any liquids, fluids or oils which may have leaked. Partial or total non-compliance with these instructions may cause serious engine damage and may also, at times, invalidate the warranty.



General instructions.

Before working on the electrical system, disconnect the batteries from the system. Disconnect the ground cable and then the positive cable. The order must be reversed when connecting the batteries. Do not reverse the polarity of the cables on the battery; it can cause irreparable damage to control units. Failure to observe these instructions could cause damage to the engine.



General instructions.

Do not start the engine with quick charger power packs. Disconnect the battery from the electrical system before charging. Failure to observe these instructions could cause damage to the engine.



General instructions.

Do not use fast screw tightening tools. Failure to observe these instructions could cause damage to the engine.



General instructions.

The forced regeneration of the exhaust gas post-treatment device is a procedure which must always be carried out by Service Centres and can only be activated via a diagnostics tool. Partial or total non-compliance with these instructions may cause serious engine damage and may also, at times, invalidate the warranty.



General instructions.

The components of the common rail system will be damaged quickly if the fuel contains water or other impurities. Immediately perform the operation on the pre-filter to drain the water present in the fuel supply circuit. Partial or total non-compliance with these instructions may cause serious engine damage and may also, at times, invalidate the warranty.



General instructions.

Replace the auxiliary device belt if it shows signs of abrasions, cracks or tears or if it is soiled with oil or fuel. Partial or total non-compliance with these instructions may cause serious engine damage and may also, at times, invalidate the warranty.



General instructions.

If the installation of mechanical or electromechanical optionals is required, always refer to the "FPT Installation Guide" documents. Failure to observe these instructions could cause damage to the engine and its electrical architecture.



General instructions.

Make sure that the oil dipstick is fully inserted and that the oil filler cap is fully tightened in a clockwise direction. Partial or total non-compliance with these instructions may cause serious engine damage and may also, at times, invalidate the warranty.



General danger, general precautions.

The engine must not be started and used before satisfying the safety requirements for the equipment in which it is installed and before ensuring compliance of the latter with the standards and local laws. Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.



Maintenance not carried out correctly!

In order to maintain the efficiency of the all parts of the engine during use, carry out the instructions in this preventive maintenance plan and the relevant replacement procedures exactly. Partial or total non-compliance with these instructions may cause serious engine damage and may also, at times, invalidate the warranty.



General danger, general precautions.

The engine must not be started and used before satisfying the safety requirements for the equipment in which it is installed and before ensuring compliance of the latter with the standards and local laws. Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.



General danger, general precautions.

The engines must only be used for the purposes declared by the Manufacturer.

Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.

Warnings - specific instructions for marine applications



General instructions.

Each time the engine is started, check that the sea water intake valve is open. Dry operation of the sea water pump causes irreversible damage to the internal impeller within just a few seconds.

Partial or total non-compliance with these instructions may cause serious engine damage and may also, at times, invalidate the warranty.

3) General risk. Warnings - safety instructions for the operator and maintenance personnel and for correct engine maintenance

The main warnings - instructions to be observed when working on the engine are provided in order to carry out maintenance operations on the engine correctly, to avoid potential dangerous situations for the operator and maintenance personnel.

Compliance with the following instructions will also protect the engine from potential damage.



General danger, general precautions.

Maintenance checks and interventions must be carried out with the engine switched off, unless specifically indicated due to the type of check or intervention.

Becoming familiar with some simple control and verification procedures is very important.

Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.



Risk of injury and accidents if used incorrectly!

Observe the maintenance instructions. If in any doubt, contact the service network before proceeding.

Failure to comply with these indications could result in death or serious injury.



General instructions.

Any intervention on the systems and any maintenance operations must be carried out by authorized technicians.

The equipment and tools used for fine-tuning, maintenance or repair work must be of a type approved by the manufacturer.

Failure to comply with these instructions can result in serious health risks and serious damage to the vehicle.



General instructions.

Before proceeding with any work on the engine, operation or maintenance, carefully read the technical service documentation, owner's manual and repair manual of both the engine and the complete vehicle to learn all the functional and necessary concepts for repairs.

Failure to comply with these instructions can result in serious health risks and damage to the engine.



General instructions.

Use the specific and general tools according to the instructions in the respective user and maintenance manuals. Check the state of wear and the suitability of the tools which are not subject to periodical checks.

Failure to comply with these instructions can result in serious health risks and damage to the engine.



General instructions.

All flammable fluids and liquids must be handled with care, in accordance with the product safety data sheets.

Store fluids and liquids in containers that comply with current regulations.

Failure to comply with these instructions can result in serious health risks and damage to the engine.



General instructions.

Handling of components during maintenance work must be assessed in advance in order to choose the best solution to be adopted according to weight, shape, volume and position.

Failure to observe these instructions could lead to serious health risks and damage to the engine - component.



General instructions.

Do not smoke or light open flames near batteries, flammable liquids or fluids.

Failure to comply with these instructions can result in serious health risks and damage to the engine.



General instructions (handling of components «>25kg»).
 When lifting using a crane or hoist, pay careful attention to the affixing points. The items attached must be cantilevered. Furthermore, the affixing point must be firm, to prevent structural yield during the lifting stages. Failure to comply with these instructions can result in serious health risks and damage to the engine.



General instructions (engine lifting accessories).
 Lifting the engine by means of cranes or hoists must only be carried out using the engine lifting accessories on the engine. Use hoists or cranes with a suitable lifting capacity for the weight of the engine. During handling operations, do not stand under the manoeuvring area. Failure to comply with these instructions can result in serious health risks and damage to the engine.



General instructions.
 Use only the specific equipment listed in the repair manual and standard equipment that complies with current regulations. Failure to comply with these instructions can result in serious health risks and damage to the engine.



General instructions – engine stop.
 In emergency situations, if present, switch off the engine using the emergency stop button. Before working on the engine, wait for its surfaces to cool down. Failure to comply with these instructions can result in serious health risks and damage to the engine.



General instructions.
 Always carry out interventions with the engine stopped; if special circumstances require maintenance with the engine running, consider all the risks involved before proceeding. Pay close attention to moving parts. Failure to comply with these instructions can result in serious health risks and damage to the engine.



*Risk of injury.
Make sure that the guards of moving parts are correctly positioned and pay attention to the warning pictograms on the engine.
Failure to comply with these instructions can result in serious health risks and damage to the engine.*



*General instructions.
Pay close attention to the adhesive safety labels on the engine.
Failure to comply with these instructions can result in serious health risks and damage to the engine.*



*General instructions.
The safety guards should only be removed when the engine is switched off and must always be reset correctly at the end of the operation before starting the engine.
Failure to comply with these instructions can result in serious health risks and damage to the engine.*



*General instructions.
Maintenance procedures requiring engine start-up, for example during the forced regeneration procedure of ATS systems.
The guards present on moving parts must be properly secured; wear sound-proof headphones.
Failure to comply with these instructions can result in serious health risks and damage to the engine.*



*General danger, general precautions.
Always keep the engine clean, removing spots of Oil, diesel and coolant.
Failure to comply with these instructions can result in serious health risks and damage to the engine.*



*General danger, general precautions.
Do not leave foreign objects on the engine.
Failure to comply with these instructions can result in serious health risks and damage to the engine.*

Warnings - safety and operating instructions related to the engine application

Depending on the application, potentially dangerous conditions such as unexpected engine start-up may occur. Before proceeding with engine operations, it is always necessary to ensure that these potential risks cannot occur. The instructions and functional descriptions in the operating and maintenance manual of the complete machine must be observed.

Affix appropriate signs at the machine control station indicating that the engine - machine is undergoing maintenance; use appropriate devices that inhibit accidental engine start-up.

The machine assembly may have auxiliary devices such as emergency switches / emergency push button; these are to be used in the event of an emergency.

When the engine is warm and in specific engine - machine assembly conditions, the belt pulleys of the auxiliary organs can rotate.

It is therefore essential to observe the following safety instructions.



*General instructions – engine stop.
In emergency situations, if present, switch off the engine using the emergency stop button. Before working on the engine, wait for its surfaces to cool down.
Failure to comply with these instructions can result in serious health risks and damage to the engine.*



*Risk of injury.
Always operate with a cold engine in order to prevent electromechanical engine components from activating suddenly due to the temperatures reached by the engine.
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.*



*General danger, general precautions.
The operations required for guaranteeing the best state of use and preservation of the engine must be carried out by personnel with proven experience using instruments considered appropriate by FPT.
Failure to comply with these instructions can result in serious health risks and damage to the engine.*

Gen-set applications - Warnings - specific instructions



General instructions.

The conditions which cause an emergency gen-set to start may occur unexpectedly. Always pay careful attention to the safety instructions indicated by the Manufacturer of the unit and the generator Bodybuilder to ensure maximum safety for the maintenance technicians.

Failure to observe these instructions could cause serious health risks.

4) Safeguarding the environment. Warnings - instructions to safeguard the environment

The main warnings - instructions for environmental protection are given.



Disposal of liquids.

Prepare recipients to collect the engine coolant, diesel and oil for the fan and power steering hydraulic systems.

Correct behaviour will ensure that vehicle is used as environmentally friendly as possible.



General danger, general precautions.

Dispose of consumables in accordance with the law, for example: filters, fluids and any rags - paper rags soaked in liquids and fluids. FPT Technical Service Network workshops are equipped for this.

Correct behaviour will ensure that vehicle is used as environmentally friendly as possible.



General instructions.

Rags soaked in flammable liquids must be placed in containers which are suitable and comply with current legislation.

Correct behaviour will ensure that vehicle is used as environmentally friendly as possible.

SAFETY WARNING SYMBOLS

You will find these symbols on the following pages; follow the instructions to which they refer, for your own safety and that of your engine.



Risk of injury: failure to comply with these instructions can result in the risk of serious injury.



Risk of serious damage to the engine: the partial or total non-observance of these instructions could cause serious damage to the engine and may nullify the warranty.



General risk: combines the risks of both the signs described above.



Safeguarding the environment: indicates the correct behaviour so that vehicle use is as environmentally friendly as possible.

ENGINE TECHNICAL DATA

The technical code and serial number are indicated on a plate, which is located on different parts of the engine, according to the model: flywheel casing, tappet cover, other.

Code	N45 ENT Z W
Engine family	F4
Cycle	Diesel 4-stroke
Number and arrangement of cylinders	4, in line
Bore x stroke	104 x 132 mm
Total displacement	4,485 cm ³
Air system	Turbocharged - with intercooler
Injection type	Direct - high pressure pump supply and common rail system
Compression ratio	17 : 1
Cooling	Liquid
Engine direction of rotation	Anticlockwise (seen from flywheel side)
Dry weight	~402 kg (Engine) ~500 kg (G-Drive)

Electrical system	12 - 24 V
Reccomanded Battery - capacity - discharge current (EN 50342)	Min: 130 Ah - Max: 500 ^(**) Ah -
Electric starter motor - Maximum output power	4 kW
Alternator - Output	70 A

Performance [gross] (*)	N45 ENT Z W	
F4HFE415B*B003	Continuous power ⁽¹⁾	92 kWm @ 1800 rpm
	Prime power ⁽²⁾	115 kWm @ 1800 rpm
	Stand-by power ⁽³⁾	126 kWm @ 1800 rpm
F4HFE415C*B001	Continuous power ⁽¹⁾	69 kWm @ 1800 rpm
	Prime power ⁽²⁾	79 kWm @ 1800 rpm
	Stand-by power ⁽³⁾	86 kWm @ 1800 rpm

(*)Power at the flywheel in accordance with directive 97/68 EC (without fan), after 50 hours' operation, tolerance \pm 3%, fuel EN590;

Test in accordance with specification ISO 3046/1, turbocharger inlet air temperature 25 °C, atmospheric pressure 100 kPa, humidity 30%.

Also in accordance with specification DIN 6271, BS 5514, SAE J1349.

All data is based on engine operation, with fuel system, water pump, lubrication oil pump, and restriction on suction and discharge within (or below) the limits shown on the data sheet.

Additional loads estimated at 20 N from the minimum speed at normal speed.

The fan operation cycle must be below 20%.

(**)To grant start below -25°C it is needed an appropriate lube oil for cold conditions

(1)The continuous power is that which a generating set is capable of delivering continuously for an unlimited number of hours per year, according to the stated maintenance intervals and under standard ambient conditions.

(2)The prime power is the maximum power available with varying loads for an unlimited number of hours. The average power output during a 24h period of operation must not exceed 80% of the declared prime power according to the prescribed maintenance intervals and at standard environmental conditions.

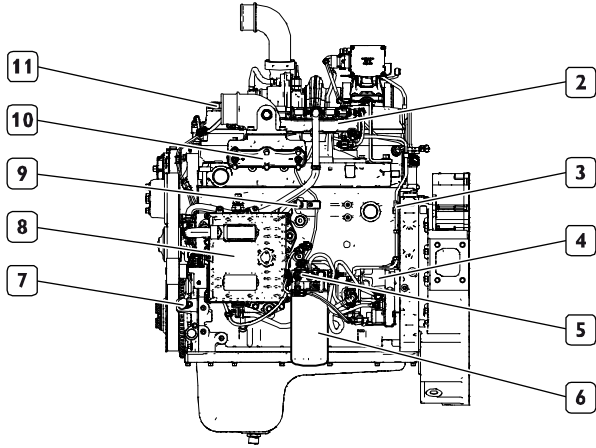
A 10% overload is permissible for 1 hour every 12 hours of operation.

(3)The stand-by power is the maximum power available for a period of 500 hours/year with a mean load factor of 90% of the declared stand-by power.

No kind of overload is permissible for this use.



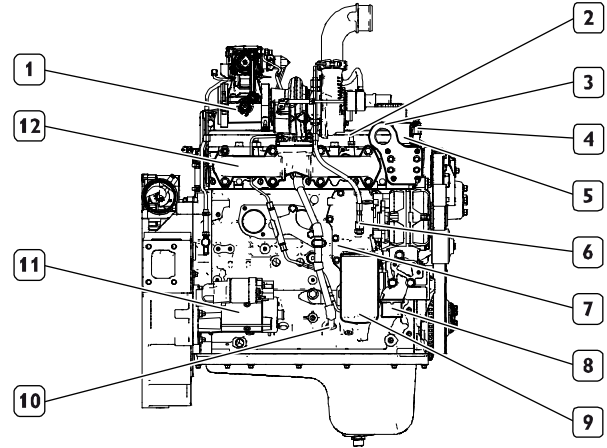
Any alteration of the above mentioned characteristics is strictly prohibited, penalty invalidation of the guarantee and absence of all liability on the part of FPT.



18 248 N

N45 ENT Z W

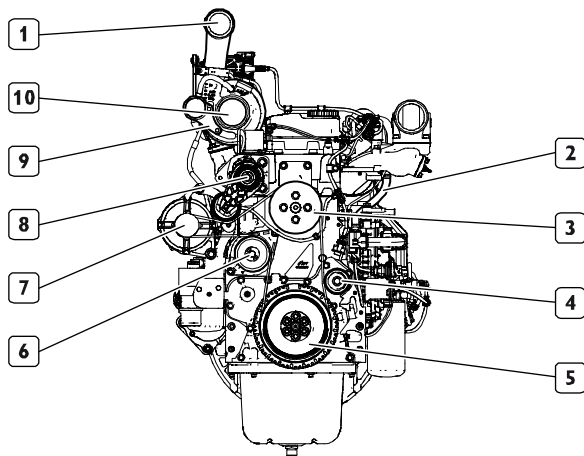
- 1. Lubricant oil filler cap - 2. Common rail - 3. Fuel discharge pipe - 4. Fuel high-pressure pump - 5. Fuel temperature sensor - 6. Fuel filter - 7. Crankshaft rpm increment speed sensor - 8. Engine Control Unit EDC17CV41 - 9. Oil level dipstick - 10. Grid heater



18 249 N

N45 ENT Z W

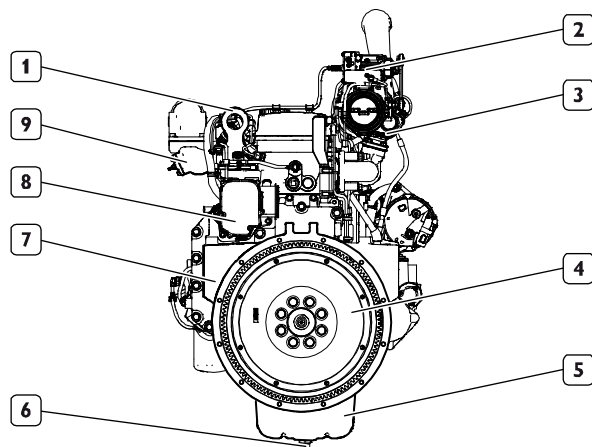
- 1. Turbocharger exhaust gas outlet from motorized throttle valve (Exhaust flap) - 2. Water degassing pipe - 3. Lifting eyelet - 4. Coolant temperature sensor - 5. Engine coolant outlet pipe (to radiator) - 6. Turbocharger lubrication oil delivery pipe - 7. Heat exchanger lubricant oil / coolant - 8. Engine coolant inlet pipe (from radiator) - 9. Engine oil filter - 10. Turbocharger lubrication oil return pipe - 11. Electric starter motor - 12. Exhaust manifold



18_250_N

N45 ENT Z W

1. Turbocharger combustant air outlet to intercooler - 2. Engine cable - 3. Fan control pulley - 4. Idler pulley - 5. Crankshaft pulley with damper - 6. Water pump - 7. Alternator - 8. Automatic belt tensioner - 9. Turbocharger - 10. Turbocharger combustant air intake from air filter

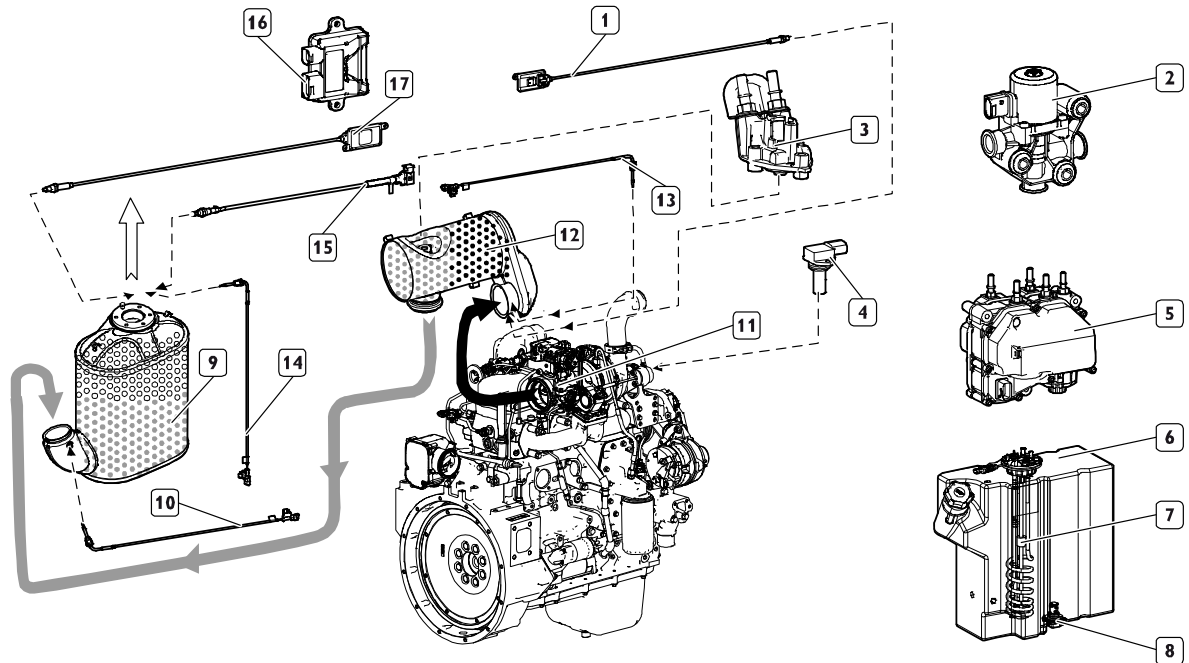


18_251_N

N45 ENT Z W

1. Lifting eyelet - 2. Motorized throttle valve (Exhaust flap) - 3. Exhaust manifold - 4. Engine flywheel - 5. Oil sump - 6. Lubricant oil drain plug - 7. Flywheel housing case - 8. Blow-by filter - 9. Intake manifold

EXHAUST GAS AFTER-TREATMENT SYSTEM (ATS)

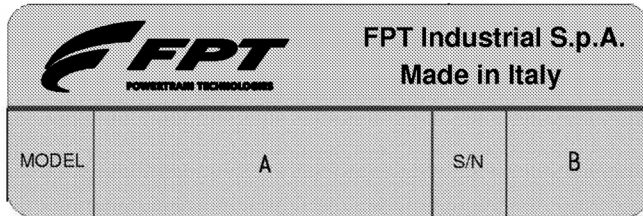


1. DOC upstream NO_x sensor - 2. Engine coolant 3 way valve - 3. Dosing module DeNO_x 2.2 - 4. Intake air humidity and temperature sensor - 5. Supply module DeNO_x 2.2 - 6. AdBlue tank - 7. AdBlue tank level sensor - 8. Urea quality sensor (UQS) - 9. Selective catalyst reduction (SCR) - 10. SCR upstream exhaust gas temperature sensor - 11. Exhaust flap module - 12. Diesel Oxidation Catalyst (DOC) - 13. DOC upstream exhaust gas temperature sensor - 14. SCR downstream exhaust gas temperature sensor - 15. NH₃ sensor - 16. NH₃ sensor ECU - 17. SCR downstream NO_x sensor

18_252_N

■ NAMEPLATES

IDENTIFICATION PLATE



17_575_C

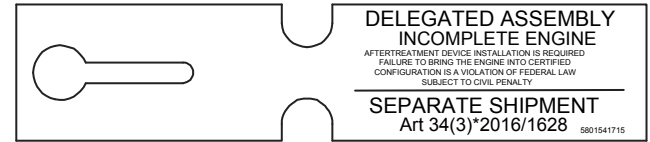
- A. Commercial code
- B. Engine serial number

TYPE-APPROVAL PLATE

		FPT Industrial S.p.A.		EMISSION CONTROL INFORMATION USE IN CONSTANT-SPEED OPERATION ONLY	
ENGINE FAMILY:	<input type="text"/>	ENGINE MODEL:	<input type="text"/>	DATE of MFG (mm-yy):	<input type="text"/>
Displ.	<input type="text"/>	ADV. POW.	<input type="text"/>	kW POW. rpm CAT	<input type="text"/>
SERIAL NUMBER:	<input type="text"/>	ECS.:	<input type="text"/>		
THIS ENGINE COMPLIES WITH U.S. EPA REGULATIONS FOR			<input type="checkbox"/>	MODEL YEAR	
NON ROAD AND STATIONARY DIESEL ENGINES AND CALIFORNIA REGULATIONS FOR			<input type="checkbox"/>		
MODEL YEAR NON ROAD DIESEL ENGINES. THIS ENGINE IS CERTIFIED TO OPERATE ON: ULTRA LOW SULFUR FUEL ONLY					
DELEGATED ASSEMBLY					

18_145_N

"DELEGATED ASSEMBLY" PLATE



18_146_N

This plate highlights the fact that the engine must be installed with the corresponding ATS system by the bodybuilder. When installation has been completed, it must be removed.

■ USE

PRELIMINARY CHECKS



*General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.*



*Risk of injury.
Make sure that no fuel vapours or gasses are present in the area in which the engine should be operated. Ensure that closed areas are adequately ventilated and fitted with a suitable exhaust extraction system.
Failure to observe these instructions could cause serious health risks.*



*General instructions.
Make sure there are no vapours of fuel or gas in the engine area. Ensure that closed areas are adequately ventilated and fitted with a suitable exhaust extraction system.
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.*



*Risk of injury.
During maintenance work on the engine, pay attention to sharp parts and/or edges and/or surfaces such as guards and heat shields (if present).
Failure to observe these instructions could cause serious health risks.*

Every time before starting the engine:

- Check the level of technical fluids (fuel, engine oil and coolant), and top-up if necessary.
- Make sure that the air aspiration filter is not blocked or obstructed.
- Make sure that the start batteries are efficient and relative clamps are correctly connected.

Prescriptions

- ❑ Do not disconnect the batteries with the engine running.
- ❑ Do not perform arc welding near the engine without first removing its electrical wiring.
- ❑ After all maintenance operations that require disconnection of the batteries, make sure the clamps have been securely reconnected to the poles.
- ❑ Do not use battery chargers to start the engine.
- ❑ Electrically disconnect the battery/ies from the network during charging.
- ❑ Do not paint the devices, components and electrical connectors of the engine equipment.
- ❑ Electrically disconnect the battery/batteries before performing any electrical work.
- ❑ Contact the Manufacturer before installing any electronic equipment.



Risk of damage.

It is strictly forbidden to alter the aforesaid characteristics and, in particular, to modify the stored data in the injection system's electronic units or the characteristics of the engine and its components.

Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.

FOR PROPER ENGINE USE

- ❑ Before starting the engine each time, check that the tank contains a sufficient amount of fuel.
- ❑ Avoid prolonging the duration of the start control.
- ❑ Follow the prescriptions shown on the maintenance plan.
- ❑ During use, check periodically that:
 - the temperature of the engine coolant does not reach the alarm thresholds;
 - the oil pressure remains within normal values.
- ❑ The speed and power values must comply with that specified in the technical-commercial documentation.
- ❑ Particular attention must be paid to engines that equip the emergency generating units for which frequent efficiency checks are required in order to guarantee their prompt start in all cases when required.



In case of use in extremely dusty environments and according to the final configuration of the generator, soundproofed or without hood, special protections must be provided on the most sensitive components.

SPECIAL WARNINGS

Coolant circuit

When the engine is running, regularly check that the engine coolant temperature does not reach the alarm threshold.

In case the temperature detected is excessive, disconnect the load and stop the engine to check the cooling circuit status.

CAUTION!



When the engine is hot, pressure builds up in the cooling circuits which may eject hot liquid violently, resulting in a risk of burns. Open the filler cap of the coolant tank only when the engine is cold.

If the temperature is considered too high, reduce speed and stop to check the state of the cooling system circuits.

Check the following:

- a) the tension of the auxiliary member drive belt;
- b) the thermostatic valve's efficiency;
- c) the conditions of the heat exchanger (to be cleaned if necessary).

Lubrication circuit

Regularly check that the oil pressure keeps within normal values. In case the value detected is too low, check the oil level and refill if necessary following the instructions reported in the CHECKS AND MAINTENANCE section.

If the condition persists, contact the Authorised Service Centre.

Fuel circuit

Avoid using the engine with small reserve of fuel in the fuel tank. Thus the vapour condensation is encouraged and makes the engine more likely to suck up dirt or air, resulting in engine stoppage.

CAUTION!



While refuelling, always pay attention to ensure that no solid or liquid pollutants enter the fuel tank; remember that smoking and live flames are prohibited during refuelling.

CAUTION!



Never loose the high pressure fuel circuit connectors in any way.

Air intake and exhaust gas circuits

Inspect the cleanliness of the air intake circuit on a regular basis. The maintenance intervals indicated in this manual vary according to the conditions in which the engine is operated.

In particular dusty environments it is necessary to carry out maintenance within more frequent intervals than indicated in the CHECKS AND MAINTENANCE section.

CAUTION!



Visually check that the exhaust circuit is not obstructed or damaged to prevent the formation of noxious and harmful fumes inside the ducts.

ATS system

This system is used to maintain the nitrogen oxide (NO_x) emissions in the exhaust within the limits required by standards, transforming the nitrogen oxide into inert compounds: nitrogen (N₂) and water vapour (H₂O). Periodically clean the filters at the intervals indicated in the CHECKS AND MAINTENANCE section.

Electric starter system

Check periodically the cleanliness and efficiency of the batteries, particularly during winter, as indicated in the CHECKS AND MAINTENANCE section. Top up if necessary.

In the event of battery replacement, observe the characteristics contained in the ENGINE TECHNICAL DATA chapter.



Contact a specialised workshop and check battery and recharging system efficiency if the voltmeter indicates a voltage below 11 V (for 12 V rated systems).



The batteries contain an acid solution that will burn the skin and corrode clothing; when checking them, always wear protective clothing, gloves and goggles, do not smoke or use live flames in the vicinity, and make sure that the room they are housed in is adequately ventilated.

RUN-IN

Thanks to modern engine design technology, no particular run-in procedure is required.

REFILLING

Parts to be supplied	N45 ENT Z W litres (kg)
Cooling circuit ⁽¹⁾	7 (6.3)
Lubrication circuit ⁽²⁾ total capacity ⁽³⁾	14.4 (12.96)
Periodic changing: oil sump at minimum level	8.3 (7.47)
oil sump at maximum level	11.3 (10.17)
Fuel tank ⁽⁴⁾	-
Urea tank ⁽⁵⁾	-

(5) Only use AdBlue®/DEF (32.5% solution in water) in accordance with ISO 22241 specification.

- (1) The quantities refer to the engine in standard configuration.
Coolant should comply with ASTM D-6210 standard.
Concentrated coolants should be used as a 50% mixture in water.
- (2) See 'Main oil features' table.
- (3) The quantities indicated relate to the first refill only and are relative to the engine, oil sump and filter filling.
- (4) Fuel tank not supplied by FPT.
Consult supplier / generator set manufacturers data.
Only use fuels which comply with ASTM D975 or EN 590 international standards.
The fuel tank capacity information is under the responsibility of the genset Manufacturer being subject to variation dependent on the different configurations of the generator set.

Main oil features

Oil quality	SAE grade	Base stock	International specifications	Fuel sulphur content
Premium	10W-40	Semi - Synthetic	API CJ-4 ACEA E6/E9	< 15 ppm
Cold climate	5W-30	Synthetic	API CJ-4 ACEA E6/E9	< 15 ppm
Not permitted	Single-grade			

(*)To identify the product recommended by FPT refer to the Oil configurator using the QR-Code indicated:



Coolant refilling

For the initial engine start-up and in the cases in which the refilling of the cooling circuit is required with a considerable quantity of coolant, proceed as follows:

- ❑ Refill the engine and the exchanger until the exchanger is completely filled.
- ❑ With the coolant filler plug open, start the engine and let it idle for approx. 1 minute. This helps to completely bleed the air contained in the cooling circuit.
- ❑ Stop the engine and then top up with coolant if necessary.



The failure to observe the aforesaid procedure does not guarantee the presence of the correct quantity of coolant in the engine.

CAUTION!



When the engine is hot, pressure builds up in the cooling circuits which may eject hot liquid violently, resulting in a risk of burns. Open the filler cap of the coolant tank only if necessary and only when the engine is cold.

Refuelling

Use only diesel oil in accordance with ASTM D975 or EN 590 standard normally commercially available. Fuel additives are not recommended.

Use of additives can limit the guarantee performance offered for the equipment.

CAUTION!



Pay maximum attention when refuelling, making sure that solid or liquid pollutants do not enter the tank; please remember that smoking is prohibited while refuelling. The couplings of the fuel circuit under high pressure must not be loosened under any circumstances.

Low temperature diesel

At low temperatures the degree of fluidity of the diesel can become low due to the separation of the paraffin resulting in the filters becoming clogged.

ASTM D975 or EN590 specifications distinguish different classes of diesel fuel, identifying the characteristics of those best suited to low temperatures.

It is entirely up to the Oil companies to comply with these regulations, which foresee that fuels suited to the climactic and geographic conditions of the various Countries be distributed.

■ CHECKS AND MAINTENANCE

MAINTENANCE PERSONNEL

The engine control and maintenance operations described in the following chapter require training, experience and compliance with current safety regulations. For this reason, the following operations must be carried out by special technicians.

- ❑ **Checks in periods of use:** by workshop personnel or if necessary by the generator set user.
- ❑ **Periodic maintenance:** by qualified personnel using suitable equipment and adequate means of protection.
- ❑ **Extraordinary maintenance:** by qualified personnel from Authorised Service Centres who have detailed technical information and specific equipment.



The most qualified Assistance Centres are those which make up the FPT Technical Assistance Network.

ACCIDENT PREVENTION

- ❑ Always wear heavy-duty footwear, gloves and suits.
- ❑ Never wear loose, flapping garments, rings, bracelets and/or necklaces close to engines or moving parts.
- ❑ Always wear protective gloves and goggles when:
 - filling up batteries with acid solution
 - check cleanliness of battery clamps and terminals
 - refilling with inhibitors or antifreeze

- replacing or topping up lubricant (hot engine oil may cause burns and scalds. Only carry out these operations when the oil has dropped to a temperature of below 50°C).

- ❑ While working in the engine compartment, pay particular attention on movements, to avoid contact with moving parts and high temperature components.
- ❑ Wear safety goggles while using compressed air jets. Maximum air pressure used to clean is 200 kPa (2 bar, 30 psi, 2 kg/cm²).
- ❑ Wear a protective helmet when working in an area where there are suspended loads or systems installed at/above head-height.
- ❑ Use protective hand creams.
- ❑ Replace wet gloves immediately.
- ❑ Always keep the engine clean removing oil, fuel and coolant stains.
- ❑ Store cloths in flame-proof containers.
- ❑ Do not leave external objects on the engine.
- ❑ Use suitable, safe containers for used oil.
- ❑ Once the repair activities are completed, take the necessary steps to stop engine air suction in case of uncontrolled increase in engine speed after start-up.




Do not carry out maintenance operations when the electric power supply is turned on: always check to ensure that the appliances are properly earthed. During diagnosis and maintenance operations, make sure that your hands and feet are dry, and whenever possible use insulating stands.


MAINTENANCE SCHEDULE


The maintenance intervals indicated below take into account the typical working factors for various types of engine use; the most suitable interval for maintenance operations for the various applications will be indicated by the maintenance staff, according to the way and working conditions in which the engine is used.

FREQUENCY

Controls in periods of use	Frequency
Engine lubricant oil level check	Daily
Engine coolant level check	Daily
Engine visual inspection	50 hours ⁽⁷⁾
Air filter and housing cleanness check	1 month
Tension and condition check of auxiliary members' belt	300 hours ⁽⁸⁾
Exhaust duct(s) condition check	6 months

 Periodic maintenance	Frequency
Water drainage from the fuel pre-filter (if present)	150 hours ⁽⁸⁾
Draining condensate water from fuel tank	150 hours ⁽⁸⁾
Engine lubricant oil replacement	600 hours ^{(2) (3)}
Engine lubricant oil filter replacement	600 hours ^{(2) (3) (4)}

 Periodic maintenance	Frequency
Fuel pre-filter replacement (if present)	600 hours ^{(1) (2) (5)}
Fuel filter replacement	600 hours ^{(1) (2) (4)}
Air filter replacement ^(*)	1,200 hours ⁽⁵⁾
Auxiliary members' belt replacement	1,200 hours ⁽⁶⁾
Heat exchanger cleaning ^(*)	1,200 hours ⁽⁵⁾
Blow-by filter replacement	1,500 hours ⁽²⁾

 Extraordinary maintenance	Frequency
Turbocharger visual inspection	1,200 hours ⁽⁵⁾
Valves/rocker arm clearance adjustment	2,400 hours
Engine coolant replacement	3,000 hours ⁽⁵⁾

(*) Indicated frequencies are valid only if the component (s) supplied by FPT.

(1) Maximum period relative to the use of high quality fuel, (specification ASTM D975 or EN 590); this is reduced based on fuel contamination and the alarm signals due to filter clogging and/or the presence of water in the pre-filter. The filter clogging signal indicates that the filter must be replaced. If the signal of water present in the pre-filter does not turn off after drainage, the filter must be replaced.

- 2) To be performed every year even if the specified operating hours interval has not been reached.
- 3) The frequencies are applicable for lubricants which meet the standards as specified in the REFILLING table.
- 4) Only use filters with the following specifications:
 - degree of filtering < 12 µm
 - filtering efficiency 99.5% ($\beta > 200$).
- 5) To be performed every two years even if the specified operating hours interval has not been reached.
- 6) To be performed every three years even if the specified operating hours interval has not been reached.
- 7) To be performed every 15 days even if the specified operating hours interval has not been reached.
- 8) To be performed every six months even if the specified operating hours interval has not been reached.



The extraordinary maintenance operations described hereunder fall within the exclusive competence of manufacturer's personnel or specialised personnel having proper working tools and adequate protection devices. The procedure and modality for carrying out these operations are illustrated in the FPT Technical and Repair Manual.



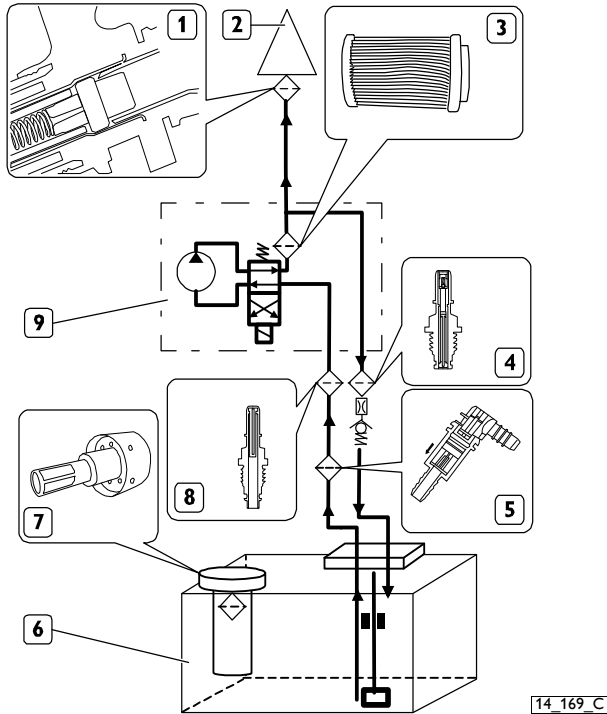
Scheduled maintenance of ATS system

Action

Tank pre-filter (300 µm or 100 µm ⁽¹⁾)	No maintenance anticipated (clean if necessary)
Pre-filter supply module (100 µm or 70 µm ⁽¹⁾)	Clean with water each time the oil is changed ⁽²⁾
AdBlue inlet filter to supply module (100 µm)	No maintenance anticipated (clean if necessary)
Filter supply module	Replace every 1200 hours ⁽³⁾
AdBlue return filter from supply module to tank (100 µm)	No maintenance anticipated (clean if necessary)
Dosing module filter (36 µm)	Not serviceable

- 1) For applications operating in dusty environments.
- 2) To be performed every year even if the specified interval of operating hours has not been reached.
- 3) To be performed every two years even if the specified number of operating hours has not been reached.

ATS System filter location



1. Dosing module filter (36 μm) - 2. Dosing module - 3. Supply module main-filter - 4. Supply module backflow-filter (100 μm) - 5. Supply module pre-filter (100 or 70 μm) - 6. AdBlue tank - 7. Tank neck filter (300 or 100 μm) - 8. Supply module inlet-filter (100 μm) - 9. Supply module

CHECKS (IN PERIOD OF USE) – HOW TO PROCEED

Safety notes - Check engine lubricant oil level



General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.



Risk of burns.
Only carry out the following operation when the engine parts have cooled down.
Failure to comply with these indications could result in death or serious injury.



Risk of injury.
Use suitable PPE (gloves, safety shoes, goggles, etc.).
Failure to observe these instructions could cause serious health risks.



Risk of injury.
Use suitable clothing, preferably tight-fitting; do not wear chains, rings, etc.
Failure to observe these instructions could cause serious health risks.



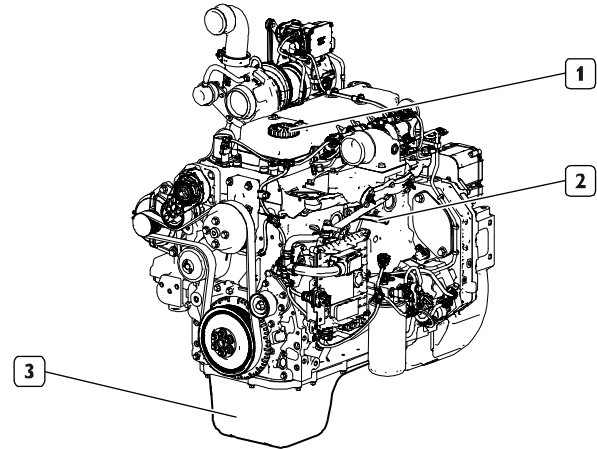
Risk of damage.
Make sure that the oil dipstick is fully inserted and that the oil filler cap is fully tightened in a clockwise direction.
Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.

Engine lubricant oil level check

The check must be executed when the engine is disconnected and possibly cool.

Only proceed with the engine stopped and at low temperature, in order to avoid the risk of burning.

- ❑ Make sure the machine is on a flat surface.
- ❑ Use the oil dipstick (2) to check that the lubricant oil level is between the "Min" and "Max" limits.
- ❑ Whether it should be difficult to make the evaluation, proceed cleaning the oil dipstick (2) using a clean cloth with no rag grinding and put it back in its slot. Draw it off again and check the level.
- ❑ If the level is insufficient, it is necessary to top up with lubricant oil which meets the international specifications API CJ-4 / ACEA E9, as indicated in the REFILLING table: remove the lubricant oil cap (1) and pour engine lubricant oil through the hole.
- ❑ Use the oil dipstick (2) to check that the lubricant oil level in the oil sump (3) does not exceed the "Max" limit.



18 253 N

Engine coolant level check

Only proceed with the engine stopped and at low temperature, in order to avoid the risk of burning.

- ❑ Remove the pressurization cap from the expansion tank.
- ❑ Check that the coolant in the expansion tank is above the minimum level.
- ❑ If necessary, top up the expansion tank with fluids, as contained in the REFILLING table. Do not fill the expansion tank to the brim.
- ❑ When the engine is cold, make sure that the coolant level is a few centimetres below the filling hole.

In the event of an externally located level indicator as regards the heat exchangers, proceed with the top up operation by making sure that the coolant does not overflow the internal volume of the exchanger in order to allow the expansion of coolant volume during increases in temperature.

Safety notes - Check engine coolant level



*General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.*



*Risk of burns.
When the engine is hot, the pressure inside cooling circuits is such that it may expel the hot liquid in an extremely violent manner with the risk of burns.
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.*



*Risk of burns.
When the engine is hot, the pressure inside cooling circuits is such that it may expel the hot liquid in an extremely violent manner with the risk of burns.
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.*



General instructions.

If the refill operations occur frequently a diagnosis of the cooling circuit is necessary.

Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.



Risk of burns.

Only carry out the following operation when the engine parts have cooled down.

Failure to comply with these indications could result in death or serious injury.



Risk of injury.

Use suitable PPE (gloves, safety shoes, goggles, etc.).

Failure to observe these instructions could cause serious health risks.



Risk of injury.

Use suitable clothing, preferably tight-fitting; do not wear chains, rings, etc.

Failure to observe these instructions could cause serious health risks.

Engine visual inspection

It is a good habit to execute, before engine start, a series of simple checks that might represent a valid warranty to avoid inconveniences, even serious, during engine running. Such checks are usually up to the operators.

- Level controls and checks of any eventual leakage from the fuel, cooling and lubricating circuits.
- Notify the maintenance if any inconvenience is detected or if any filling is necessary.

After engine start and while engine is running, proceed with the following checks and controls:

- Check presence of any eventual leakage from the fuel, cooling and lubricating circuits.
- Verify absence of noise or unusual rattle during engine working.
- Verify, using the equipment devices, the prescribed pressure temperature and other parameters.
- Visual check of fumes (colour of exhaust emissions)
- Visual check of cooling liquid level, in the expansion tank.

Safety notes - Air filter cleaning



*General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.*



*General danger, general precautions.
Before performing the procedure, put on the appropriate personal protective equipment (especially protective gloves, ear protectors and glasses).
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.*

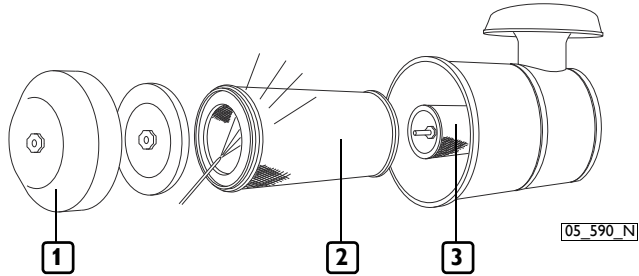


*General instructions.
Do not use detergents or diesel to clean the air filter.
Never strike the filter element with tools. Incorrect assembly of the air filter can allow the introduction of unfiltered air causing serious damage to the engine.
Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.*

Air filter and housing cleanness check

Only proceed with the engine stopped.

- Remove the filter cover (1) after first unscrewing the locking handle.
- Remove the external cartridge (2), after unfastening the second locking handle; during this operation, take care to ensure that no dust get into the sleeve.
- Check that there is no dirt. If there is, clean the filter element as indicated below.
- Blow dry compressed air through the filter element, from the inside outward (maximum pressure 200 kPa). Do not use detergents; do not use diesel.
- Never use tools to beat the filter element, and check its condition before replacing it.
- Replace the filter if any breakages or tears are found.
- Check that the gasket at its base is in good condition. Some filter systems are fitted with a second filter element (3) which does not require cleaning; this must be replaced at least once every 3 changes in the main element.
- Reassemble by repeating the above operations in reverse order.
- Set up the mechanical blockage indicator for operation by pressing the button located on the top part of the indicator. This operation is not necessary if there is an electrical sensor.



Safety notes - Check condition of auxiliary belts



General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.



Risk of injury.
Make sure that the guards of moving parts are correctly positioned and pay attention to the warning pictograms on the engine.
Failure to comply with these instructions can result in serious health risks and damage to the engine.



Risk of burns.
Only carry out the following operation when the engine parts have cooled down.
Failure to comply with these indications could result in death or serious injury.



Risk of injury.

Use suitable PPE (gloves, safety shoes, goggles, etc.).

Failure to observe these instructions could cause serious health risks.



Risk of injury.

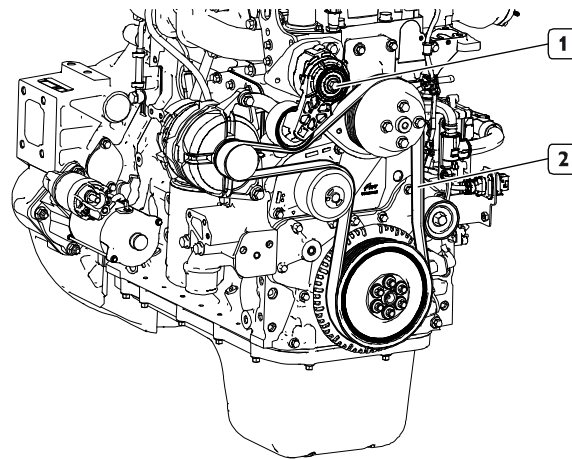
Use suitable clothing, preferably tight-fitting; do not wear chains, rings, etc.

Failure to observe these instructions could cause serious health risks.

Tension and condition check of auxiliary members' belt

Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- ❑ Check that the belt (2) is not worn, soiled with oil or fuel, or showing signs of tears. Otherwise replace the belt if necessary .
- ❑ Use a ½ inch square wrench to check the efficiency of the automatic belt tensioner (1).



18_254_N

Safety notes - Air filter cleaning



*General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.*



*General danger, general precautions.
Before performing the procedure, put on the appropriate personal protective equipment (especially protective gloves, ear protectors and glasses).
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.*



*General instructions.
Do not use detergents or diesel to clean the air filter.
Never strike the filter element with tools. Incorrect assembly of the air filter can allow the introduction of unfiltered air causing serious damage to the engine.
Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.*

Exhaust duct(s) condition check

Visually check that the exhaust gas system is not blocked, corroded or damaged.

In the event of any problems, perform the operations necessary to restore the exhaust duct.

PERIODIC MAINTENANCE - HOW TO PROCEED

Safety notes - Drain water from fuel pre-filter



General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.



General danger, general precautions.
Before performing the procedure, put on the appropriate personal protective equipment (especially protective gloves, ear protectors and glasses).
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.



General instructions.
The components of the common rail system will be damaged quickly if the fuel contains water or other impurities. Immediately perform the operation on the pre-filter to drain the water present in the fuel supply circuit.
Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.



Risk of burns.
Only carry out the following operation when the engine parts have cooled down.
Failure to comply with these indications could result in death or serious injury.



Fire hazard.
Pay the utmost attention to parts glowing with heat and guards with warning pictograms.
Failure to observe these instructions could cause serious health risks.



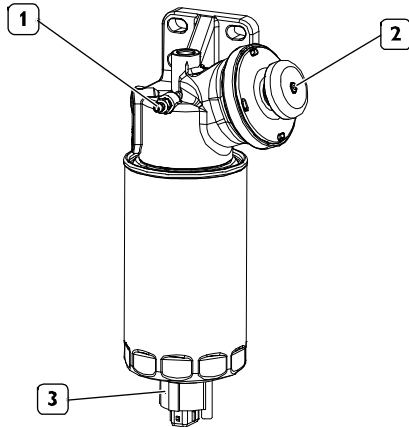
Fire risk!
Fire hazard: pay the utmost attention to flammable liquids, dusts and vapours.
Failure to comply with these indications could result in death or serious injury.

Water drainage from the fuel pre-filter (if present)

The high risk of refuelling with fuel that is polluted by foreign bodies and water makes it advisable to carry out this control every time you refuel.

Proceed with the engine stopped.

- Place a container under the pre-filter to collect the fluid.
- Unscrew the tap plug (3) in the bottom part of the filter; in some lay-outs the plug includes a sensor to detect the presence of water in the diesel.
- Drain off liquid until only "diesel" can be seen.
- Close the plug again, tightening it completely by hand.
- Dispose of the drained fluids according to current requirements.



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Safety notes - Draining condensate from fuel tank



General danger, general precautions.

Before proceeding with the operation, please refer to the section "Warnings and safety instructions".

Failure to comply with these instructions can result in serious health risks and damage to the engine.



General danger, general precautions.

Before performing the procedure, put on the appropriate personal protective equipment (especially protective gloves, ear protectors and glasses).

Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.



General instructions.

The components of the common rail system will be damaged quickly if the fuel contains water or other impurities. Immediately perform the operation on the pre-filter to drain the water present in the fuel supply circuit.

Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.



Risk of burns.

Only carry out the following operation when the engine parts have cooled down.

Failure to comply with these indications could result in death or serious injury.



Fire hazard.

Pay the utmost attention to parts glowing with heat and guards with warning pictograms.

Failure to observe these instructions could cause serious health risks.



Fire risk!

Fire hazard: pay the utmost attention to flammable liquids, dusts and vapours.

Failure to comply with these indications could result in death or serious injury.

Draining condensate water from fuel tank

- ❑ Proceed to the drainage / water extraction, condensation and impurities from the fuel tank following the instructions in the manual provided by the manufacturer of the generator.
- ❑ Proceed as required by structure or location of the tank: engines that operate in harsh environments and conditions and / or which are supplied by drums or canisters, require more care when cleaning the tank.

Safety notes - Replace engine lubricant oil



General danger, general precautions.

Before proceeding with the operation, please refer to the section "Warnings and safety instructions".

Failure to comply with these instructions can result in serious health risks and damage to the engine.



General danger, general precautions.

Before performing the procedure, put on the appropriate personal protective equipment (especially protective gloves, ear protectors and glasses).

Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.



Risk of burns.

Only carry out the following operation when the engine parts have cooled down.

Failure to comply with these indications could result in death or serious injury.



General instructions.

For correct engine operation, only use recommended oils or oils with the required characteristics. In the case of refilling, do not mix oils with different characteristics. Failure to observe these indications will void the warranty. Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.



Risk of damage.

Make sure that the oil dipstick is fully inserted and that the oil filler cap is fully tightened in a clockwise direction. Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.



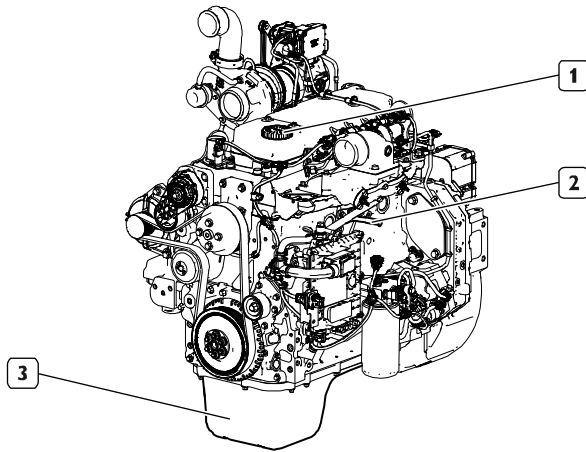
General danger, general precautions.

Dispose of consumable materials and the parts in contact with them (for example filters) in accordance with the law. FPT Technical Service Network workshops are equipped for this. Correct behaviour will ensure that vehicle is used as environmentally friendly as possible.

Engine lubricant oil replacement

Only proceed with the engine stopped and at a low temperature, so as to avoid the risk of burning.

- Place a suitable container for collecting the spent oil under the oil sump (3) next to the lubricant oil drain plug.
- Unscrew the lubricant oil drain plug; afterwards extract the oil level dipstick and remove the lubricant oil cap (1) to assist the flow of the engine lubricant oil.
- Wait until the oil sump (3) has completely emptied, then retighten the lubricant oil drain plug.
- Proceed with the refilling operation through the hole situated on the tappet cover, using lubricant oil that meets the international standards API CJ-4 / ACEA E9, as indicated in the REFILLING table.
- Use the oil dipstick (2) to check that the lubricant oil level does not exceed the "Max" limit.
- Whether it should be difficult to make the evaluation, proceed cleaning the oil dipstick (2) using a clean cloth with no rag grinding and put it back in its slot. Draw it off again and check the level.
- Retighten the lubricant oil cap (1).
- Together with the replacement of the engine lubricant oil it is necessary to replace the oil filter (see REPLACE ENGINE OIL FILTER paragraph).



18 253 N

Safety notes - Replace engine lubricant oil filter



General danger, general precautions.
 Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
 Failure to comply with these instructions can result in serious health risks and damage to the engine.



General instructions.
 Always carry out interventions with the engine stopped; if special circumstances require maintenance with the engine running, consider all the risks involved before proceeding. Pay close attention to moving parts.
 Failure to comply with these instructions can result in serious health risks and damage to the engine.



Risk of burns.
 Only carry out the following operation when the engine parts have cooled down.
 Failure to comply with these indications could result in death or serious injury.



General instructions.

Always carry out interventions with the engine stopped; if special circumstances require maintenance with the engine running, consider all the risks involved before proceeding. Pay close attention to moving parts. Failure to comply with these instructions can result in serious health risks and damage to the engine.



Danger of skin irritation or allergic reactions.

The engine oil is highly pollutant and harmful.

In case of contact with the skin, wash thoroughly with soap and water.

Protect skin and eyes appropriately; work in accordance with accident prevention regulations.

Failure to observe these instructions could cause serious health risks.



General danger, general precautions.

Dispose of consumable materials and the parts in contact with them (for example filters) in accordance with the law. FPT Technical Service Network workshops are equipped for this.

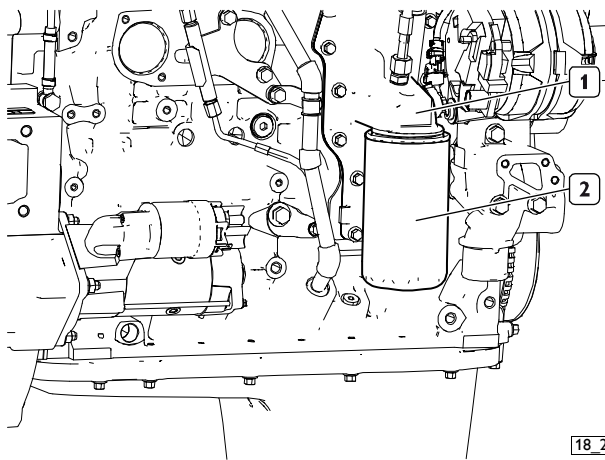
Correct behaviour will ensure that vehicle is used as environmentally friendly as possible.

Engine lubricant oil filter replacement

The filter must also be replaced when the lubricant oil is changed.

Only use filters with a filtering degree that is the same as the previous one (see the FREQUENCY chapter).

- Only proceed with the engine stopped and at low temperature, in order to avoid the risk of burning.
- Place a container for collecting the spent oil under the filter support (1).
- Unscrew and remove the filter (2) from its relative support (1) by suitable tool.
- Replace the filter element and the sealing gasket contained inside the filter (2).
- Carefully clean the surfaces of the support (1) in contact with the sealing gasket.
- Moisten the sealing gasket of the new filter (2) with a thin layer of oil.
- Manually tighten the new filter (2) on the support (1) until it comes into contact with the gasket. Additionally tighten it using a specific tool to a torque of 20 ± 2 Nm.
- Operate the engine for a few minutes and then check the level using the dipstick. If necessary, top up to compensate for the quantity of oil used to fill up the filtering cartridge.



18_255_N

Safety notes - Fuel pre-filter replacement



General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.



General danger, general precautions.
Before performing the procedure, put on the appropriate personal protective equipment (especially protective gloves, ear protectors and glasses).
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.



General instructions.
The components of the common rail system will be damaged quickly if the fuel contains water or other impurities. Immediately perform the operation on the pre-filter to drain the water present in the fuel supply circuit.
Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.



Risk of burns.

Only carry out the following operation when the engine parts have cooled down.

Failure to comply with these indications could result in death or serious injury.



Fire hazard.

Pay the utmost attention to parts glowing with heat and guards with warning pictograms.

Failure to observe these instructions could cause serious health risks.



Fire risk!

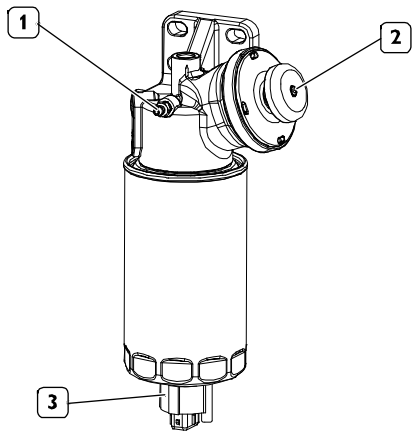
Fire hazard: pay the utmost attention to flammable liquids, dusts and vapours.

Failure to comply with these indications could result in death or serious injury.

Fuel pre-filter replacement (if present)

Only proceed with the engine stopped.

- Should the filter be fitted with a sensor to detect the presence of water (3), remove the whole sensor from its seat.
- Remove the pre-filter by unscrewing it.
- Check that the new filter has performance levels that satisfy the needs of the engine (e.g. by comparing them with the old one).
- Damp the new filter seal with diesel or engine oil.
- Hand screw the new filter into place until the seal gasket touches the support, then lock by a further 3/4 of a turn.
- Place the water presence sensor in its seat, taking care to couple the threads correctly.
- Loosen the bleeder screw (1) on the pre-filter support and activate the hand pump (2) until the supply circuit is full. Ensure that any fuel coming out is not dispersed into the environment.
- Lock the bleeder screw tightly.
- Start the engine and run it at idle for a few minutes to eliminate any residual air.



08_012_F

Safety notes - Replace fuel filter(s)



General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.



General danger, general precautions.
Before performing the procedure, put on the appropriate personal protective equipment (especially protective gloves, ear protectors and glasses).
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.



Electric shock hazard.
Pay attention to the electrical fuel pre-heater (if installed) and its electrical connections.
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.



Electric shock hazard.

Pay attention to the electrical fuel pre-heater (if installed) and its electrical connections.

Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.



Risk of injury.

Do not smoke or use open flames during this operation.

Do not inhale the vapours that exit the filter.

Failure to observe these instructions could cause serious health risks.



General instructions.

Make sure that the fuel coming from the bleed plug or drain screw does not dirty the transmission belt of the auxiliary organs and do not dispose of it in the environment. Never loose connectors of the high-pressure fuel pipes and of the common rail in any way.

Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.



General instructions.

Do not fill the new fuel filter before having placed it on the support, to avoid at harmful impurities to enter the circuit of the fuel and in the injection system.

Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.



Risk of burns.

Only carry out the following operation when the engine parts have cooled down.

Failure to comply with these indications could result in death or serious injury.



General instructions.

If it is necessary to speed up the residual air bleeding phase, use the hand pump also while starting.

Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.

Fuel filter replacement

Only proceed with the engine stopped and at low temperature, in order to avoid the risk of burning.

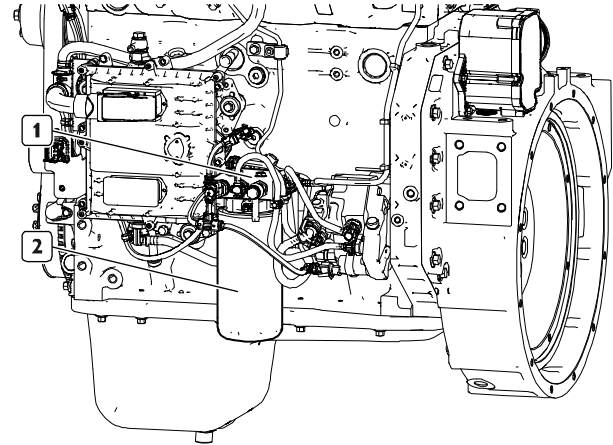
Only use filters with the following specifications (see the FREQUENCY chapter):

- degree of filtering $< 12 \mu\text{m}$
 - filtering efficiency 99.5% ($\beta > 200$).
- ❑ Place a container for collecting the diesel under the filter support (1).
 - ❑ Remove the filter (2) by unscrewing it from its relative support.
 - ❑ Replace the filter element and the O-ring seal contained inside the filter (2).
 - ❑ Carefully clean the surfaces of the support (1) in contact with the O-ring seal.
 - ❑ Smear the O-ring seal of the new filter with oil.
 - ❑ Manually tighten the new filter (2) onto the support (1) until it comes into contact with the gasket. Additionally tighten it using a specific tool to a torque of $20 \pm 2 \text{ Nm}$.

After the fuel filter (2) has been replaced it is possible that air bubbles get trapped inside the fuel supply circuit.

- ❑ Bleed residual air from the fuel filter (2) by loosening the vent plug connecting it to a suitable container by a transparent flexible hose.
- ❑ With the hand pump of the fuel pre-filter pump until fuel completely free of air bubbles flows from the vent plug.
- ❑ Tighten the vent plug to prescribed torque.

- ❑ Start the engine and allow it to run at minimum for a few minutes to expel any remaining air.



18 256 N

Safety notes - Air filter replacement



*General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.*



*General danger, general precautions.
Before performing the procedure, put on the appropriate personal protective equipment (especially protective gloves, ear protectors and glasses).
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.*



*General instructions.
Do not use detergents or diesel to clean the air filter.
Never strike the filter element with tools. Incorrect assembly of the air filter can allow the introduction of unfiltered air causing serious damage to the engine.
Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.*

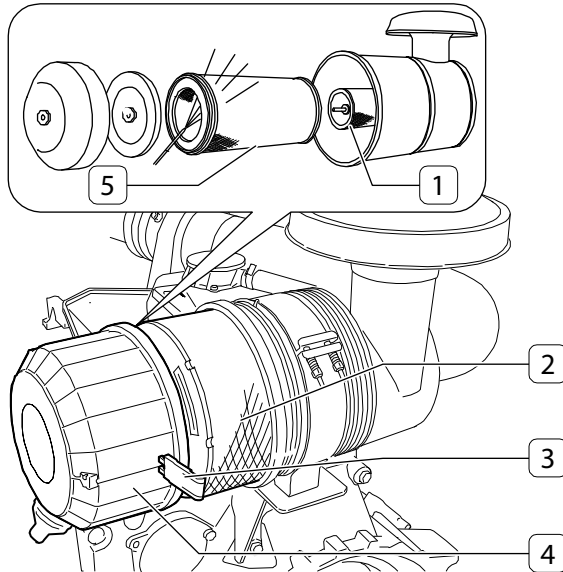
Air filter replacement (Demonstrative)

Only proceed when the engine is not running.

- Remove the cover (4) of the air filter after having undone the two quick release clips (3).
- Remove the filter element (5); make sure that dust does not enter the sleeve during this operation.
- Replace the filter element (5) and the relative gasket.
- Position the new filter element (5) in its seat.
- Refit the cover (4) of the air filter and lock it using the two quick release clips (3).

NOTE:

Some filter systems are fitted with a second filter element (1).



17_121_N

Safety notes - Replace auxiliary components belt



General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.



General danger, general precautions.
Before performing the procedure, put on the appropriate personal protective equipment (especially protective gloves, ear protectors and glasses).
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.



General instructions.
The safety guards should only be removed when the engine is switched off and must always be reset correctly at the end of the operation before starting the engine.
Failure to comply with these instructions can result in serious health risks and damage to the engine.



Risk of injury.
Make sure that the guards of moving parts are correctly positioned and pay attention to the warning pictograms on the engine.
Failure to comply with these instructions can result in serious health risks and damage to the engine.



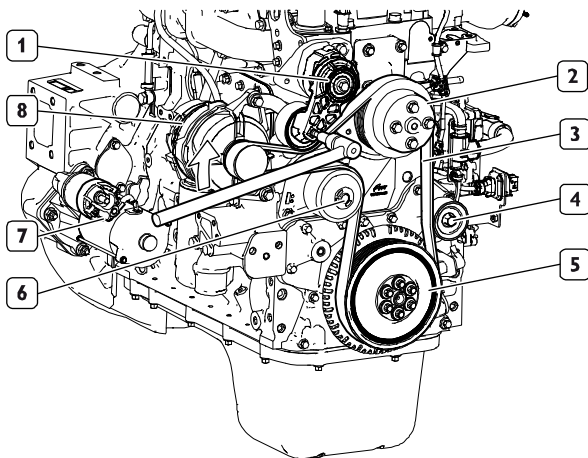
Risk of burns.

Only carry out the following operation when the engine parts have cooled down.

Failure to comply with these indications could result in death or serious injury.

Auxiliary members' belt replacement

- Pull the automatic belt tensioner (1) by using appropriate tool and remove the auxiliary members' belt (3) from alternator (8), water pump (6), fan control pulley (2), crankshaft pulley with damper (5) and fixed guide roller (4).
- Replace the worn belt (3) with new one.
- Fit the auxiliary members' belt (3) on the pulleys and guide roller.
- Use the appropriate tool on the automatic belt tensioner (1) in order to fit the new belt (3) in the operating position.
- Additional adjustments are not required. The belt (3) tension is adjusted automatically by the calibrated spring in the automatic belt tensioner (1).
- Operate the engine for a few hours and check that the auxiliary members' belt (3) is properly fitted.



18 257 N

Safety notes - Clean the heat exchanger (radiator)



General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.



Risk of injury.
Use suitable PPE (gloves, safety shoes, goggles, etc.).
Failure to observe these instructions could cause serious health risks.



Risk of burns.
Only carry out the following operation when the engine parts have cooled down.
Failure to comply with these indications could result in death or serious injury.



Risk of injury.

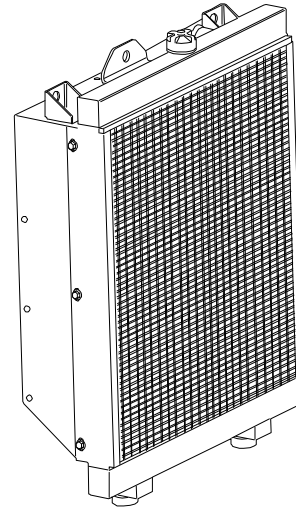
When the engine is hot, the pressure inside cooling circuits is such that it may expel the hot liquid in an extremely violent manner with the risk of burns. Only open the coolant tank filler cap when the engine is cold.

Failure to observe these instructions could cause serious health risks.

Heat exchanger cleaning (radiator) (Supplied on demand)

Check that the air intake surfaces of the radiators are free of impurities (dust, mud, straw etc.).

Clean them if necessary using compressed air or steam.



13_068 N

Safety notes - Blow-by filter replacement



*General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.*



*General danger, general precautions.
Before performing the procedure, put on the appropriate personal protective equipment (especially protective gloves, ear protectors and glasses).
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.*

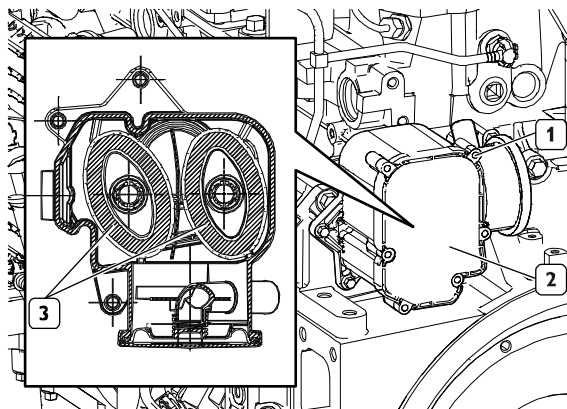


*Risk of burns.
Only carry out the following operation when the engine parts have cooled down.
Failure to comply with these indications could result in death or serious injury.*

Blow-by filter replacement

The blow-by filter has been developed and equipped for the collection, filtering and condense of the lubricating oil vapours. Only proceed with the engine stopped and at low temperature, in order to avoid the risk of burning.

- Unscrew the fastening screws (1) and remove the blow-by filter cover (2).
- Replace and install the two cartridge filters (3) included within the filter unit (2).
- Fit the blow-by filter cover (2) and tighten the fastening screws (1).



14 078 N

EXTRAORDINARY MAINTENANCE - HOW TO PROCEED

Turbocharger visual inspection

Only proceed when the engine is not turning over. Visually check that the turbine and compressor impellers and the relative inlet and outlet ducts are not obstructed or damaged, otherwise replace them.

Safety notes - Valves/rocker arm clearance adjustment



*General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.*



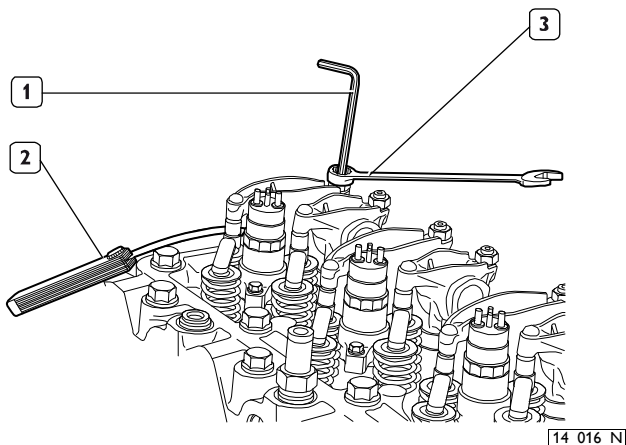
*General danger, general precautions.
Before performing the procedure, put on the appropriate personal protective equipment (especially protective gloves, ear protectors and glasses).
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.*



*Risk of burns.
Only carry out the following operation when the engine parts have cooled down.
Failure to comply with these indications could result in death or serious injury.*

Valves/rocker arm clearance adjustment

The adjustment of the clearance between the rocker arms and the intake and exhaust valve control rods must be strictly carried out using an Allen wrench (1), box-end wrench (3) and a feeler gauge (2).



The values to be checked are detailed below:

Intake valve: 0.25 ± 0.05 mm

Exhaust valve: 0.50 ± 0.05 mm

Safety notes - Change engine coolant



General danger, general precautions.
Before proceeding with the operation, please refer to the section "Warnings and safety instructions".
Failure to comply with these instructions can result in serious health risks and damage to the engine.



General danger, general precautions.
Before performing the procedure, put on the appropriate personal protective equipment (especially protective gloves, ear protectors and glasses).
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.



Risk of burns.
Open the filler cap of the coolant tank only if necessary and only when the engine is cold.
Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.



Risk of burns.

When the engine is hot, the pressure inside cooling circuits is such that it may expel the hot liquid in an extremely violent manner with the risk of burns.

Failure to observe the indications provided could cause serious personal injury and damage to the vehicle.



Risk of burns.

Only carry out the following operation when the engine parts have cooled down.

Failure to comply with these indications could result in death or serious injury.



General instructions.

Failure to observe the procedure described above will not guarantee the presence of the correct quantity of coolant in the engine.

Failure to observe this indication (fully or in part) can cause serious damage to the engine and can even, at times, invalidate the warranty.

Engine coolant replacement

Only proceed when the engine is not turning, and is at low temperature, so as not to run the risk of burns.

- Place a container for collecting coolant under the heat exchanger (radiator).
- Remove the pressurization cap from the expansion tank.
- Loosen the retaining elements and remove the sleeves connecting the engine cooling circuit to the heat exchanger.
- Drain the coolant from the heat exchanger (radiator) and wait until it is completely empty.
- Once emptied, refit the cooling circuit making sure the sleeves are perfectly sealed.
- Refill the engine and the heat exchanger until the cooling circuit has been completely refilled with fluids, as contained in the REFILLING table. Do not fill the expansion tank to the brim.
- With the coolant cap open, start the engine and let it idle for approx. one minute. This helps to completely bleed the air contained in the cooling circuit.
- Stop the engine and top up with more coolant, if necessary.
- When the engine is cold, make sure that the coolant in the expansion tank is a few centimetres below the filling hole.

In the event of an externally located level indicator as regards the heat exchangers, proceed with the top up operation by making sure that

the coolant does not overflow the internal volume of the exchanger in order to allow the expansion of coolant volume during increases in temperature.

ENGINE HANDLING

The engine must only be removed and installed by authorised Service Centre personnel.

For lifting only the engine use the eyelets indicated in this manual in the chapter ENGINE TECHNICAL DATA and marked on the engine with specific plates.

It must be hoisted using a rocker arm that keeps the wire cables that support the engine parallel, using all the provided eyelets at the same time; The use of a lower number of lifting eyelets is not permitted.

The capacity and dimensions of the engine hoisting system must be suitable for the engine weight and dimensions; make sure there is no interference between the hoisting system and the engine components. Do not hoist the engine before removing the transmission components coupled to it.

DISPOSAL OF WASTE

The engine consists of parts and elements that can cause ecological damage if disposed of in the environment.

The materials listed below must be delivered to authorised collection centres:

- Starter batteries.
- Spent lubricant oils.
- Water and antifreeze mixtures.
- Filters.
- Auxiliary cleaning material (e.g. rags soaked in or moistened with fuel).

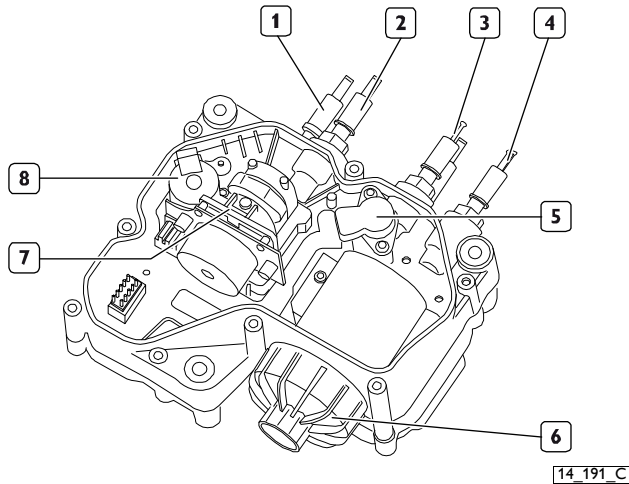
Laws in force in various Countries provide for severe penalties to offenders.

SCHEDULED MAINTENANCE FOR THE ATS SYSTEM - HOW TO PROCEED

Change Supply Module main-filter

To prevent damage to the pump and dosing module, the supply module contains a filter which removes any impurities from the AdBlue.

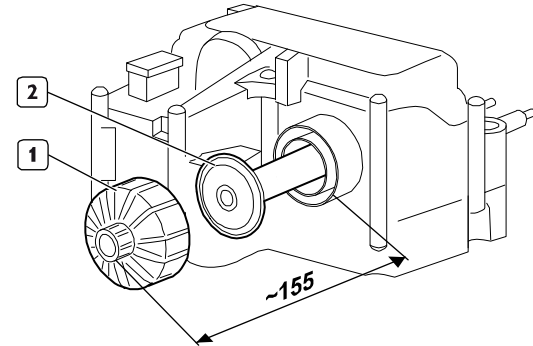
Please refer to the following procedure for replacement of the filter.



1. Coolant connector - 2. AdBlue inlet from tank - 3. AdBlue back-flow to tank - 4. AdBlue outlet to Dosing Module - 5. Pressure sensor - 6. Supply Module main-filter - 7. Membrane pump - 8. 4/2 Way valve.

Filter disassembly

- ❑ Unscrew and remove the filter cover (1).
- ❑ Remove the equalizing element (2).

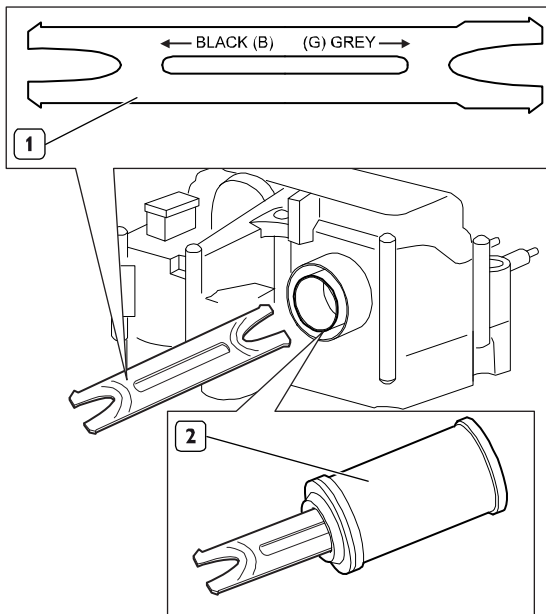


14_188_C



During installation of the supply module on the equipment, take into account the minimum aperture for filter replacement.
The minimum value is approx. 155 mm.

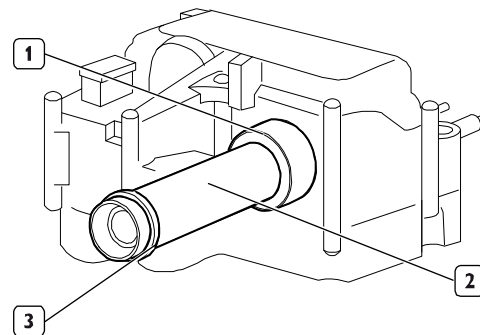
- ❑ Insert the appropriate tool (1) in the correct direction in the filter, based on the colour of the filter supplied.
- ❑ Insert the appropriate tool (1) until a click is felt which indicates the complete engagement of the filter (2).
- ❑ Remove the filter (2).



14_189 C

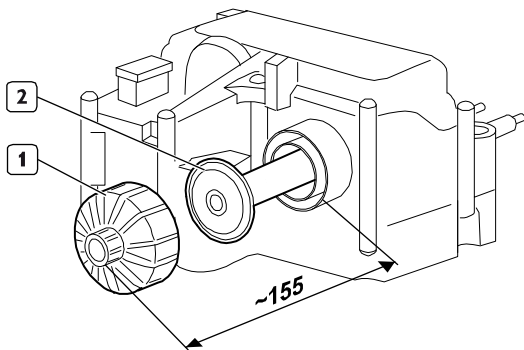
Filter assembly

- ❑ Carefully clean with water the contact surface (1).
- ❑ Oil gasket (3) and assembly the new filter (2).



14_190 C

- ❑ Assemble a new equalizing element (2).
- ❑ Carefully clean the filter cover (1).
- ❑ Tighten the filter cover (1) to a torque of 20 ± 5 Nm.



14 188 C



Check that the filter cover and the contact surface of the supply module are not cracked or damaged. If necessary, replace any damaged components.

■ LONG PERIODS OF INACTIVITY

PREPARING THE ENGINE FOR A LONG PERIOD OF INACTIVITY

In order to prevent oxidation of the internal parts of the engine and of certain components in the injection system, when the engine is expected to be inoperative for periods of more than two months, the following operations must be carried out in preparation for this:

1. Drain the lubricant from the sump, after first warming up the engine.
2. Fill the engine with protective oil (complying with MIL-L-2160B type 2 / ISO 3498/6743-4 HM standard), up to the "minimum" level indicated on the dipstick. Start the engine and keep it running for approximately 5 minutes.
3. Drain the fuel from the injection circuit, from the filter and from the injection pump pipes.
4. Connect the fuel circuit to a tank containing CFB (ISO 4113) protective fluid, and feed in the fluid by putting the circuit under pressure and running the engine for approximately 2 minutes, after first disabling the injection system. This operation can be performed by polarising terminal 50 of the starter motor with a positive voltage equivalent to the rated voltage of the system, using a conductor provided for that purpose.
5. Nebulise approximately 45 g protective oil (10 g per litre displacement) into the air inlet manifold, during the pressurised filling operation described in the previous point.
6. Close all the suction, delivery, ventilation and bleeder openings in the engine with suitable plugs, or seal them with adhesive tape.

7. Drain the residual protective oil from the sump. This oil can be used again for a further 2 preparation operations.
8. Fit signs reading "ENGINE WITHOUT OIL" to the engine and to the on-board control panel.
9. Drain the coolant, if it has not been mixed with suitable antifreeze and corrosion inhibitors, and affix a sign to indicate the fact.

In the event of prolonged inactivity, the operations described must be repeated every 6 months, following the procedure given below:

- A) drain the 30/M protective oil from the sump;
- B) repeat the operations described from point 2 to point 7.

Should you intend to protect external parts of the engine, proceed by spraying anti oxidation (Anticorit) protective liquid on unpainted metal parts, such as the flywheel, pulleys and the like, avoiding belts, connector cables and electrical equipment.

Protect the connectors and electrical connections with VCI spray. Wrap the Engine in VCI bag with hygroscopic salt bags.

RESTARTING THE ENGINE AFTER A LONG PERIOD OF INACTIVITY

1. Drain the residual protective oil from the sump.
2. Fill the engine, as prescribed, with lubricant of the type and amount indicated in the REFILLING table.
3. Drain the CFB protective fluid from the fuel circuit, carrying out this operation as indicated under point 3 of PREPARING THE ENGINE FOR A LONG PERIOD OF INACTIVITY.
4. Remove the plugs and/or seals from the suction, delivery, ventilation and bleeder openings in the engine, restoring it to a normal state of use. Connect the turbocharger suction inlet to the air filter.
5. Connect the fuel circuits to the machine's fuel tank, completing the operations as indicated in point 4 of PREPARING THE ENGINE FOR A LONG PERIOD OF INACTIVITY. During filling operations, connect the fuel return pipe to a collection tank, so as to prevent any residual CFB protective fluid from flowing into the machine's fuel tank.
6. Check the engine and fill it up with coolant as prescribed.
7. Start the engine and keep it running until the idling speed rate has stabilised completely.
8. Check that the instruments on the on-board control panel/s are showing plausible values, and that no alarms are shown.
9. Stop the engine.
10. Remove the "ENGINE WITHOUT OIL" signs from the engine.

■ ENGINE MALFUNCTIONS

The electronic unit overseeing management and control of all operation of the engine is capable of recognising any malfunctions that may occur, and of adopting strategies that will allow you to proceed in full safety.

The event, signalled by light-up of the EDC MALFUNCTION indicator on the on-board control panels, results in programmed limitation of power within certain thresholds, set according to the severity of the case.

In the case of temporary malfunctions the reduction in performance will remain in force until the engine is stopped.

■ BEHAVIOUR IN EMERGENCY

The user of a machine that has been constructed according to safety regulations, when following the instructions provided in this manual and the indications given on the engine labels, will be working in safe conditions.

Should improper conduct result in accidents, always request the intervention of trained first aid specialists immediately.

In an emergency and while awaiting the arrival of first aid specialists, follow the instructions given below.

In case of fire

Extinguish the fire using the fire-fighting equipment foreseen, and in the manner indicated by Fire prevention authorities (fire-fighting equipment for certain machines and equipment is compulsory under current safety legislation).

Burns and scalds

- ❑ Extinguish any flames on the burned person's clothing, by:
 - throwing water over them;
 - using a powder fire-extinguisher, without directing the jet at the person's face;
 - covering with blankets or rolling the victim on the ground.
- ❑ Do not attempt to remove pieces of clothing that may have stuck to the skin;
- ❑ In the case of scalding, immediately but carefully remove any clothing that may be soaked in the hot liquid;

- ❑ Cover the burn with a special burn dressing or sterile bandage.

Carbon monoxide intoxication (CO)

Carbon monoxide from the engine exhaust is without smell, and is dangerous both because it causes intoxication, and because when combined with air it forms an explosive mixture.

In closed rooms, carbon monoxide is extremely dangerous, as it can reach critical concentrations within a very short time.

When assisting an intoxicated person in a closed room:

- ❑ Ventilate the room immediately, to reduce the concentration of gas.
- ❑ When entering the room, hold your breath, do not light flames, lights or ring electric doorbells or phones, to avoid the risk of explosion.
- ❑ Carry the intoxicated person out into the fresh air or into a well ventilated room, resting him on one side if he is unconscious.

Electrocution

The engine 12 V electrical system does not involve the risk of electrocution, however, in the event of a short-circuit caused, for example, by a metal tool, there is a risk of burning due to overheating of the object through which the electrical current runs. In these circumstances:

- ❑ Remove the object that caused the short-circuit, using means that provide sufficient heat insulation.
- ❑ Switch off the power at the main switch, if there is one.

Injuries and fractures

The vast number of possible circumstances and the specific nature of operations required means that the intervention of a medical team is necessary.

- ❑ In the event of bleeding, keep the edges of the wound pressed together until help arrives.
- ❑ If there is any suspicion of a fracture, do not move the injured part and only move the patient if absolutely necessary.

Caustic burns

Caustic skin burns are caused by contact with extremely acid or alkaline substances.

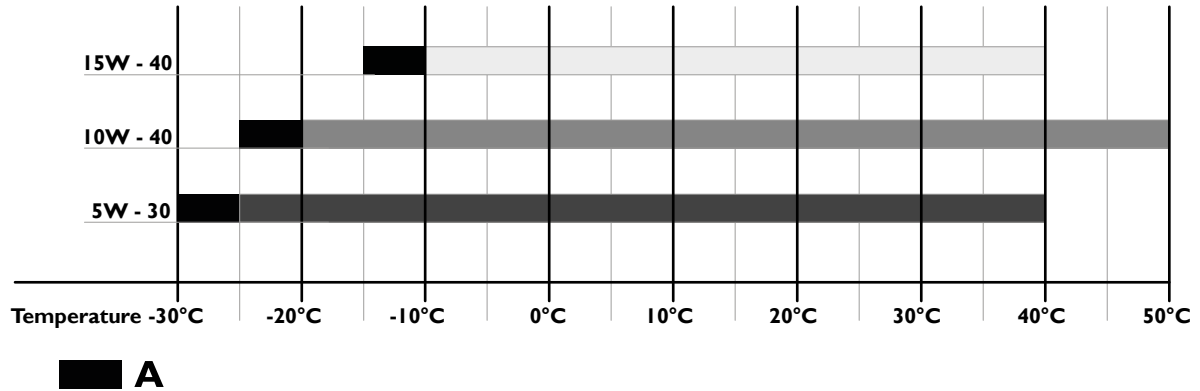
For electric maintenance technicians these are typically caused by acid from batteries; in these circumstances, proceed as follows:

- ❑ Remove any clothing soaked in the caustic substance.
- ❑ Wash the area with lots of running water, avoiding parts that have not been burned.

If either battery acid, lubricants or diesel come into contact with the eyes: wash the eyes with water for at least 20 minutes, keeping the eyelids open so that the water flows over the eyeball (move the eye in all directions to wash more thoroughly).

RECOMMENDED OPERATING TEMPERATURE RANGE

The use of viscosity grade to be used depends on the ambient temperature, as shown in the figure below



17 076 N

A: Engine oil pan or coolant block heater recommended in this range

Note: Cold startability is strongly related to the Diesel fuel quality