

GB

Thank you for preferring Iveco Aifo and may we compliment you on the choice you have made.

Before carrying out any work on the engine, read through the procedures set out in this manual carefully.

If you follow these instructions your engine will be guaranteed trouble-free operation and a long life.

Remember that, wherever you are, the Iveco Aifo Service Network will be at your side to offer you highest levels of skill and professionalism.

Guarantee

In order to get the best performance from your engine and benefit from the guarantee you must comply with the instructions contained in this publication.

Failure to carry out these operations correctly or not at all may invalidate the guarantee.

Spare parts

It is essential to use only Original Iveco Aifo Spare Parts if the engine is to be kept in its original sound condition.

The use of non-original spare parts will invalidate the guarantee and release Iveco Aifo from any long-term liability.

Liability

The manufacturer's liability is dependent on the execution of the "Checks and Maintenance" operations mentioned in this manual.

For this purpose, a record must be kept of the maintenance operations carried out, which, as far as extraordinary maintenance is concerned, must be performed by authorised workshops.

Warning

The contents of this manual refer to the engine only; in particular, illustrations are approximate and some instructions are described in a purely functional manner, to permit the operations to be carried out on the engine.

The ways of executing the above instructions depend on the configuration of the controls and/or accessories of the machine on which the engine is installed and reference is made to the machine manual. The information contained in this manual is correct at the time of publication.

The Manufacturer reserves the right to make amendments without prior notice at any time for reasons of a technical or commercial nature as well as to comply with legal requirements in different countries. It declines any liability for any errors or omissions.

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SAFETY REQUIREMENTS

Basic rules

The following recommendations are given so as to reduce the risk to persons and property when an engine is in service or out of service. Engines must not be used for applications other than those declared by the manufacturer.

Incorrect handling, modifications and use of non-original parts may affect safety.

When handling the engine, take care to use suitable equipment to be applied to the points specially provided on the engine (see paragraph "Handling engine").

This publication refers to the engine component; the machine on which it is installed must meet the specific safety requirements.

WARNING LABELS

Warning labels are applied to the engine by the machine's builder. Their meanings are given below.

N. B. Labels which show an exclamation mark indicate that there is a possibility of danger.



Lift point for engine only.



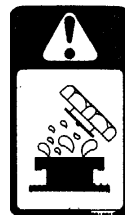
Fuel filler indication on tank
(where present).



Lubricating oil filler indication.



Oil dipstick indication.



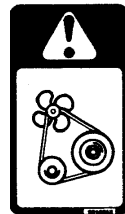
Danger of burns:
Expulsion of pressurised hot water.



Danger of burns:
Hot parts indication.



Risk of fire:
Due to presence of fuel.



Risk of entangling and cutting:
Indication of rotating parts
(pulleys, belts, fan).

MAINTENANCE OPERATIONS

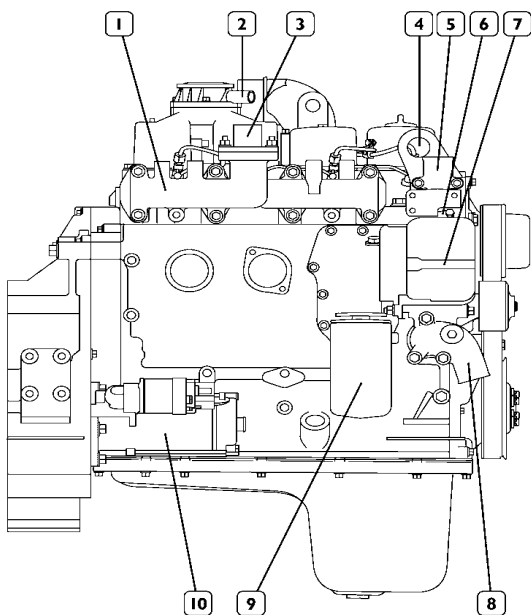
For the purposes of safety it is important that the maintenance operations indicated in this manual are carried out according to the following guidelines:

- **checks**, can be carried out both by the workshop and the machine user;
- **routine maintenance checks**, marked by the spanner symbol (see diagram below), must be carried out by qualified persons using the appropriate equipment and protections;
- **non-routine maintenance operations**, given their particular nature, must be carried out by authorised workshops which are equipped with the appropriate tools and are in possession of the proper technical information.

"*Authorised workshops*" are those workshops belonging to the Iveco Aifo service organisation and those belonging to the machine manufacturer's service organisation if authorised by Iveco Aifo.

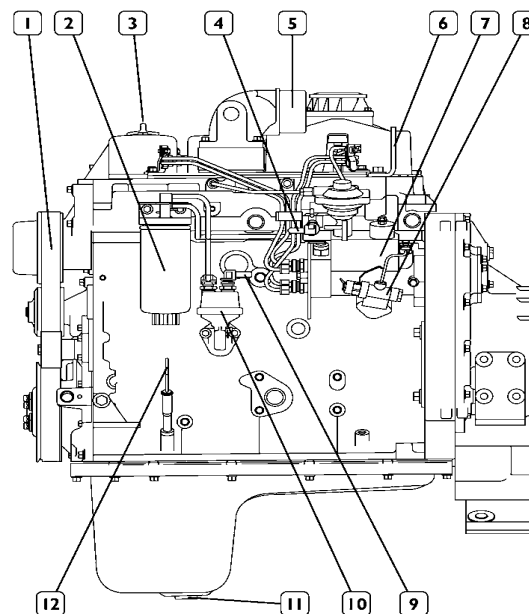
ENGINE IDENTIFICATION DATA

The technical code and the serial number are stamped on a label positioned on the tappet cover.



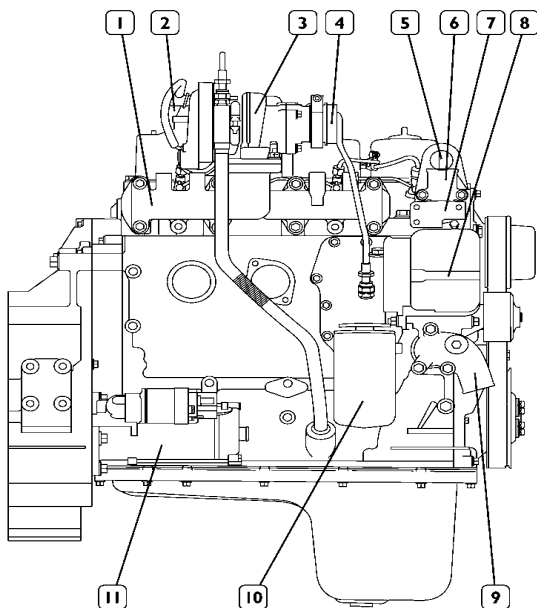
Engine N45 MNA : right side view

1. Exhaust manifold - 2. Oil vapour breather - 3. Exhaust gas outlet - 4. Engine lift eye - 5. Cooling liquid outlet - 6. Thermostatic valve housing - 7. Alternator - 8. Cooling liquid inlet - 9. Oil filter - 10. Starter motor.



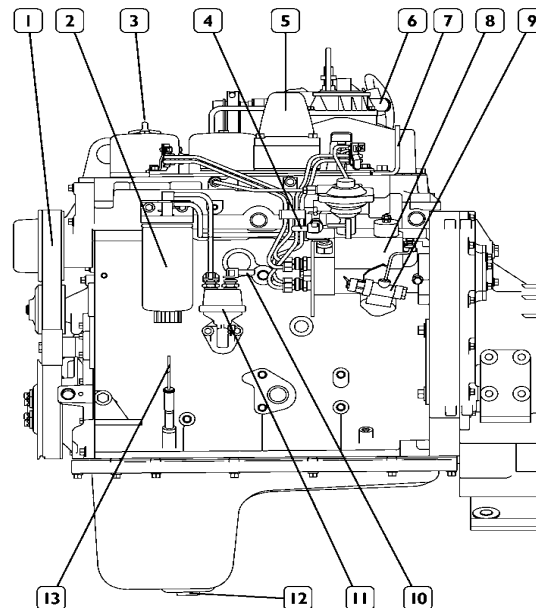
Engine N45 MNA : left side view

1. Auxiliaries drive belt - 2. Fuel filter - 3. Oil filler plug - 4. Fuel output joint - 5. Engine air intake - 6. Engine lift eye - 7. Injection pump - 8. Cold operated injection advance variator device - 9. Fuel input joint - 10. Fuel pump - 11. Oil drain plug - 12. Oil dipstick.



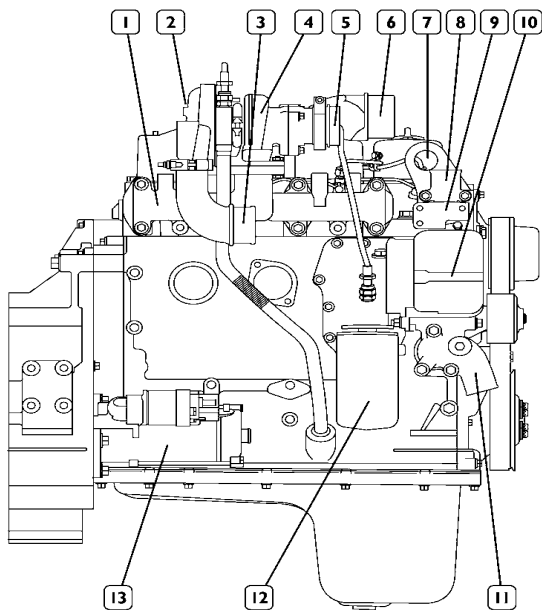
Engine N45 MNS : right side view

1. Exhaust manifold - 2. Turbocharging air intake - 3. Turbocharger - 4. Exhaust gas outlet from turbocharger - 5. Engine lift eye - 6. Cooling liquid outlet - 7. Thermostatic valve housing - 8. Alternator - 9. Cooling liquid inlet - 10. Oil filter - 11. Starter motor.



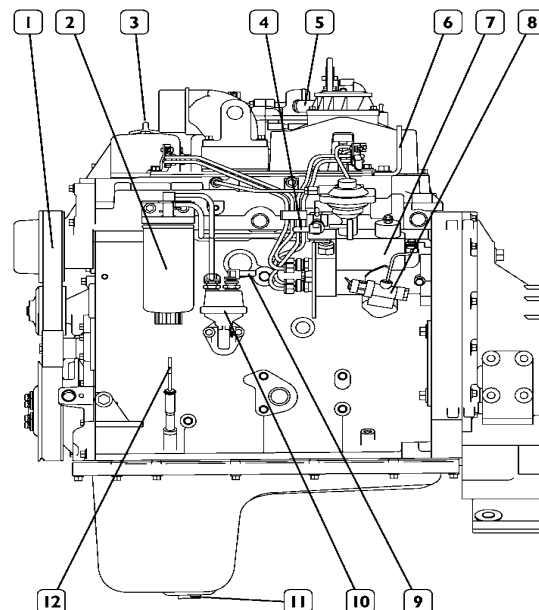
Engine N45 MNS : left side view

1. Auxiliaries drive belt - 2. Fuel filter - 3. Oil filler plug - 4. Fuel output joint - 5. Engine air intake - 6. Oil vapour breather - 7. Engine lift eye - 8. Injection pump - 9. Cold operated injection advance variator device - 10. Fuel input joint - 11. Fuel pump - 12. Oil drain plug - 13. Oil dipstick.



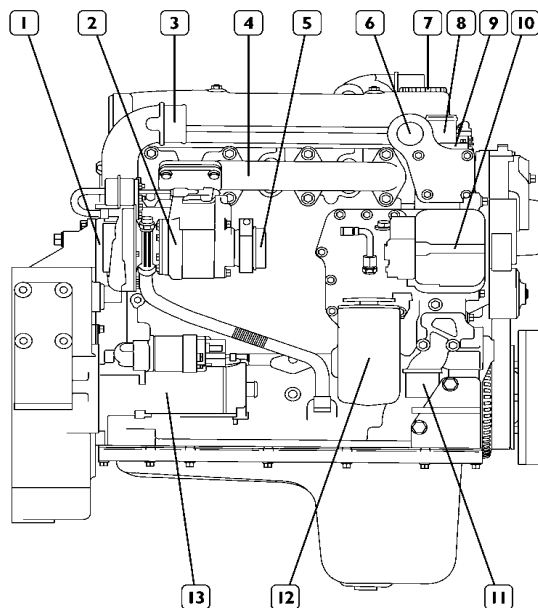
Engine N45 MNT : right side view

1. Exhaust manifold - 2. Turbocharging air intake - 3. Turbocharging air outlet - 4. Turbocharger - 5. Exhaust gas outlet from turbocharger - 6. Engine air intake - 7. Engine lift eye - 8. Cooling liquid outlet - 9. Thermostatic valve housing - 10. Alternator - 11. Cooling liquid inlet - 12. Oil filter - 13. Starter motor.



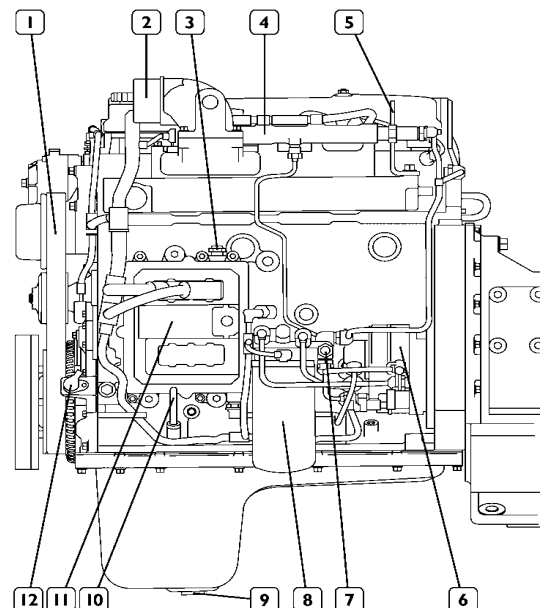
Engine N45 MNT : left side view

1. Auxiliaries drive belt - 2. Fuel filter - 3. Oil filler plug - 4. Fuel output joint - 5. Oil vapour breather - 6. Engine lift eye - 7. Injection pump - 8. Cold operated injection advance variator device - 9. Fuel input joint - 10. Fuel pump - 11. Oil drain plug - 12. Oil dipstick.



Engine N40 ENT : right side view

1. Turbocharging air intake - 2. Turbocharger - 3. Turbocharging air outlet - 4. Exhaust manifold - 5. Exhaust gas outlet from turbocharger - 6. Engine lift eye - 7. Oil filler plug - 8. Cooling liquid outlet - 9. Thermostatic valve housing - 10. Alternator - 11. Cooling liquid inlet - 12. Oil filter - 13. Starter motor.



Engine N40 ENT : left side view

1. Auxiliaries drive belt - 2. Engine air intake - 3. Fuel input joint - 4. Common rail - 5. Engine lift eye - 6. Common rail high pressure pump - 7. Fuel output joint - 8. Fuel filter - 9. Oil drain plug - 10. Oil dipstick - 11. Electronic central unit - 12. Sensor on crankshaft phonic wheel.

ENGINE TECHNICAL DATA

N45 MNA - N45 MNS - N45 MNT

- Cylinders, number and arrangement4, in line
- Bore 104 mm
- Stroke..... 132 mm
- Displacement 4.5 l
- Type Diesel 4 stroke - VE injection pump
- Max Rating :

N45 MNA : 60 kW (81 CV) @ 2300 rpm - 320 Nm @ 1400 rpm

N45 MNS : 74 kW (100 CV) @ 2300 rpm - 398 Nm @ 1400 rpm

N45 MNT : 94 kW (128 CV) @ 2300 rpm - 500 Nm @ 1400 rpm

N40 ENT

- Cylinders, number and arrangement4, in line
 - Bore 102 mm
 - Stroke..... 120 mm
 - Displacement 3.9 l
 - Type Diesel 4 stroke - Unijet Common Rail
 - Max Rating :
- 107 kW (145 CV) @ 2300 rpm - 490 Nm @ 1200 rpm



WARNING

It is absolutely forbidden, at risk of invalidating the guarantee and the liability of Iveco Aifo, to change the above characteristics, and in particular to change the adjustment of the injection pump or to tamper with the electronic control unit, modify the electrical system and the injection system.

BEFORE STARTING

Every day, before starting the engine:

- check the fluid levels (fuel, engine oil and coolant).
- check that the air intake cleaner is not clogged, checking that the mechanical indicator on the cleaner is not showing "red".

If the cleaner is clogged, clean it following the instructions set out in the paragraph "Routine Checks and Maintenance".

N.B. When an electric indicator is fitted (optional) a warning light on the control panel will light up immediately; in this case the cleaner must be cleaned straightaway.



Attention!

Before starting the engine, check that the environment in which you are to work is suitable for the mixture of harmful exhaust gases. Also check that combustible fuel gases such as hydrocarbons are not present in the ambient air.

INDUSTRIAL ENGINE STARTING

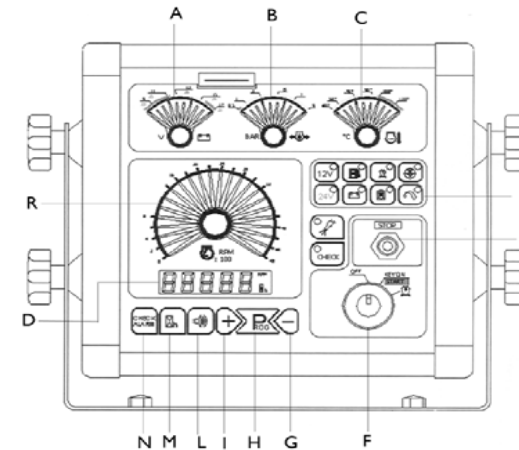
For engines fitted with Iveco Aifo instrument panel

WITH COLD ENGINE

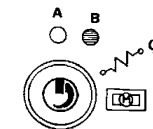
1. Turn ignition switch from position "A" to position "B".
 - 1.1 **For electronic control engines**, the injection system warning turns on; wait for it to turn off and continue with procedure.
2. Wait for "pre-heating glow plugs" warning light to turn off.
3. Turn ignition switch to position "C" and keep it so until start-up is performed.
When the engine is started, the "pre-heating glow plug" warning light turns on, to warn that the pre-heating function is on, and this is to prevent engine from having an excessive smokiness cold.
4. **Only for mechanical control engines:** Set accelerator lever to a position where engine speed is slightly than idling speed.

WHEN ENGINE IS HOT

1. Turn ignition switch from position "A" to position "B".
 - 1.1 **For electronic control engines**, the injection system warning light turns on; wait for it to turn off and continue with procedure.
2. Turn ignition switch to position "C" and keep it so until engine is started.
When the engine is started, the "pre-heating glow plugs" warning light turns on to warn that the after-heating function is on, and this to prevent the engine from having an excessive cold smokiness.



- A = Power supply voltage indicator
- B = Engine oil pressure indicator
- C = Coolant fluid temperature indicator
- D = 12/24 V power supply voltage indicator warning lights; Preheating glow plugs; Alarms: Battery charging, Clogged air filter, Fuel level, Minimum coolant fluid level, Engine runaway speed rate.
- E = Emergency stop button
- F = Engine ignition switch key
- G = Programming (-) key
- H = Programming key
- I = Programming (+) key
- L = Buzzer alarm stop key
- M = Working hours display key
- N = Alarm diagnostic key
- Q = 5 figure LCD 5 screen displaying RPM, work hours
- R = RPM indicator.



ENGINES WITHOUT IVECO AIFO INSTRUMENT PANEL

If the engines are not fitted with an Iveco Aifo instrument panel, the starting instructions given previously may vary according to the type of control panel fitted to the machine on which the engine is installed (see the instructions supplied by the machine's manufacturer).

GENERAL GUIDELINES FOR STARTING (valid for all engines)

Release the starter control as soon as the engine starts so as not to damage the engine and starter motor.

Remember that it is not efficient, in terms of reaching the operating temperatures, to keep the engine idling.

After about 1 minute start to use the engine but avoid using it at high output.

STOPPING THE ENGINE

1. Before stopping the engine, let it idle for a few minutes with no load; this allows a uniform reduction in the water and oil temperature, avoiding serious damage to the engine caused by thermal shock.

2. The engine is stopped by turning the starter key to "A".

WATER PRE-HEATING (electric 220 V, single-phase - optional)

This device, supplied on request, is provided to aid starting at low temperatures or in circumstances where an immediate supply of power is required. It incorporates a thermostat which cuts off the supply when the set temperature is reached.



WARNING!

Always check that the equipment is properly earthed.

PRECAUTION FOR NORMAL OPERATION OF THE ENGINE

- Increasing engine speed from idling to full speed and viceversa must be achieved gradually in order to ensure perfect combustion and trouble-free operation of all the engine components.
- The speed/power values in engine use must conform to the specifications given in the technical/commercial documentation.
- During engine operation, monitor the following points:

Engine cooling system - Check that the water temperature is kept within the maximum permitted values as specified in the table "Main regulation and repair data". If the water temperature is excessive, check the cause consulting the table "Engine fault diagnosis". When topping up the engine coolant, follow the instructions given in the paragraph "Checks and maintenance".



Attention!

Never open the water filler plug when the engine is hot. The cooling system is pressurised and the hot liquid will be expelled violently if the pressure is released too violently, causing burns.

Lubrication system - Check that the oil pressure, with the engine hot and operating at normal speed, falls within the limits indicated in the table "Main regulation and repair data". If the oil pressure does not correspond to the values indicated check the cause for this by consulting the table "Engine fault diagnosis". When topping up the oil in the lubrication system, follow the instructions given in the paragraph "Checks and maintenance".

Fuel system- Avoid using the engine with the fuel tank at minimum reserve levels in order to avoid the possible formation of condensate and defusing of the system in the event of air intake, which would cause the engine cut out.



Attention!

When filling up with fuel be particularly careful that the solid or liquid pollutants do not enter the tank with the fuel. Do not smoke or use naked flames.

Intake and exhaust system - Check regularly that the air intake system is clean. The maintenance intervals change according to the working conditions. In particularly dusty environments more regular cleaning is required; follow the instructions set out in the paragraph "Checks and maintenance".



Attention!

Visually inspect that the exhaust system is not blocked or damaged so as to prevent dangerous fumes.

Electrical starter system - Check the battery state of charge regularly, particularly during the winter months.

When topping up the electrolyte level in the batteries, follow the instructions set out in the paragraph "Checks and maintenance".

When replacing, adhere strictly to the instructions regarding the capacity of the batteries. In particular, for engines with electronic control, the supply voltage must be higher than the prescribed values in order to ensure correct operation of the engine; low voltages, close to the minimum limit, may automatically increase the idle speed to enable recharging with the alternator.



Attention!

Do not smoke or bring naked flames in the vicinity of the batteries to avoid explosions.

RUNNING IN (50 Hours)

Avoid using the engine for long periods, at high output.

ON THE SPOT MAINTENANCE

Precautionary measures for electronic units installed on the vehicle

In order to avoid improper operations which can result in permanent damage to the control units installed on the vehicle, it is advisable to observe the following instructions :

- Proceed as follows to carry out electric arc welding on the chassis; disconnect battery positive terminal and connect it to chassis earth; disconnect connector from control units.
- When welding close to an electric control unit, remove the latter from the chassis; use d.c. to carry out the welding operation; ensure the welding machine is earthed as close to the welding point as possible; ensure battery cables are not parallel to the vehicle's electrical cables.
- Never disconnect and/or connect connectors from control units with engine running or with control unit energized.
- After any servicing operation requiring battery disconnection make sure that, on reconnection, terminals are well secured to the poles.
- Do not disconnect the battery with engine running.
- Do not use a battery charger to start the engine.
- Disconnect the battery from on-board mains when charging it.
- Remove the electronic control units if special operations require temperatures higher than 80°C.
- When inserting the connectors in the central unit, do not force them as this could damage the terminals.

Air bleeding from the fuel feeding system

Bleed air from the feeding system as follows:

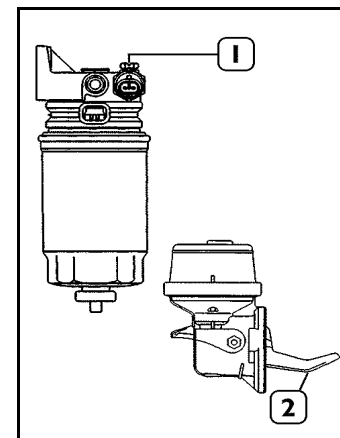
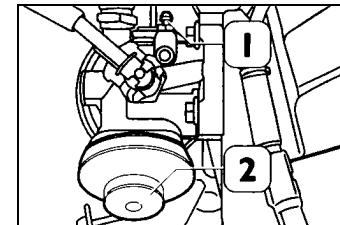
- Unscrew screw 1 on the pre-filter of engines with electronic control and on the filter of engines with mechanical injection pump and connect the specific tube for draining bleed residues into a suitable container.
- Operate the manual primer pump control 2 until fuel without air is let out from bleeder screw 1.
- Close screw 1.
- Continue to operate the manual control until the primer pump 2 becomes stiff.
- Start the engine and let it run of a few minutes to eliminate any residual air.

Fire risk: take extreme care when closing the bleed screw to avoid dangerous fuel leakages.



Attention!

*The common rail injection system on engines with electronic control is self-bleeding: **do not** unscrew the couplings of the electro-injectors and the rail.*



CHECKS AND MAINTENANCE

INTRODUCTION

The **checks** indicated in this section can be carried out either by the workshop or by the machine user.

The **routine maintenance operations**, identified by the key symbol, must be carried out by qualified personnel who have the appropriate equipment and protections.

The **non-routine maintenance operations** identified by the spanner symbol, given their particular nature, must be carried out by authorised workshops equipped with appropriate equipment and with the proper technical information.



DURING MAINTENANCE

- Never wear loose clothing, rings, bracelets and/or chains when working next to engines or moving parts.
 - Use protective gloves and goggles:
 - when topping up batteries with acid
 - when topping up with inhibitors or anti-freeze
 - when changing or topping up the lubricating oil (hot engine oil can cause burns when it is drained. Let it cool down to under 50°C).
- Use goggles if compressed air is used (in this case the maximum pressure of the air, used for cleaning, must be under 2 Atm (30 psi, 2 kg/cm²).

- Use the protective helmet if working in an area with suspended loads or with installations at head height.
- Always wear safety shoes and overalls.
- Use protective cream for the hands.
- Always change out of wet overalls.



Attention!

Avoid carrying out maintenance when there is live voltage; always check that the equipment is properly earthed. During regulation operations make sure that you have dry hands and feet and use insulating platforms.

- Never carry out repairs with which you are unfamiliar. Always follow the instructions and, if these are not available, contact the supplier or qualified personnel as described above.
- Always keep the engine clean, eliminating oil, diesel and/or coolant stains.
- Place dirty rags inside flameproof containers.
- Do not leave rags on the engine.
- Use suitable secure containers for used oil.
- When you start an engine after a repair, take steps to stop the intake of air in case of over-revving on starting.

PERIODICAL CHECKS

	Regularity
Check oil level in sump	daily
Check water level in radiator (1).....	daily
Check air cleaner for clogging (1).....	daily
Check radiator/intercooler for restriction (1)	daily
Fuel prefilter water drain.....	weekly
Check electrolyte level in batteries (1) (2)	every 300 hours



ROUTINE MAINTENANCE

	Regularity
Adjust drive belt tension (2)(7) _____	300 hours
Change engine oil (2)(4)(5) _____	600 hours
Change oil filter (2)(4) _____	600 hours
Blow-by filter replacement (Common Rail engines) (2)(4) _	600 hours
Change fuel filter (2) _____	600 hours (3)
Fuel prefilter replacement _____	1200 hours
Auxiliary belts replacement _____	1200 hours
Injectors calibration (2 valve engines) _____	1800 hours
Adjust valve clearance _____	3000 hours



NON-ROUTINE MAINTENANCE

During its life the engine will also require certain specialist operations to be carried out, such as: valve seat dressing, turbocharger and heat exchanger cleaning, injection pump, water pump and electrical system overhaul.

Consult the Iveco Aifo Service Network which is available to give you advice and carry out the above operations promptly using fully trained and professional personnel to ensure that the engine has a long and efficient life.

(1) The regularity of these operations can vary depending on engine use and the ambient conditions in which it operates.

(2) These operations must be carried out annually even when the specified operating hours have not been reached.

(3) Maximum period, with high-quality fuel; it may vary depending on fuel contamination.

(4) The frequency applies to lubricants conforming with specifications ACEA E3, E5 API CH4; for lubricants conforming with ACEA E2 o API CF4, the frequency is reduced to every 300 hours.

(5) If fuel with a sulphur content of more than 0.5% is used, the engine oil change intervals must be halved.

(6) Whenever the engine is subject to a general overhaul.

(7) Only for engines with manual belt tensioner.

ROUTINE CHECKS

ENGINE OIL LEVEL CHECK

Carry out the check with the engine off, cold and with the machine on the level.

Check that the oil level falls between the "Min" and "Max" limits etched on the dipstick. If necessary, top up through the oil filler, after turning the cap 2 anti-clockwise.



WARNING

The level must never exceed the "Max" mark etched on the dipstick. After the check, reposition the dipstick correctly and fully tighten the filler cap, turning it clockwise as far as it will go.

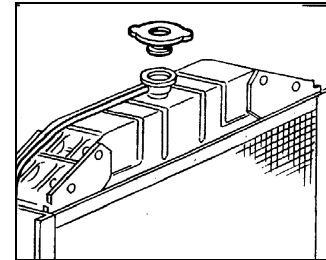
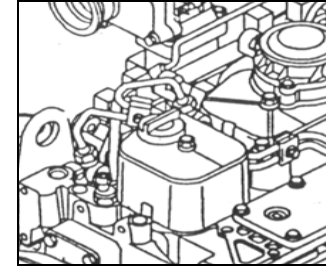
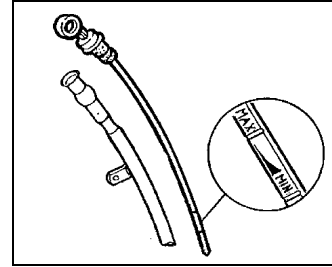
RADIATOR WATER LEVEL CHECK

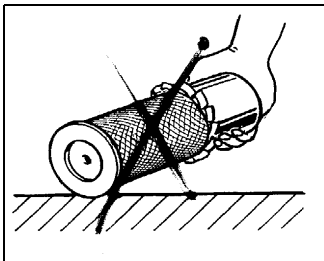
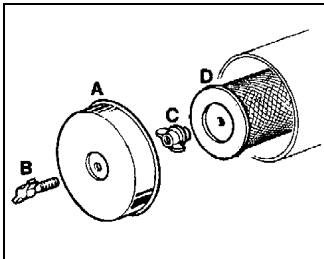
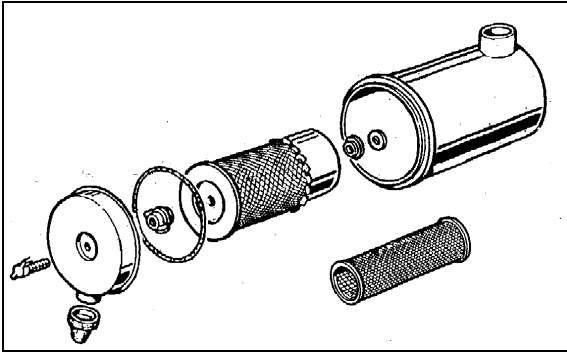
Carry out the check with the engine off and cold.

Remove the radiator water filler cap by turning it anti-clockwise and inspect the water level.

The level must never exceed two thirds of the height of the reservoir to allow for an increase in volume when the engine is hot.

If necessary, top up bearing in mind that overfilling may, during engine operation, result in excess water being expelled from the drain pipe or pressure relief valve.





Refill with a 50% mixture of clean water and anti-freeze/and corrosion inhibitor of the type described in the "Capacities" table all the year round in order to protect the circuit against corrosion.

Different water level check procedures may be required depending on the various cooling system configurations of the machine on which the engine is installed.



Attention!

Never open the water filler cap when the engine is hot. The cooling system is pressurised and the hot fluid will spurt out if the pressure is released too quickly, causing burns.

AIR CLEANER CONDITION CHECK

As previously indicated in the paragraph "Before starting", if the air cleaner requires cleaning, proceed as follows:

- stop the engine and leave to cool
- lift the cleaner cover A turning the wing nut B anti-clockwise
- turn the retaining nut D anti-clockwise and take out the external cartridge C, making sure that no dust gets into the hose.

Pay attention to the following advice when working on the cartridge:

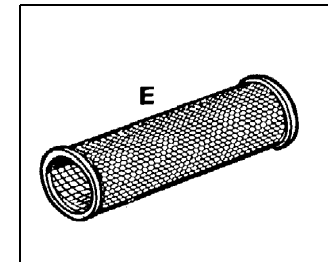
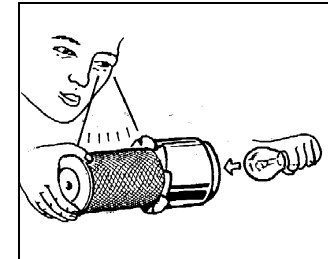
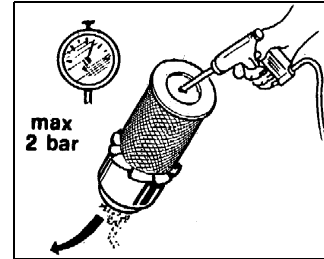
- never strike the cartridge with tools
- clean the cartridge with dry compressed air working from the inside outwards from the inside (the pressure must not exceed 2 bar so as not to damage the cartridge);
- check the condition of the cartridge before removing it, using a lamp to light up the inside;

Change the cartridge if it has any tears or holes;

- check that the seal on the base of the cartridge is in good condition.

Some air cleaners are fitted with a safety cartridge (optional); this cartridge (E) must never be cleaned but changed every 3 changes of the external cartridge.

To refit, reverse the dismantling operations, checking that the cartridge is housed correctly in its seat.

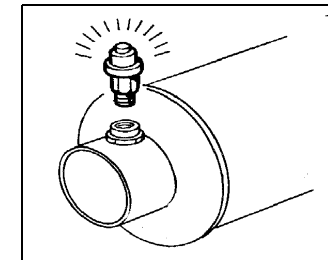


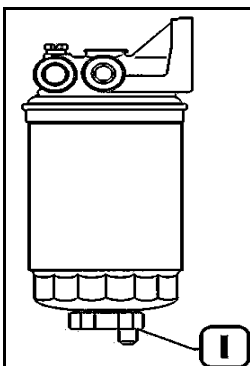
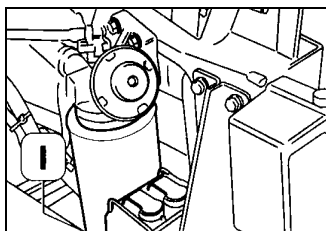
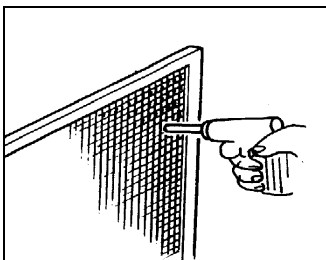
WARNING

If the cartridge is not properly fitted, unfiltered air could enter the engine and cause serious damage.

Where possible, have the above operations carried out by qualified personnel. After the work on the cartridge has been completed, the mechanical clogging indicator (see figure opposite) must be put back into service by pressing the special button located at the top of the indicator.

The electrical indicator does not require this operation.





RADIATOR/INTERCOOLER RESTRICTION CHECK (AIR/AIR)

Check that the air input surfaces in the radiators are free of dirt (dust, mud, straw etc.) and clean them straightaway using compressed air/steam.

The use of these cleaning methods means that suitable protection must be worn on the hands, face and eyes.

WATER BLEEDING FROM THE FUEL PREFILTER (Engines with electronic control)

Slacken tap I to drain water which may have accumulated in the fuel prefilter.

WATER BLEEDING FROM THE FUEL FILTER (Engines with mechanical injection pump)

Slacken tap I to drain water which may have accumulated in the fuel filter.

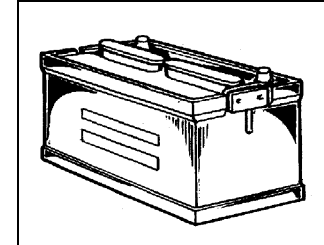
BATTERY ELECTROLYTE LEVEL CHECK

With the batteries out of service and cold, check that the electrolyte level falls between the "Max" and "Min" limits; if the level is below the minimum, top up with distilled water.

During the summer months, check the level more frequently.

If the engine is unused, check the electrolyte monthly and, if the battery needs to be recharged, consult a specialist workshop.

Also check that the terminals and clamps are clean, tightened and protected with vaseline.



Attention!

The batteries contain highly corrosive sulphuric acid; when topping up with distilled water wear protective gloves and goggles. Where possible, have the above operations carried out by qualified personnel.

Do not smoke or bring naked flames within the vicinity of the batteries to avoid explosions.

Battery specifications

12 V applications :

- min. capacity : 176 Ah
- cold cranking capacity : 800 A

24 V applications (2 series batteries) :

- min. capacity : 130 Ah
- cold cranking capacity : 800 A

PROTECTING THE ENGINE FROM COLD

Cooling circuit

Check the percentage of PARAFLU 11 in the coolant every year.

It should be at least 50% at all times throughout the year; if necessary, top up with water and PARAFLU 11 to provide adequate protection from rust.

Every 2 years replace the cooling fluid.

Fuel supply

Use the winter fuels provided by oil companies.

Keep the fuel tank as full as possible at all times.

Electrical system

Cold creates additional stress on batteries; their capacity decreases as the temperature drops.

Check the batteries frequently; a flat battery will be damaged by frost.

ENGINE FAULT DIAGNOSIS

The diagnosis of the faults described below refers to the general causes which are valid for the majority of the applications; faults caused by specific configurations of the machine or installation on which the engine is installed cannot be envisaged.

Engine faults can be remedied, depending on their type by:

- user
- qualified personnel
- authorised workshop.

The table overleaf describes only those operations that the user and the qualified personnel are authorised to perform to eliminate faults.

All other circumstances should be referred to an authorised workshop equipped with the appropriate equipment and in possession of adequate technical information.

Fault	Possible cause	Carried out by/remedy
The engine does not start	Batteries not fully charged	Qualified personnel: check and recharge the batteries. Change if necessary.
	Battery terminal connections corroded or loose	Qualified personnel: clean, inspect and tighten the battery terminal nuts. Change the terminals and nuts if they are badly corroded.
	Insufficient fuel reserve	User: fill up
	Type of fuel not suited for temperatures below freezing.	Qualified personnel: change the fuel filter; then use a fuel suitable for winter use.
	Air in fuel system	Qualified personnel: check lines, connections, fuel pump, filters and injection pump for air; bleed as necessary.

Fault	Possible cause	Carried out by/remedy
The engine does not start	Other	Consult authorised workshop
The engine stops	Fuel filters clogged	Qualified personnel: remove the filtering elements and change if necessary.
	Air in the fuel system.	Qualified personnel: check lines, connections, fuel pump, filters and injection pump for air; bleed system.
	Other	Consult an authorised workshop.
The engine overheats	Radiator/cooler clogged	User: clean the radiator air intake surfaces (dust, mud, straw etc).

Fault	Possible cause	Carried out by/remedy
The engine overheats	Not enough tension on water pump and fan drive belt	Qualified personnel: check and adjust the belt tension
	Coolant level too low	User: top up the radiator to the right level with the correct fluid
	Air cleaner obstructed	Qualified personnel: clear the air cleaner and the whole system connected to it.
The engine is losing power and its operation is irregular	Impurities or water in the fuel and injection system	Qualified personnel: clean thoroughly and refill with fuel
	Fuel filters clogged	Qualified personnel: remove the filtering elements and change if necessary.
	Air cleaner obstructed	Qualified personnel: clean the air cleaner and the whole system connected to it.
There is abnormal knocking in the engine	Various	Refer to authorised workshop

Fault	Possible cause	Carried out by/remedy
The engine is smoking unduly: black or dark grey smoke	Air cleaner clogged or deteriorated	Qualified personnel: clean or replace the filtering element
	Defective injectors	Qualified personnel: check the injectors
Conspicuous and persistent blue, grey-blue smoke	Various	Refer to authorised workshop
The engine does not stop	Various	Refer to authorised workshop

MAINTENANCE PROCEDURES WHEN ENGINE IS OUT OF COMMISSION FOR LONG PERIODS

If the engine has to remain out of commission for a period of more than 2 months, it should be protected from oxidation and faults in the following way:

1. Drain the oil from the sump and refill with flushing oil (e.g. FIAT L20 oil). This operation applies only for engines which have already operated for more than 200 hours.

2. Run the engine for 15 minutes at 800 - 1000 rpm; stop the engine and drain the oil. This operation applies only for those engines which have already operated for more than 200 hours.

3. Pour into the engine sump FIAT Prot. 30/M oil up to the "Min" level indicated on the dipstick. If Prot. 30/M oil is not available use a brand oil which meets requirements MIL-2160B - type 2.

4. After loosening the fuel filters, disconnect the injection system line up-stream the fuel pump, and connect it to a special tank containing CFB oil (ISO 4113).

5. Run the engine for 15 minutes at 800 - 1000 rpm; at the end, using a syringe, slowly nebulise (in about 10 sec.) the following quantity of Prot. 30/M oil in the intake manifold: 40 grammes.

6. With the engine warm, drain the Prot. 30/M oil poured into the sump; the oil can be reused two or three more times.
Slacken all the Vee-belts.

7. Detach the injection system fuel line from the tank containing the CFB oil and reconnect it to the fuel tank.

8. Seal with adhesive tape all the access, vent and bleed openings on the engine and exhaust pipe.

9. Affix a clearly visible label to the engine indicating that the unit is "WITHOUT ENGINE OIL".

10. Disconnect the batteries and place them in a dry place. Keep them charged all the time.

IMPORTANT - THIS TREATMENT MUST BE REPEATED EVERY 6 MONTHS.

RESTORING OPERATING CONDITIONS

To restore normal operating conditions, carry out the following operations:

- 1) Drain the Prot. 30/M oil contained in the injection pump.
- 2) Pour oil into the engine sump and injection pump up to the specified level.
- 3) Adjust the tension of all the belts.
- 4) Remove the seals from the access, vent and bleed openings.
- 5) Remove the label with the indication "WITHOUT ENGINE OIL".



MAIN REGULATION AND REPAIR DATA

Firing order _____ 1 - 3 - 4 - 2

Valve clearance, engine cold :

- intake (2 valve engines) _____ $0.25 \div 0.35$ mm
- exhaust (2 valve engines) _____ $0.50 \div 0.60$ mm
- intake (4 valve engines- common rail) _____ $0.20 \div 0.30$ mm
- exhaust (4 valve engines - common rail) _____ $0.45 \div 0.55$ mm
- Injector setting NA and TC (2 valve engines) _____ 245 bar
- Injector setting TAA (2 valve engines) _____ 260 bar

Max. water temperature (modulating range) _____ $83 - 99^{\circ}\text{C}$

Minimum oil pressure (industrial engines):

- max speed _____ 4 bar
- min speed _____ 0.7 bar

Tightening torques (I)

Cylinder head (common rail engines) :

- 1st phase (pre-torque) screws M12x1.75x130 _____ 35 ± 5 Nm.
- 1st phase (pre-torque) screws M12x1.75x150 _____ 55 ± 5 Nm.
- 2nd phase (angle) _____ 90°
- 3rd phase (angle) _____ 90°

Cylinder head (2 valve engines) :

- Screws M12x70 (pre-torque + angle) _____ 50 Nm + 90°
- Screws M12x140 (pre-torque + angle) _____ 40 Nm + 180°
- Screws M12x180 (pre-torque + angle) _____ 70 Nm + 180°

Connecting rod caps :

- 1st phase _____ 30 Nm
- 2nd phase _____ 60 Nm
- 3rd phase _____ 60°

Main bearing caps :

- 1st phase _____ 50 Nm
- 2nd phase _____ 80 Nm
- 3rd phase _____ 90°

Pulley hub fixing screws (N45 MN) _____ 110 Nm

Damper M12 fixing screws (N40 ENT) :

- 1st phase _____ 50 Nm
- 2nd phase _____ 90°

Pulley M10 fixing screws (N40 ENT) _____ 68 Nm

Flywheel screws (*) _____ $30 \div 40$ Nm + 60°

(*) Lubricate with "Loctite HVX576".

(I) For the complete list of the tightening torques consult the workshop manual.

CAPACITIES

Parts	Quantity		Product
	l	kg	
Cooling system	-	-	Mixture of water and 50% Paraflu II (1)
Engine sump :			Lube oil
- Min.level	from 5.5 to 9	from 5 to 8.2	ACEA E3 - E5 (3)
- Max level (2)	from 8.4 to 12	from 7.6 to 11	
Fuel tank	-	-	Diesel (4)

1) Use a mixture of water and 50% Paraflu II in the summer months as well to provide optimal protection of the cooling system. As an alternative to PARAFLU II, a similar product can be used provided that it corresponds to international specifications SAEJ 1034.

2) The quantity indicated is that required for routine oil changes.

3) Use lubricants corresponding to the following international specifications: ACEA E3-E5 (MIL L 2104E/F).

Allowable oil consumption : max 0.5% of fuel consumption.

4) With atmospheric temperature below freezing, use a winter-type fuel.



WARNING

If fuel is used with a percentage of sulphur above 0.5% or if lubricants corresponding to the specifications ACEA E2 (MIL L 2104E/F), are used the oil change intervals must be reduced to 300 hours.

Refueling

Use standard type diesel oil only (EN 590 standard).

Fuel additives are not recommended. The use of fuel additives could restrict the warranty conditions provided for by the vehicle's manufacturer.

Refueling from barrels or cans can lead to fuel pollution resulting in irregular operation of the fuel feed system. If so, either filter the fuel by means of the suitable equipment or let possible impurities settle, as required.

Low temperature fuel:

To low temperatures the fuel's fluidity rate can be lower than specified owing to the separation of the paraffin wax. This process may result in filter restriction.

The EN 590 standard provides for several fuel classes to be adhered to at low ambient temperatures.

Complying with the regulations in force depending on climate conditions (yearly seasons and different countries' geographical position) is the oil companies' full responsibility.

HANDLING THE ENGINE

If the engine is dismantled and then reassembled on the machine, the appropriate operations must be carried out solely by authorised workshops which are equipped with the appropriate lifting and handling equipment.

The eyes to be used to lift only the engine are indicated in this manual in the section "Engine views" and, on the engine, by special labels.

All the lifting eyes available must be used at the same time; **the use of just one eye is forbidden.**

It is not permitted to lift the engine before removing the transmission components connected to it or other machine components supported by the engine.

The capacity and size of the engine lifting system must be adequate for the weight and size of the engine; in particular, check that there is no fouling between the lift system and the engine components.

It is important to use a lift balance to hold the metal lift cables parallel.

DISPOSAL

Please note that the engine and its components contain material necessary for its operation which, if dispersed in the environment, may cause ecological damage.

The following materials must be consigned to special authorised collection centres:

- starter batteries
- used lubricating oils
- mixtures of water and anti-freeze
- filters
- auxiliary cleaning material (e.g. dirty or fuel-sodden rags)

Severe penalties are envisaged for transgressors, in accordance with the laws in force in every country.

WHAT TO DO IN AN EMERGENCY

Any user of the machine, constructed according to safety regulations, who follows the instructions set out in this manual and complies with the instructions on the labels affixed to the engine is working in safe conditions.

If operating mistakes cause accidents call for help immediately from the emergency services.

In the event of an emergency, and whilst awaiting the arrival of the emergency services, the following general advice is given for the provision of first aid.

Fire

Put out the fire using extinguishers recommended by the manufacturer of the machine or the installation..

Burns

1) Put out the flames on the clothing of the burns victim by means of:

- drenching with water
- use of powder extinguisher, making sure not to direct the jets onto the face
- blankets or rolling the victim on the ground.

2) Do not pull off strips of clothing which are sticking to the skin

3) In the case of scalding with liquids, remove the soaked clothing quickly but carefully;

4) cover the burn with a special anti-burn packet or with a sterile bandage.

Carbon monoxide poisoning (CO)

Carbon monoxide contained in engine exhaust gases is odourless and dangerous because it is poisonous and because, with the air, it forms an explosive mixture.

Carbon monoxide is very dangerous in enclosed premises because it can reach a critical concentration in a short time.

When attending a person suffering from CO poisoning in enclosed premises, ventilate the premises immediately to reduce the gas concentration.

When accessing the premises, the person providing the aid must hold his breath, not light flames, turn on lights or activate electric bells or telephones so as to avoid explosions.

Take the victim to a ventilated area or into the open air, placing him on his side if he is unconscious.

Caustic burns

1) Caustic burns to the skin are caused by acid escaping from the batteries:

- remove the clothes
- wash with running water, being careful not to affect injury-free areas

2) Caustic burns to the eyes are caused by battery acid, lubricating oil and diesel fuel.

- wash the eye with water for at least 20 minutes, keeping the eyelids open so that the water runs over the eyeball and moving the eye in all directions.

Electrocution

Electrocution can be caused by:

- 1) the engine's electrical system (12/24 V)
- 2) the electrical generator system (generating units)

In the first case, the low voltage does not involve high current flows through the human body; however, if there is a short circuit, caused by a metal tool, sparks and burns may occur.

In the second case, the high voltage causes strong currents which can be extremely dangerous.

If this happens, break the current by operating the switch before touching the injured person.

If this is not possible, bear in mind that any other attempt is highly dangerous also for the person assisting; therefore, any attempt to help the victim must be carried out without fail using means which are insulating.

Wounds and fractures

The wide range of possible injuries and the specific nature of the help needed means that the medical services must be called.

If the person is bleeding, compress the wound externally until help arrives.

In the case of fracture do not move the part of the body affected by the fracture. Move the injured person with extreme care and then only if strictly necessary.