

USE AND MAINTENANCE
N45AM2 Бриз Моторс

NEF SERIES

N45AM2 Бриз Моторс
G-DRIVE ENGINES

N45AM2 Бриз Моторс



ENGINE TECHNICAL DATA NEF45AM2.S500

The technical code and serial number are specified on the nameplate positioned on different parts of the engine, depending on the model: flywheel case, tappet cover, coolant tank, etc.

Code	NEF45AM2.S500
Engine family	F4
Cycle	4-stroke diesel
Number and arrangement of cylinders	4, in line
Bore x stroke	104 x 132 mm
Total displacement	4,500 cm ³
Air system	Natural
Injection type	Direct injection with rotary pump
Compression ratio	17,5:1
Cooling	Liquid
Engine direction of rotation	Anticlockwise (seen from flywheel side)
Control system	Mechanical
Dry weight	~400 kg (G-Drive)

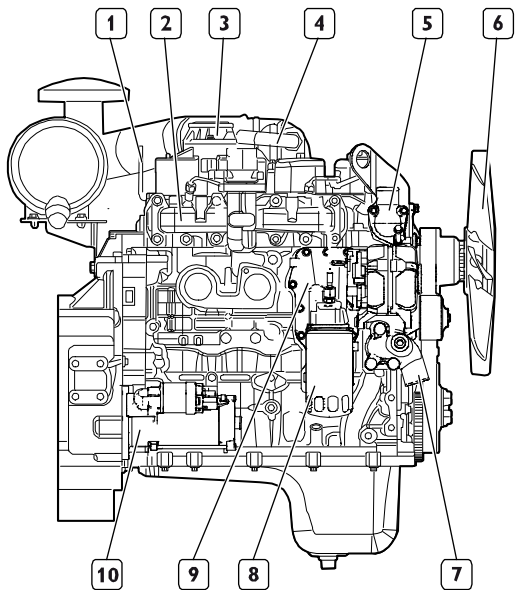
Electrical system	12 V
Battery capacity	100 Ah
Pick-up current	60 A
Maximum input	3 kW
Discharge current (EN 50342)	650 A

Performance (*)	NEF45SM3.S500	
Without emissions certificate	50 Hz 60 Hz	Prime 45 kWm @ 1.500 rpm Stand-by 49,7 kWm @ 1.500 rpm Prime - kWm @ 1.800 rpm Stand-by - kWm @ 1.800 rpm
Engine idle speed unladen	50 Hz 60 Hz	1.500 rpm - rpm
Maximum engine rpm unladen	50 Hz 60 Hz	1.570 rpm - rpm



It is strictly forbidden to alter the aforesaid characteristics and, in particular, to modify the calibration of the injection pump or the characteristics of the engine and its components. Failure to comply with the above shall result in the loss of warranty, in addition to FPT declining all responsibility.

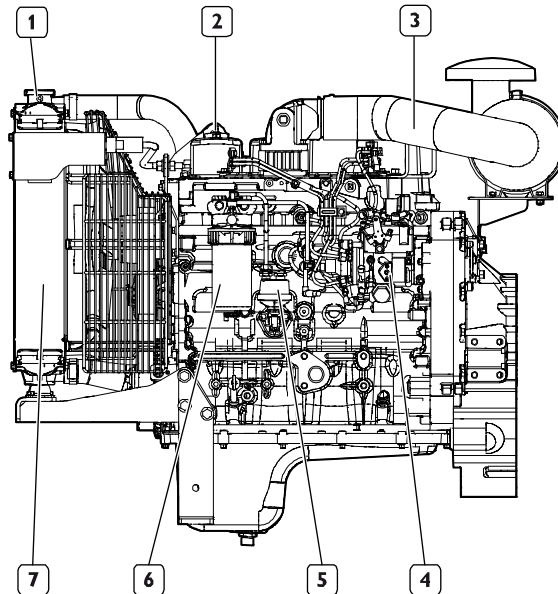
(*) Net power at the flywheel in accordance with the standard ISO 8528. Test conditions: T 25 °C; atmospheric pressure 100 kPa; relative humidity 30%.



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NEF45AM2.S500

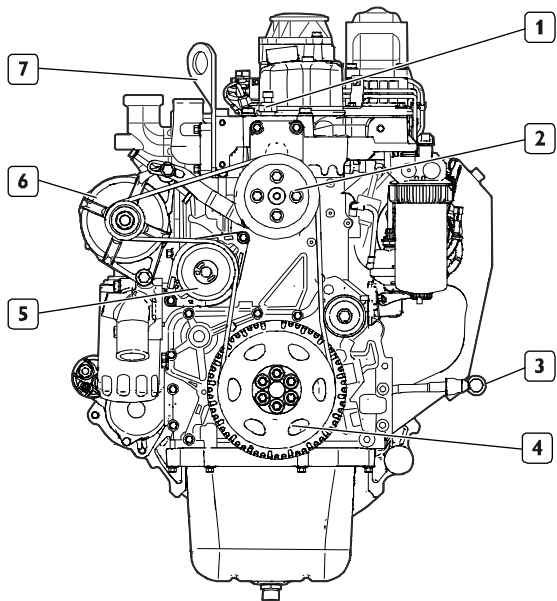
1. Lifting eyelet - 2. Exhaust manifold - 3. Regulator valve (blow-by) - 4. Oil vapour breather pipe - 5. Engine coolant outlet pipe - 6. Fan (radiator) - 7. Engine coolant inlet pipe - 8. Oil filter - 9. Heat exchanger lubricant oil / coolant - 10. Electric starter motor



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NEF45AM2.S500

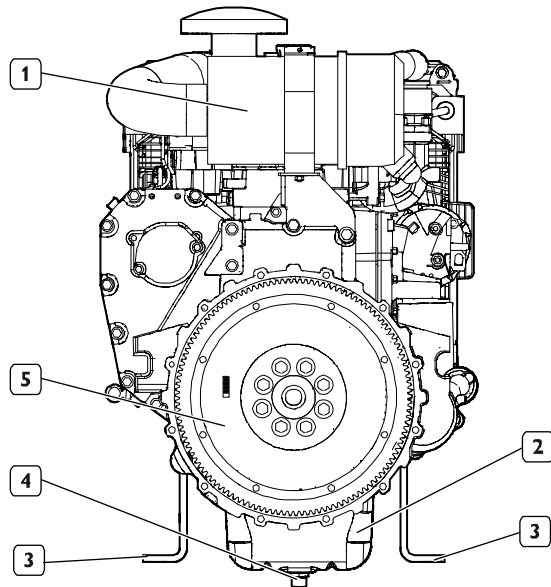
1. Coolant inlet plug - 2. Lubricant oil filler cap - 3. Comburent air intake duct to engine - 4. Rotary fuel supply pump - 5. Fuel suction pump - 6. Fuel filter - 7. Heat exchanger external air / coolant



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NEF45AM2.S500

1. Coolant temperature sensor – 2. Fan control pulley - 3. Oil level dipstick – 4. Crankshaft pulley - 5. Water pump – 6. Alternator - 7. Lifting eyelet



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NEF45AM2.S500

1. Air filter - 2. Oil sump - 3. Engine mounts - 4. Lubricant oil drain plug - 5. Engine flywheel

SIGNS

Certain warning signs are affixed to the engine by the Manufacturer, and their meanings are indicated below.

N.B. The signs with an exclamation mark on them underline a potential **danger**.



Lifting point (engine only).



Fuel Cap
(on the fuel tank, if there is one).



Oil Cap.



Oil dipstick.



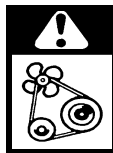
Danger of burning:
Expulsion of hot water under pressure.



Danger of burning:
Presence of high temperature parts.



Danger of fire:
Fuel present.



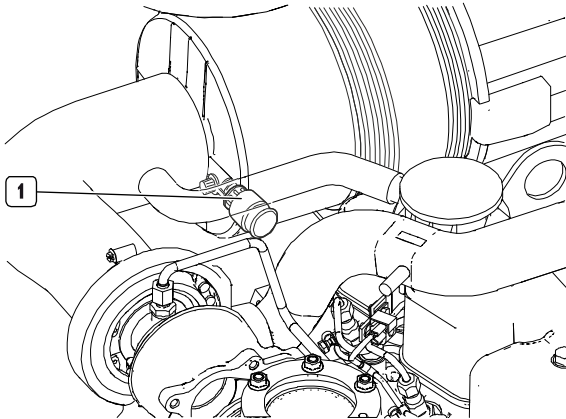
Danger of impact or catching
on moving parts:
Presence of fans, pulleys, belts or the like.

■ USE

PRELIMINARY CHECKS

Before starting the engine each time:

- ❑ Check the level of technical fluids (fuel, engine oil and coolant), and top-up if necessary.
- ❑ Make sure that the air intake filter is not obstructed or clogged and check, at the same time, that the visual indicator (1) on the filter is not showing the "red" signal. The air filter clogging visual indicator (1) signals when it is necessary to carry out maintenance in order to protect and optimize filter operation. The sensor (1) remains locked in the alarm position ("red") until it is reset.



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Note: The procedures required to clean the filter are indicated in the chapter CONTROLS AND MAINTENANCE.

CAUTION!



Make sure that no combustible vapours or gasses are present in the area in which the engine is to operate. Ensure that closed areas are adequately ventilated and fitted with a suitable exhaust extraction system.

ENGINE PRE-HEATING (optional)

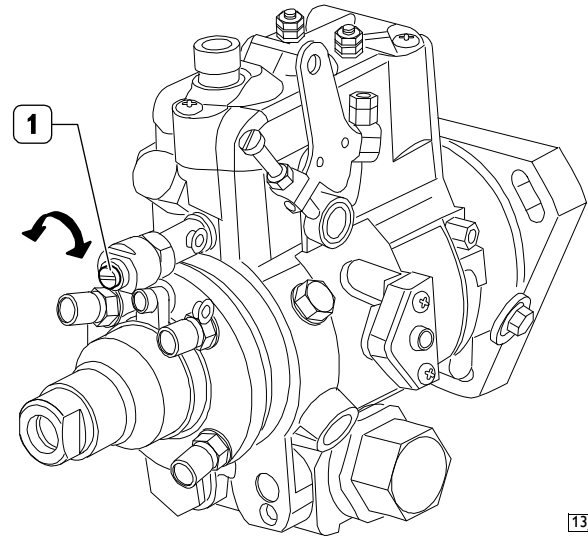
The engines which require low start-up temperatures and an immediate delivery of power may be equipped with an electrical heating device enabling an increase in the temperature of the air entering the engine. The device is mounted on the intake manifold and is fitted with a coolant temperature sensor which interrupts the power supply once the required temperature has been reached.

SWITCHING OF OPERATING FREQUENCY

Based on the specific operational requirements of the engine, it is possible to vary the adjustment of the rotary injection pump so as to obtain a different operating frequency:

- 1,500 rpm @ 50 Hz
- 1,800 rpm @ 60 Hz

To switch from 50 Hz to 60 Hz it is necessary to turn the adjustment screw (1) of the "droop setting", clockwise a number of turns depending on the identification code of the pump indicated on the nameplate.



13_066_N

FOR PROPER USE OF THE ENGINE

- ❑ Before starting the engine, check there is enough fuel in the fuel tank.
- ❑ Do not keep on starting.
- ❑ Do not idle for long periods since this increases the production of harmful emissions from the engine and does not guarantee its optimum performance.
- ❑ The engine speed must be increased and decreased gradually so as to permit normal combustion and the optimum functioning of all engine components.
- ❑ During use, check periodically that:
 - the temperature of the engine coolant does not reach the alarm thresholds;
 - the oil pressure remains within normal values.
- ❑ Actual power values must comply with the rated values reported in the technical documentation.
- ❑ Particular attention must be drawn on emergency power unit engines, which must be submitted to frequent overhauls in order to ensure their prompt start whenever required.

SPECIAL WARNINGS

High coolant temperature

In the event of an excessive temperature or the signalling of the alarm, disengage the load and stop the engine in order to check the condition of the cooling circuit.

Moreover, check the following:

- ❑ tension of ancillary belt;
- ❑ the thermostatic valve's efficiency;
- ❑ the conditions of the heat exchanger (to be cleaned if necessary).

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.

Low lubricant oil pressure

Should the pressure indicated by the instrument be considered insufficient or if the "low oil pressure" warning light comes on, stop the engine and check the oil level. If necessary, top up the oil according to the instructions contained in the section CHECKS AND MAINTENANCE. If the fault persists, contact a Service centre.

Presence of water in the fuel filter

It is advisable to drain the water from the filters before the relevant warning light comes on.

Avoid using the engine with only a small reserve of fuel in the fuel tank; this encourages the formation of condensation and makes it more likely you will suck up dirt or air, resulting in engine stoppage.



Refuelling from drums or jerry cans may contaminate the diesel, resulting in problems with the fuel supply system; in these cases it is necessary to carry out adequate filtration or sedimentation of any impurities present.

CAUTION!



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

Intake and exhaust circuit inefficiencies

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 used.

In particularly dusty environments it is necessary to carry out maintenance at more frequent intervals than indicated in the chapter CONTROLS AND MAINTENANCE.

CAUTION!



Visually check that the exhaust circuit is not blocked or damaged, so as to prevent dangerous fumes.

Electrical start-up system irregularities

Periodically check, particularly during the winter, to ensure that the batteries are clean and in full working order, checking and topping up as indicated in the chapter CONTROLS AND MAINTENANCE.

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



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), or 22 V (for 24 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.

Battery or alternator recharging faults

Periodically check or have someone check the cleanliness, wear and full tensioning of the drive belt.

CAUTION!



The ancillary members are located under protective grilles. Their removal must be carried out only when the engine is not turning.

RUNNING IN

Thanks to modern engine construction technology, no particular running in procedure is required. However, it is recommended that, for the first 50 hours, you do not use the engine at high power for long periods.

REFUELLING

NEF45SM3.S500 / NEF45AM2.S500

Parts to be supplied	litres (kg)	
Cooling circuit ⁽¹⁾	engine ⁽⁴⁾	8,5
	G-Drive ⁽⁵⁾	18,5
Lubrication circuit ^{(2) (3)}	12.8 (11.8)	
Periodic changing:		
oil sump at minimum level	5.5 (5.1)	
oil sump at maximum level	8.5 (7.8)	

- (1) Use a 50% mixture of water and PARAFU 11 or the equivalent corresponding to the specification SAE J1034.
- (2) Use lubricants which meet the international standards ACEA E5-E7 (high power engines). The oil used is considered to be acceptable until a quantity equalling 0.1% of fuel consumption is reached.
- (3) The quantities indicated relate to the first refuel only and are relative to the engine, oil sump and filter filling.
- (4) The quantities indicated only relate to the engine in its standard configuration.
- (5) The quantities indicated relate to the total capacity of the generating set including the engine capacity, the radiator and the pipes.

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 EN 590 standard normally commercially available. Fuel additives are not recommended. Use of additives can limit the guarantee performance offered for the vehicle.

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.

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.

■ CONTROLS 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 they must be carried out by special technicians, as indicated below.

- Checks to be made during periods of use:** by workshop technicians or the machine user if necessary.
- Periodic maintenance:** by qualified personnel using suitable equipment and adequate means of protection.
- Special 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 and overalls.
- Never wear loose, flapping garments, rings, bracelets and/or necklaces in the vicinity of engines or moving parts.
- Always wear protective gloves and goggles when:
 - filling up batteries with acid solution
 - check cleanliness of battery clamps and terminals
 - refuelling 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).
- When working in the engine compartment, pay particular attention to how you move, to avoid contact with moving parts or high temperature components.
- Wear goggles and use high pressure 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 head-height.
- Use protective hand cream.
- Immediately replace wet overalls.
- Always keep the engine clean, removing oil, grease and coolant stains.
- Store cloths in flame-proof containers.
- Do not leave foreign bodies on the engine.
- Use suitable, safe containers for used oil.
- When completing a repair, make suitable provisions to stop the engine taking in air if, after start-up, an uncontrolled increase in engine speed were to occur.



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.



The conditions provoking the emergency power unit start may suddenly occur. Whenever executing checks and maintenance operations, strictly follow the safety instructions prescribed by the unit's Manufacturer and power unit system's outfitter to operate safely and prevent injury.

FREQUENCY

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Controls when in use	Frequency
Check oil level in engine	Daily
Check engine coolant level	Daily
Check cleanliness of the heat exchanger	Daily
Check that the air filter is clean	300 hours ⁽²⁾ ⁽⁴⁾
Inspection of the exhaust duct/s	Daily
Check tightening and cleanliness of battery clamps	Six-months
Check electrolyte level of the batteries	Six-months

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.



Planned maintenance

Frequency

Engine lubricant oil change	800 hours ⁽³⁾ ⁽⁴⁾
Change oil filter	800 hours ⁽³⁾ ⁽⁴⁾ ⁽⁵⁾
Change fuel filter	600 hours ⁽¹⁾ ⁽⁴⁾ ⁽⁵⁾
Drain water from the fuel pre-filter	300 hours ⁽¹⁾
Drainage/suction of water, condensation and impurities from the fuel tank/s	300 hours ⁽¹⁾
Check tension and condition of ancillary belt	300 hours
Change engine coolant	1200 hours / 2 years
Change air filter	1200 hours / 2 years ⁽²⁾



Special maintenance

Frequency

Change ancillary belt	1200 hours / 3 years
Turbocharger visual inspection	1200 hours
Clean heat exchanger	1200 hours
Injector calibration	1800 hours
Adjust play in valves-rocker arms	3000 hours

- 1) Maximum period relating to the use of high quality fuel, (specification EN 590); this is reduced, basing on fuel contamination and alarm signals caused by filter clogging and/or the presence of water in the filter. The filter clogging signal indicates that the filter must be replaced. If the warning light of water present in the filter does not go off after drainage, then the filter must be replaced.
- 2) The frequency depends on the ambient conditions and product efficiency/wear. After long periods of engine inactivity, perform the check before starting the engine.
The filter clogging signal indicates that the filter must be replaced.
- 3) The frequencies are applicable for lubricants which meet the international standards ACEA E5-E7 (high power engines).
- 4) To be performed every year even if the specified operating hours interval has not been reached.
- 5) Only use filters with the following specifications:
 - degree of filtering < 12 μm
 - filtering efficiency 99.5% ($\beta > 200$).



In the event in which fuel is used with a sulphur percentage greater than 0.5%, or oils are used which do not meet the specifications in the section FLUIDS, then the replacement frequencies of the engine oil, engine oil filter and blow-by filter must be halved, or suitably adjusted, in accordance with the use and operating conditions of the engine; please consult the personnel in charge of maintenance operations for appropriate advice.



The operations described above require the use of specific tools which guarantee safe and effective results.

It is recommended that such operations are carried out by qualified personnel of the FPT Technical Service Network.

The unscheduled maintenance operations described in the relative table are under the exclusive responsibility of qualified personnel in possession of suitable technical information and equipped with suitable work tools and protective devices. The instructions for their fulfilment are contained in the FPT technical and repair manuals.

REQUIREMENTS

- Do not disconnect the batteries with the engine running.
- Do not carry out arc welding operations in the vicinity of the engine without first removing electrical cables.
- After each maintenance operation involving disconnection of the battery/batteries, make sure that the terminals have been properly locked onto the poles.
- Do not use battery chargers to start the engine.
- Do not paint the appliances, components and electrical connectors equipping the engine.
- Disconnect the battery/batteries before any electrical operations.
- Contact the Manufacturer before installing electronic equipment.



*Do not execute any operation which may change the ignition pump's calibration.
The ignition pump's calibration has been carried out in phase of engine system test based on its final use or destination.*

CHECKS TO BE MADE DURING PERIODS OF USE - HOW TO PROCEED

Check oil level in engine

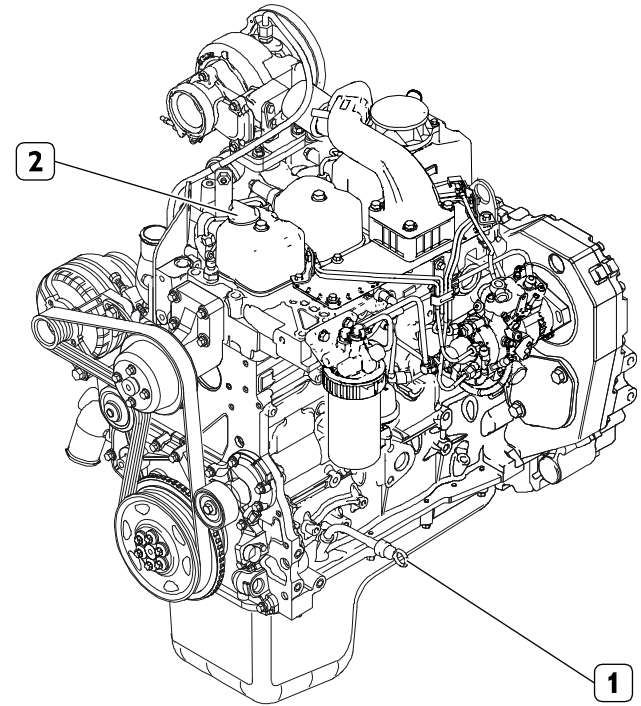
Only proceed with the engine stopped and at a low temperature, so as to avoid the risk of burning.

- ❑ Use the oil dipstick (1) to check that the lubricant oil level is between the "Min" and "Max" limits.
- ❑ If the level is insufficient, it is necessary to top up with lubricant oil which meets the international specifications ACEA E5-E7 (high power engines), as indicated in the section FLUIDS: remove the lubricant oil cap (2) and pour engine lubricant oil through the hole.
- ❑ Use the oil dipstick (1) to check that the lubricant oil level does not exceed the "Max" limit.



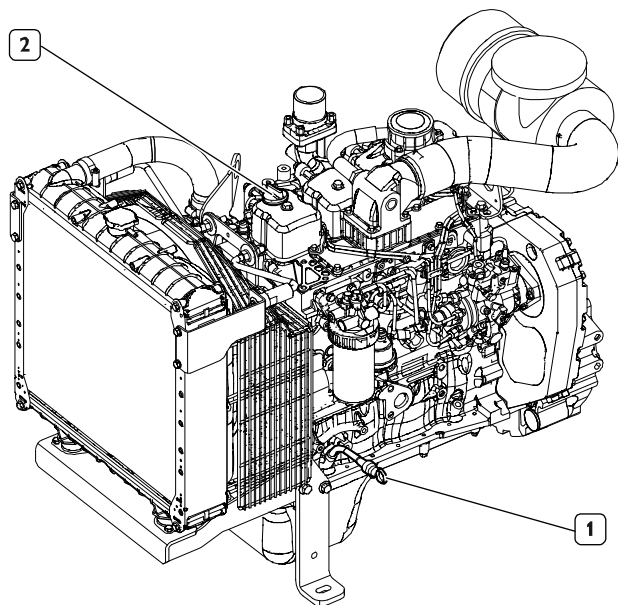
Make sure that the oil dipstick is fully inserted and that the oil filler cap is fully tightened in a clockwise direction.

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Check engine coolant level

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

- 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 a mixture of 50% water and PARAFLU 11, as contained in the section FLUIDS. 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.



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

CAUTION!

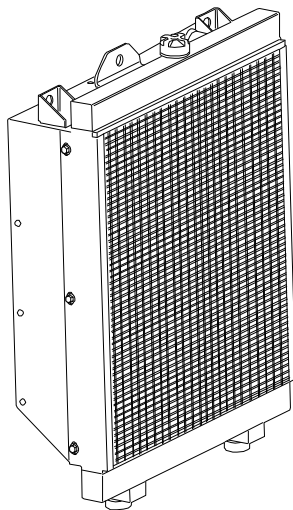


When the engine is hot, pressure builds up in the cooling circuits which may eject hot liquid violently, resulting in a risk of burns.
Open the filler cap of the coolant tank only if necessary and only when the engine is cold.

Check cleanliness of the heat exchanger

Check that the radiator air inlets are free from dirt (dust, mud, straw, etc.).

Clean them if necessary, using compressed air or steam.



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Check cleanliness of the air filter

Only proceed with the engine stopped.

- Remove the cover (3) of the air filter after having undone the two quick release catches (2).
- Remove the filter element (1); make sure that dust does not enter the sleeve during this operation.
- Make sure there are no impurities. Otherwise, clean the filter element according to the instructions provided below.
- Blow dehumidified compressed air onto the filter element, working from the inside outwards (maximum pressure 200 kPa).
- Check the condition of the air filter before refitting it. Replace it if broken or torn.
- Check the condition of the gasket at its base.
- Position the filter element (1) in its seat.
- Replace the cover (3) of the air filter and lock it using the two quick release catches (2).

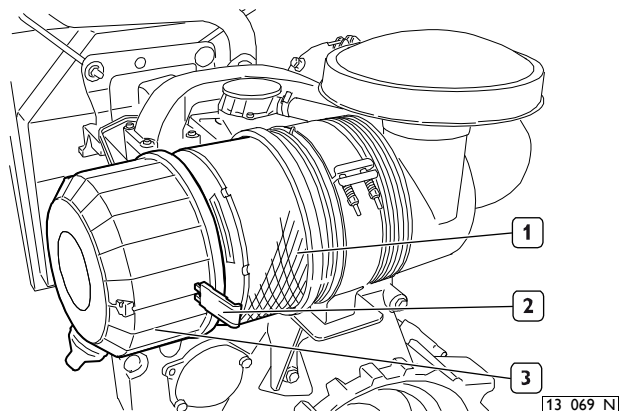


Do not use detergents or diesel to clean the air filter. Never strike the filter element with tools. The imprecise assembly of the air filter may result in the intake of unfiltered air and therefore cause serious damage to the engine.

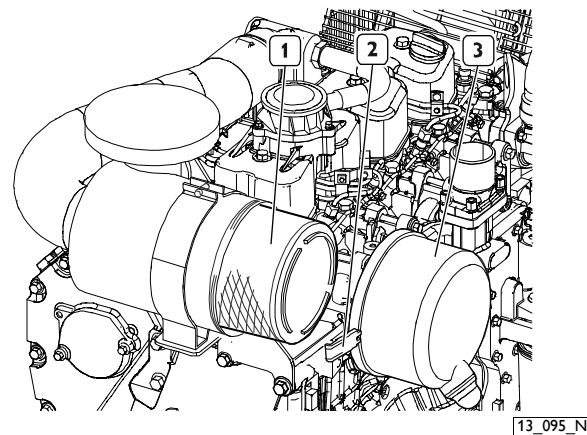


The use of compressed air makes it necessary to use suitable protective equipment for the hands, face and eyes. Please see the prescriptions in the paragraph on ACCIDENT PREVENTION.

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Inspection of the exhaust duct/s

Visually check that the exhaust gas / exhaust system is not obstructed or damaged.

- Make sure that there is no danger from harmful fumes in the environment where the engine is being worked on. Contact the manufacturer if necessary.

Check tightening and cleanliness of battery clamps

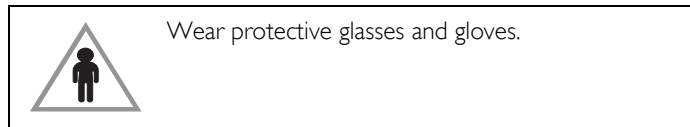
Check that the battery terminals and cable clamps are clean, well tightened and protected by Vaseline.

In the event of dirty cable clamps and battery terminals:

- ❑ Loosen the nut and remove the clamp from the negative terminal (indicated by the "-").
- ❑ Loosen the nut and remove the clamp from the positive terminal (indicated by the "+").
- ❑ Use a metal brush or fine grade emery paper to clean the cable clamps and battery terminals until they are shiny.
- ❑ Smear the cable clamps with Vaseline and insert them onto the battery terminals making sure that the positive pole is connected first, followed by the negative pole, and then tighten each clamp.

Check the cables and clamps for signs of wear and corrosion; replace them if in poor condition.

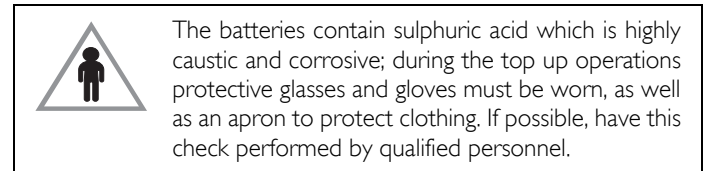
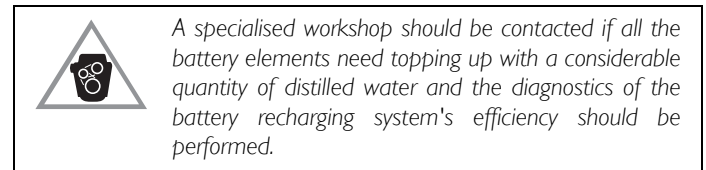
Visually check the condition of the battery: the terminals must not show signs of deterioration and the body must not be damaged, otherwise they should be replaced.



Check electrolyte level of the batteries

The batteries used are of reduced maintenance type. Therefore, under normal conditions of use, no top up of the electrolyte is required. However, the routine checking of the electrolyte level is recommended. Proceed after positioning the batteries on a horizontal surface.

- ❑ Visually check that the electrolyte level is between the "Min" and "Max" reference marks on the batteries; in the absence of any reference marks, make sure the liquid covers the lead plates contained in the elements by approx. 5 mm.
- ❑ Only use distilled water to top up the elements whose level is below the minimum.
- ❑ If the battery requires recharging, contact a specialised workshop.

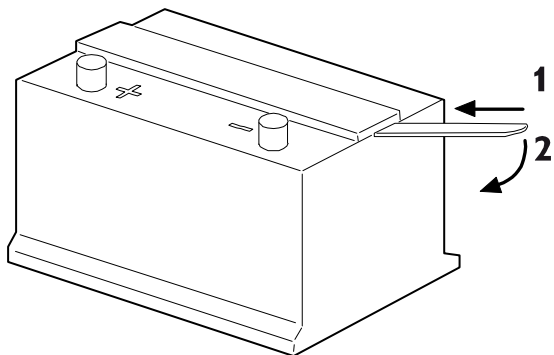


CAUTION!



During the checks do not smoke or allow naked flames near the batteries. Ensure that the work area is suitably ventilated.

Some batteries have a single cover for the inspection plugs. To access the elements, use a lever as shown in the figure.



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PERIODIC MAINTENANCE - HOW TO PROCEED

Engine lubricant oil change

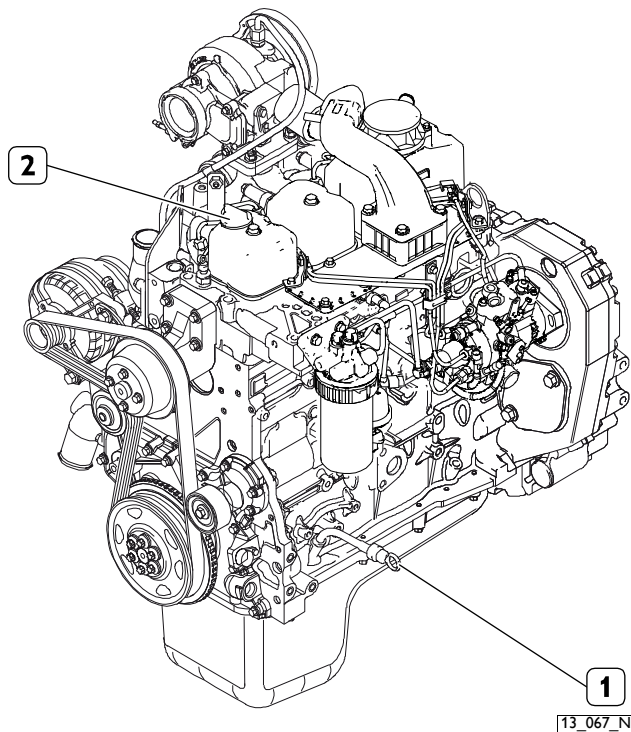
Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- Place a suitable container for collecting the spent oil under the oil sump next to the lubricant oil drain plug (see the figures in the section ENGINE TECHNICAL DATA).
- Unscrew the lubricant oil drain plug; afterwards extract the oil level dipstick (1) and remove the lubricant oil cap (2) to assist the flow of the engine lubricant oil.
- Wait until the oil sump has completely emptied, then retighten the lubricant oil drain plug.
- Proceed with the refilling operation through the hole situated on the tappet cover of cylinder no. 1, using lubricant oil that meets the international standards ACEA E5-E7 (high power engines), as indicated in the section FLUIDS.
- Use the oil dipstick (1) to check that the lubricant oil level does not exceed the "Max" limit.
- Retighten the lubricant oil cap (2).
- Together with the replacement of the engine lubricant oil it is necessary to replace the oil filter (see paragraph OIL FILTER REPLACEMENT).

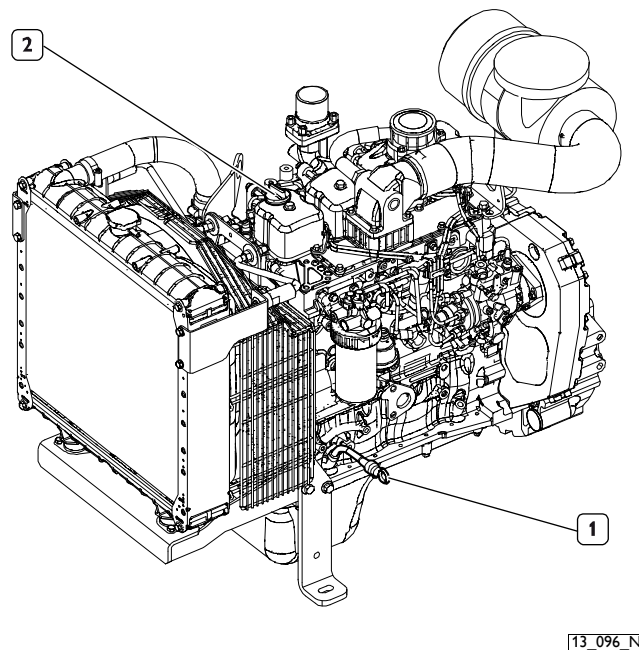


Eliminate the consumables and any materials in contact with them (for example, filters) in accordance with current regulations.
The FPT Technical Service Network workshops are equipped for this purpose.

NEF45SM3.S500



NEF45AM2.S500



Make sure that the oil dipstick is fully inserted and that the oil filler cap is fully tightened in a clockwise direction.



Make sure that the oil dipstick is fully inserted and that the oil filler cap is fully tightened in a clockwise direction.

Oil filter change

Only use filters with the following specifications (see the section FREQUENCIES):

- degree of filtering <math>< 12 \mu\text{m}</math>
- filtering efficiency 99.5% ($\beta > 200$).

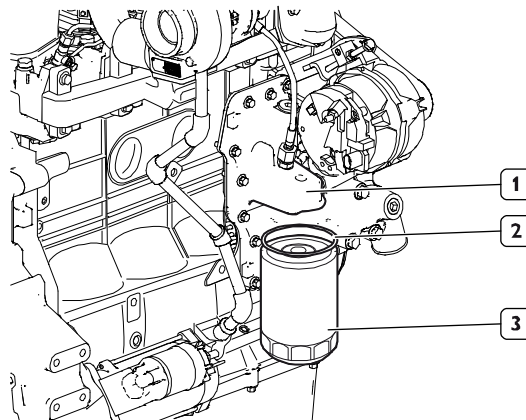
Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- ❑ Proceed with the emptying of the spent oil (see paragraph ENGINE LUBRICANT OIL CHANGE).
- ❑ Place a container for collecting the spent oil under the filter support (1).
- ❑ Remove the filter (3) by unscrewing it from its relative support.
- ❑ Replace the filter element and the O-ring seal (2) contained inside the filter (3).
- ❑ Carefully clean the surfaces of the support (1) in contact with the O-ring seal (2).
- ❑ Smear the O-ring seal (2) of the new filter with oil.
- ❑ Screw the new filter (3) onto the support (1).



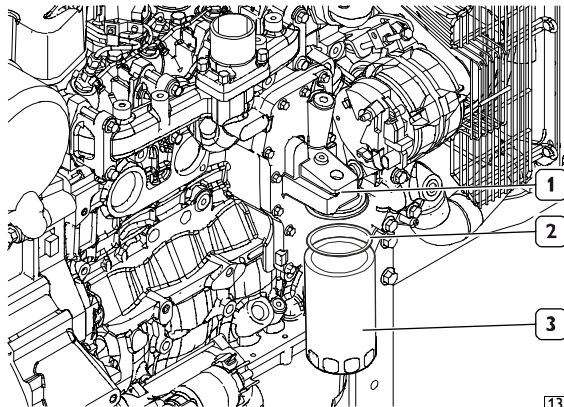
*Eliminate the consumables and any materials in contact with them (for example, filters) in accordance with current regulations.
The FPT Technical Service Network workshops are equipped for this purpose.*

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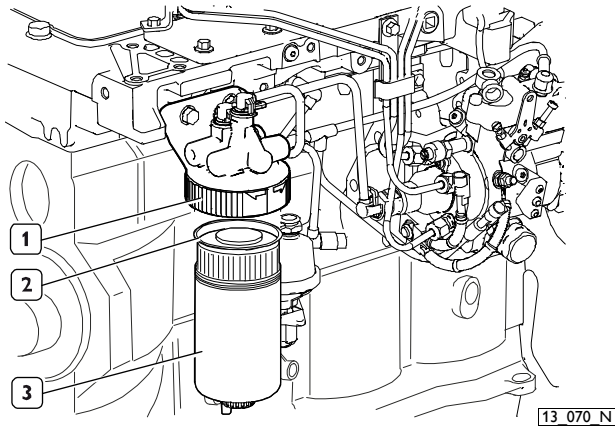
Fuel filter change

Only use filters with the following specifications (see the section FREQUENCIES):

- degree of filtering <math>< 12 \mu\text{m}</math>
- filtering efficiency 99.5% ($\beta > 200$).

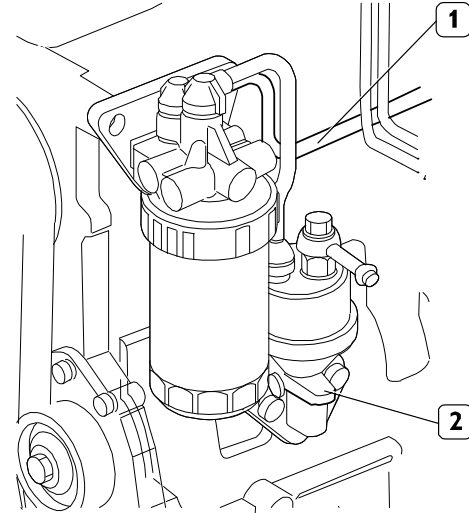
Only proceed when the engine is not turning and is at low temperature so as not to run the risk of burns.

- ❑ Place a container for collecting the diesel under the filter support (1).
- ❑ Remove the filter (3) by unscrewing it from its relative support.
- ❑ Replace the filter element and the O-ring seal (2) contained inside the filter (3).
- ❑ Carefully clean the surfaces of the support (1) in contact with the O-ring seal (2).
- ❑ Smear the O-ring seal (2) of the new filter with oil.
- ❑ Screw the new filter (3) onto the support (1).



Residual air bleeding procedure:

- ❑ Loosen the fuel outlet coupling (1) located on the top of the filter.
- ❑ Make sure that the discharge of diesel does not soil the ancillary belt and does not leak into the surroundings.
- ❑ Use the fuel suction pump (2) until the diesel coming out is free from any residual air.
- ❑ Correctly tighten the previously loosened coupling.
- ❑ Start the engine and let it run idle for a few minutes to remove any residual air.





Do not fill the new fuel filter before placing it on the support in order to prevent harmful impurities from entering the fuel circuit and the injection system.



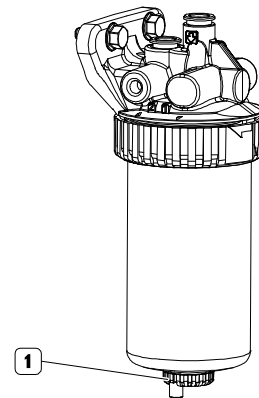
*Eliminate the consumables and any materials in contact with them (for example, filters) in accordance with current regulations.
The FPT Technical Service Network workshops are equipped for this purpose.*

Drain water from the fuel filter

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.

Only proceed when the engine is not turning over.

- Place a container for collecting liquids under the fuel filter.
- Unscrew the tap plug (1) 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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Drainage/suction of water, condensation and impurities from the fuel tank/s

Perform the drainage/suction of water, condensation and impurities from the fuel tank/s by following the instructions contained in the manual supplied by the tank manufacturer.

Proceed as necessary based on the structure or location of the tank; engines that operate in adverse environments and conditions and/or that are refuelled using drums or jerry cans, require more attention when cleaning the tank.

Check tension and condition of ancillary belt

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

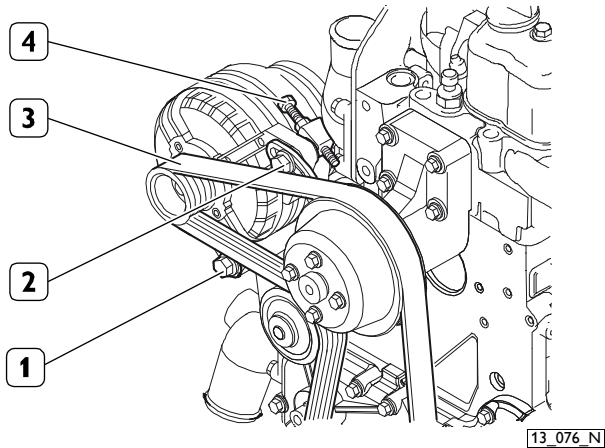
- ❑ Remove the protective grilles of the fan by undoing the relative fasteners.
- ❑ Check that the belt is free from tears, signs of wear or lubricant or fuel deposits. Replace if necessary (see paragraph ANCILLARY BELT REPLACEMENT).
- ❑ Use the appropriate tool to check the tension of the new ancillary belt at the intermediate point of the branch between the guide pulley and the fan control pulley. The correct tension must correspond to 245 ± 10 Hz ($1,200 \pm 100$ N). Should it prove necessary to reset the tension of the ancillary belt, proceed as follows:

Remove the fan together with spacer.

- Loosen the bolt (1) anchoring the alternator to its lower support and the screw (2) fastening the alternator to the bracket.
- Turn the adjustment screw (4) to tighten the ancillary belt (3), then tighten the relative lock nut. For engines without a screw

tensioner it is necessary to rotate the alternator in order to obtain the prescribed tension.

- Use the appropriate tool to check the tension of the new ancillary belt at the intermediate point of the branch between the guide pulley and the fan control pulley. The correct tension must correspond to 245 ± 10 Hz ($1,200 \pm 100$ N).
 - Repeat the aforesaid procedure if necessary.
 - After setting the prescribed tension, tighten the screw (2) fastening the alternator to the bracket and the bolt (1) anchoring the alternator to its lower support to a torque of 43 ± 6 Nm.
- ❑ Reposition the fan together with spacer in its seat and the protective grilles and tighten the relative fasteners.



Change engine coolant

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 using a mixture of 50% water and PARAFLU 11, as contained in the section FLUIDS. 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.



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.

Change air filter

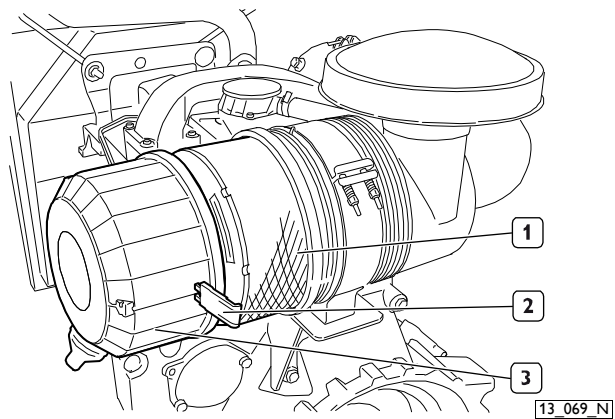
Only proceed when the engine is not turning over.

- Remove the cover (3) of the air filter after having undone the two quick release catches (2).
- Remove the filter element (1); make sure that dust does not enter the sleeve during this operation.
- Replace the filter element and the relative gasket at its base.
- Position the filter element (1) in its seat.
- Replace the cover (3) of the air filter and lock it using the two quick release catches (2).

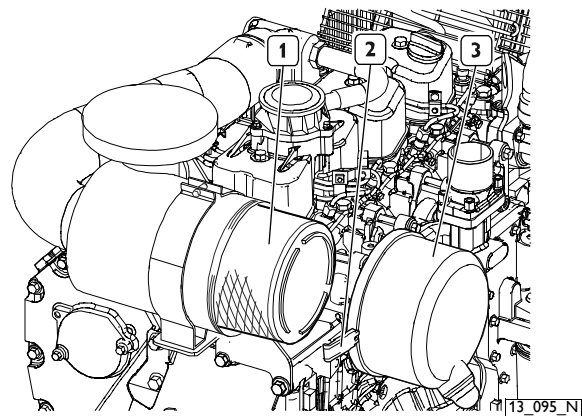


Do not use detergents or diesel to clean the air filter. Never strike the filter element with tools. The imprecise assembly of the air filter may result in the intake of unfiltered air and therefore cause serious damage to the engine.

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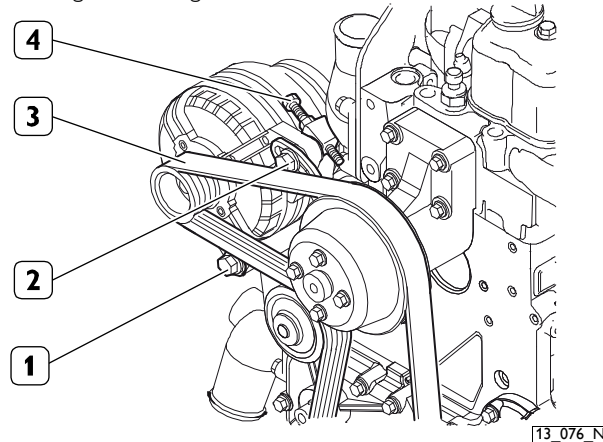
UNSCHEDULED MAINTENANCE - HOW TO PROCEED

Change ancillary belt

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

- ❑ Remove the protective grilles and the fan together with spacer by undoing the relative fasteners.
- ❑ Loosen the bolt (1) anchoring the alternator to its lower support and the screw (2) fastening the alternator to the bracket.
- ❑ Unscrew the adjustment screw (4) to loosen and remove the ancillary belt (3).
- ❑ Fit the new ancillary belt inside the shoulders of all the pulleys, in the following order: damper, guide pulley, fan control pulley, alternator, water pump.
- ❑ Set the tension of the new ancillary belt by turning the adjustment screw (4), then tighten the relative lock nut. For engines without a screw tensioner it is necessary to rotate the alternator in order to obtain the prescribed tension.
- ❑ Tighten the screw (2) fastening the alternator to the bracket and the bolt (1) anchoring the alternator to its lower support to a torque of 43 ± 6 Nm.
- ❑ Fully rotate the crankshaft to ensure that the new ancillary belt has been correctly fitted.
- ❑ Use the appropriate tool to check the tension of the new ancillary belt at the intermediate point of the branch between the guide pulley and the fan control pulley. The correct tension must correspond to 245 ± 10 Hz ($1,200 \pm 100$ N).
- ❑ Repeat the aforesaid procedure if necessary.

- ❑ Reposition the fan together with spacer in its seat and the protective grilles and tighten the relative fasteners.



Replace the ancillary belt if it shows signs of abrasions, cracks or tears or if it is soiled with oil or fuel.

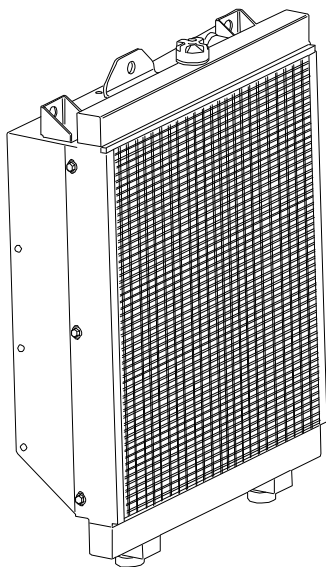


CAUTION!

When the engine is off, but still hot, the belt may start to move without warning. Wait for the engine temperature to decrease to prevent serious danger of an accident.

Clean heat exchanger

The surfaces of the heat exchanger (radiator) come into contact with external air and may be subjected to deposits and impurities (dust, mud, straw, etc.). Clean them if necessary using compressed air or steam.



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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.



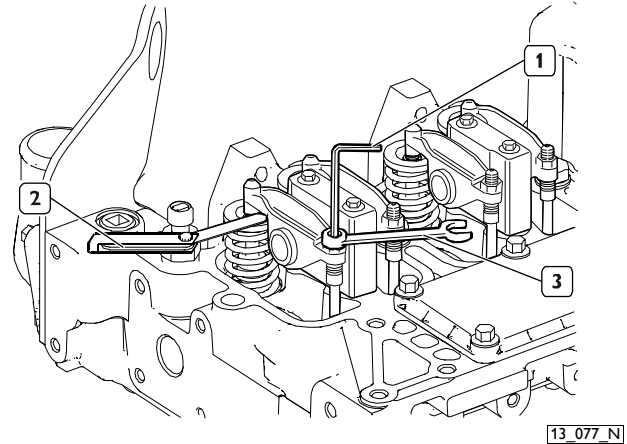
When using compressed air, it is required to use suitable personal protections for hands, face and eyes. The requirements can be found in the ACCIDENT PREVENTION paragraph.

Injector calibration

The injectors require periodic cleaning and calibration of the exact injection pressure, by adding or replacing the shim washers inserted under the spring; check the injection pressure by using a hand operated pump equipped with a pressure gauge which, operated by the lever, enables the injector calibration pressure to be obtained and which is displayed on the pump pressure gauge at the moment in which diesel delivery occurs. During the test it is also possible to note whether the direction of the jet is correct and whether the injectors show any signs of fuel leakage. Clean the injectors using a metal brush to remove the carbon deposits from the nozzle tips.

Adjustment of valve/rocker arm clearance

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).



MOVING THE ENGINE

The operations necessary to disconnect and subsequently reconnect the engine must only be carried out by technicians from Service Centres.

When lifting the engine only, use the U-bolts indicated in this manual in the section ENGINE TECHNICAL DATA and marked on the engine with special stickers.

Lifting must be carried out using a rocker arm that keeps the metal cables supporting the engine parallel, using all the U-bolts provided simultaneously; the use of a lower number of lifting eyelets is not permitted.

The engine lifting system must have a capacity and size suited to the weight and dimensions of the engine; check that there is no interference between the lifting system and the engine components.

Do not lift the engine before removing the members that are coupled to it.

The laws in force in the various countries provide for severe penalties for lawbreakers.

DISPOSAL OF WASTE

The engine is made up of parts and elements that, if discarded, may cause damage to the environment.

The materials listed below must be handed over to specialised Collection Centres:

- Starter batteries
- Used lubricants
- Mixtures of water and antifreeze
- Filters
- Additional cleaning materials (e.g. greasy or fuel-soaked cloths).

■ BEHAVIOUR IN AN 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's electrical 12 V or 24 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.

The electric generator systems (generator units) normally produce high voltages that are liable to result in extremely dangerous current levels. In the event of medium or high voltage electrocution:

- ❑ Turn off the power supply at the main switch before touching the victim. If this is not possible, use equipment that is both safe and adequately insulated when touching the victim; remember that touching a victim of electrocution is also extremely dangerous for the person giving aid.
- ❑ Proceed as indicated by the competent authorities (cardiac massage, mouth-to-mouth resuscitation, etc.)

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 personnel performing maintenance on electrical devices, this is typically caused by acid escaping from the batteries; in this circumstance proceed as follows:

- ❑ Remove clothing that has been splashed with any caustic substance.
- ❑ Wash the affected part thoroughly in running water.

If battery acid, lubrication oil or diesel comes into contact with the eyes: wash the affected eye with water for at least 20 minutes, keeping the eyelid open to facilitate the flow of water around the eyeball (and while moving the eye in all directions).