

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

S HPI EURO 4

AUTOMOTIVE ENGINES



SOFIM HPI SERIES

S23 ENT 4

S30 ENT 4

USE AND MAINTENANCE

INTRODUCTION

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

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

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

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

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

The Manufacturer declines all liability for any errors or omissions.

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

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■ GENERAL INFORMATION

GUARANTEE

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

SPARE PARTS

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

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

LIABILITY

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

SAFETY

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

- ❑ The engines must only be used for the purposes indicated by the Manufacturer.
- ❑ Any tampering, modification and use of non-original spare parts may compromise proper operation and safe use of the engine; never, under any circumstances make modifications to the wiring and to the units equipping the engine, or connect them to other power systems.
- ❑ Pay particular attention to moving parts of the engine, to high temperature components and to circuits containing pressurised fluids; its electrical equipment houses electrical currents and voltage.
- ❑ Engine exhaust gases can be dangerous for health.
- ❑ The operations required to guarantee the best possible use and preservation of the engine must only be carried out by persons of proven experience, equipment with tools considered suitable by IVECO MOTORS-FPT approved staff.

See INSPECTIONS AND MAINTENANCE for further safety recommendations.

S23 ENT 4 ENGINE TECHNICAL DATA

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

Code	S23 ENT 4
Engine family	F1A
Cycle	4-Stroke Diesel
Number and arrangement of cylinders	4, in line
Bore x Stroke	88 x 94 mm
Total displacement	2,286 cm ³
Air supply	Supercharged and Aftercooled (TCA or TAA)
Injection type	Common Rail with electronic management
Engine rotation direction	Counter-clockwise (seen from flywheel side)
Dry weight	210 kg
Electrical system	12 V (rated)
Alternator	14 V - 110 A
Starter motor	12 V - 2.3 kW

Performance (*)

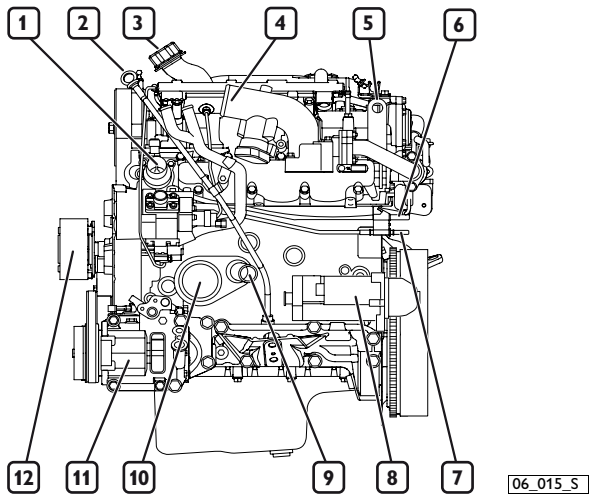
Maximum power Maximum torque

	71 kW (96 CV) @ 3900 rpm 240 Nm (24.4 Kgm) @ 1800 rpm
EURO 4 Light Duty	85 kW (116 CV) @ 3900 rpm 270 Nm (27.5 Kgm) @ 1800 rpm
	100 kW (136 CV) @ 3900 rpm 320 Nm (32.6 Kgm) @ 1700 rpm

(*) Flywheel net performance compliant with ISO 3046-1 standard. Testing conditions: T 25 C; atmospheric pressure 100 kPa; relative humidity 30%.

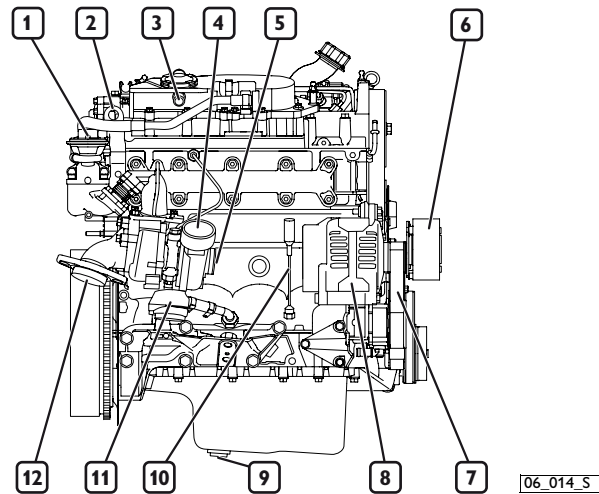
WARNING!

It is strictly forbidden to alter the above mentioned features and more specifically to change the information stored in the electronic units of the injection system or the engine and relevant fitting features. Any non observance of the above shall null any warranty and IVECO MOTORS-FPT liability.



S23 ENT 4 Engine

1. Coolant outlet to heat exchanger - 2. Dip-stick for oil level check - 3. Oil filler cap - 4. Engine air intake - 5. Lifting eyebolt - 6. Fuel outlet fitting to tank - 7. Fuel inlet fitting from tank - 8. Electrical starter motor - 9. Coolant inlet from heat exchanger - 10. Lubrication oil filter - 11. A/C compressor - 12. A/C compressor drive belt.



S23 ENT 4 Engine

1. E.G.R. adjustment valve - 2. Lifting eyebolt - 3. Blow-by vapour outlet to engine intake - 4. Air outlet to after-cooler - 5. Turbocharger air intake - 6. Pulley with electromagnetic coupling - 7. Auxiliary member drive belt - 8. Alternator - 9. Lubrication oil drain plug - 10. Oil level sensor - 11. Actuator for variable geometry turbine (VGT version only) - 12. Exhaust gas outlet from turbocharger.

S30 ENT 4 ENGINE TECHNICAL DATA

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

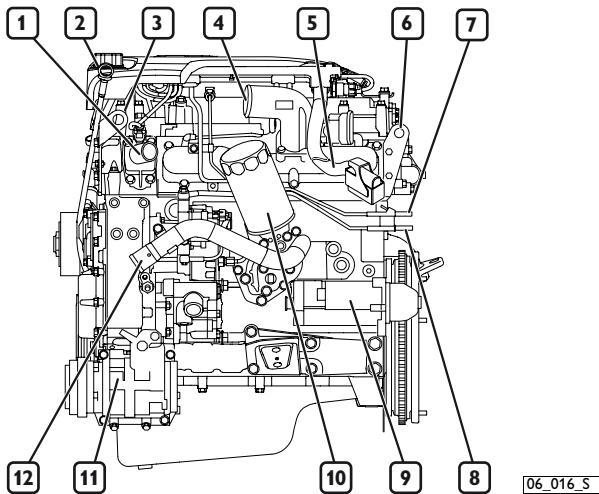
Code	S30 ENT 4
Engine family	F1C
Cycle	4-Stroke Diesel
Number and arrangement of cylinders	4, in line
Bore x Stroke	95.8 x 104 mm
Total displacement	2,998 cm ³
Air supply	Supercharged and Aftercooled (TCA or TAA)
Injection type	Common Rail with electronic management
Engine rotation direction	Counter-clockwise (seen from flywheel side)
Dry weight	245 kg
Electrical system	12 V (rated)
Alternator	14 V - 110 A
Starter motor	12 V - 2.3 kW

Performance (*)	Maximum power Maximum torque
EURO 4 Heavy Duty	80 kW (109 CV) @ 2,800 rpm 280 Nm (28.5 Kgm) @ 1,400 rpm
	90 kW (122 CV) @ 3,000 rpm 310 Nm (31.6 Kgm) @ 1,400 rpm
EURO 4 Light Duty Heavy Duty	107 kW (146 CV) @ 3,500 rpm 350 Nm (35.7 Kgm) @ 1,400 rpm
	130 kW (177 CV) @ 3,500 rpm 400 Nm (40.8 Kgm) @ 1,450 rpm

(*) Flywheel net performance compliant with ISO 3046-1 standard. Testing conditions: T 25 C; atmospheric pressure 100 kPa; relative humidity 30%.

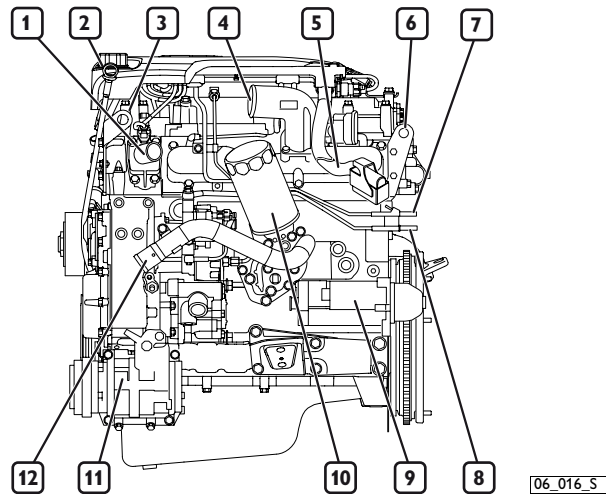
WARNING!

It is strictly forbidden to alter the above mentioned features and more specifically to change the information stored in the electronic units of the injection system or the engine and relevant fitting features. Any non observance of the above shall void any warranty and IVECO MOTORS-FPT liability.



S30 ENT 4 Engine

1. Coolant outlet to heat exchanger - 2. Dip-stick for oil level check - 3. Lifting eyebolt - 4. Engine air intake - 5. EDC system electric connector - 6. Lifting eyebolt - 7. Fuel outlet fitting to tank - 8. Fuel inlet fitting from tank - 9. Electric starter motor - 10. Lubrication oil filter - 11. A/C compressor - 12. Coolant inlet from heat exchanger.



S30 ENT 4 Engine

1. Air outlet to after-cooler - 2. Oil level sensor - 3. E.G.R. adjustment valve - 4. Oil filler cap - 5. Lifting eyebolt - 6. Pulley with electromagnetic coupling - 7. Auxiliary member drive belt - 8. Lubrication oil drain plug - 9. Alternator - 10. Turbocharger air intake - 11. Actuator for variable geometry turbine (VGT version only) - 12. Exhaust gas outlet from turbocharger.

LABELS

On the engine or on its parts, warnings may be available. The meaning is illustrated hereunder.

NOTE: The indications with an exclamation mark highlight a potential danger.



Lifting point (engine only).



**Fuel refill plug
(on tank, if available).**



Lubricant refill plug.



Lubricating oil dip-stick.



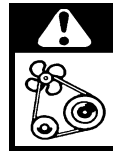
**Burn hazard:
Pressurised hot water expulsion.**



**Burn hazard:
High temperature parts.**



**Fire hazard:
Fuel presence.**



**Hazard of collision and contact
with moving parts:
Presence of fans, pulleys, belts or other.**

■ USE

PRELIMINARY CHECKS

Before each engine start-up:

- ❑ Check and refill technical fluids level if necessary (fuel, engine oil and coolant).
- ❑ Make sure that the air aspiration filter is not clogged or obstructed. If the engine is equipped with an electrical blockage sensor, an alarm will be displayed on start-up by means of the indicator light on the instrument panel.

NOTE: The current document refers only to the standard engine configuration and does not contain any explanation related to the checks of the power train parts and components installed on the engine. Refer to the corresponding documentation of the manufacturer for any information about those systems.

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.

STARTING AND STOPPING THE ENGINE

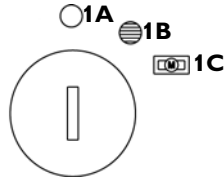
The start-up and shut-down operations described below are applicable if is available on-board a key switch that is peculiar to automotive application; if the Manufacturer of the vehicle or machine has fitted a customised instrument panel, these operations may vary according to the various choices made during manufacturing. In these cases, follow the start-up/shut-down sequences and use the instrument panel description provided in the specific documentation.

Starting the engine

1. Insert the key into the switch (1) and turn it to the right to position **1B** RUN. Once the indicator lights have been tested, check the plausibility of the indications on the dashboard.
2. If the engine is fitted with a pre-heating system (optional) and the engine temperature is lower than the minimum value foreseen for it to come into operation, wait for the relevant indicator light to go out.
3. Turn the key to position **1C** START and release it once the engine has started, without accelerating.
4. In the event that the efficiency indicators such as the “Accumulator recharge” or “Oil pressure” are available on the on-board equipment, check that the operation status is appropriate. If the pre-heating system is enabled, the relevant indicator will turn on again to indicate that the post-heating phase is in progress; the duration of this function is proportional to the temperature value.

5. If the engine does not start, after releasing the key it will only be possible to turn it back to the start position after first returning the switch to the rest position **1A**.

Detail of the key switch



06_001_S

- 1A** REST position allowing the key to be removed
1B Stable RUN position
1C Unstable START position

Stopping the engine

Before stopping the engine it is recommended to keep it running at idle and unloaded for a few minutes; this will allow a uniform decrease of temperature and avoid harmful thermal shocks.

Shutting down the engine:

- Turn the key switch to position **1A** REST.

Restarting the engine:

1. Return the key switch from the position **1A** to position **1B** only after a few minutes.
2. Turn the key to position **1C** START and release it once the engine has started, without accelerating.
3. Proceed as described previously.

CAUTION!



In the event of momentary stoppages of the engine, check for any alarm signals. Do not restart the engine until the cause of the problem has been removed or proper operating conditions have been restored.

Starting the engine at low temperatures

Electrical devices - managed by the Electronic Control Unit controlling the engine - for the preheating of the inducted air are used to assist the starting of the engine at low temperatures. In the event that the starting of the engine is not requested anymore after the key has been turned on the position **1B** RUN, the device will be disabled shortly after the relevant indicator light is off.

Proceed to the next starting repeating the sequence beginning with the key on the position **1A** REST.

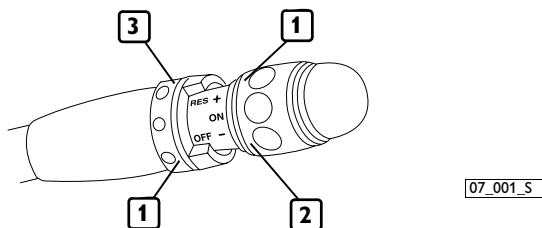
EDC indicator light - Electronic Diesel Control (if applicable)

In the event that, after the starting phase, the EDC indicator light is on, contact a centre of the Service Network asking for instructions. The anomaly state - recognised by the electronic unit managing the engine - may allow the vehicle to reach the Service Centre (for more information see the section ENGINE MALFUNCTIONS).

ENGINE RPM AND SPEED MANAGEMENT - PTO / CRUISE CONTROL (optional)

Some vehicles are equipped with optional controls through which they manage the engine rpm or the vehicle speed. Management is done manually by using the push-buttons located near the steering wheel or another suitable position; here are their functions:

- ON+** Increase rpm or speed (1)
- ON -** Decrease rpm or speed (2)
- RESUME** Save a new data or recall the last data setting (3)
- OFF** Disable the function currently active (4)



- The figure is relevant to an IVECO MOTORS-FPT component -

Engine speed setting with the POWER TAKE-OFF engaged (if foreseen)

The procedure here below will be triggered only if the engine has achieved the operating temperature and the vehicle is parked. The procedure must be completed without applying any load to the engine.

1. Start the engine and wait until has been reached the idle speed. Apply the parking brake.
2. Apply the clutch pedal and, after 5 seconds, enable the PTO following the instructions shown in the relevant documentation.
3. Once the PTO has been engaged, and the relevant PTO indicator light is on, slowly release the clutch pedal and wait for the pre-set value of 1200 rpm has been reached.
4. Act on the ON + or ON – buttons to adjust the speed at the desired value or press the RESUME button for 1 second to recall the value previously set.
5. Press the RESUME button for about 5 seconds to save the new value.

Press the clutch pedal to take back the engine to the idle value and disable the PTO.

Speed adjustment or CRUISE CONTROL (if foreseen)

The CRUISE CONTROL function allows to set/modify the vehicle speed without using the accelerator pedal. The CRUISE CONTROL should not be used under heavy traffic conditions or on roads where the driver must have a constant control on the vehicle speed.

The function is active only if the following conditions are met:

- Vehicle in motion with the transmission gear engaged;
- Vehicle speed exceeding 30 km/h;
- The brake pedal is not applied;
- The clutch pedal is not applied;

ON + button:

- Pressed only once, it allows to release the accelerator pedal and retain the speed achieved by the vehicle at that moment.
- Kept pressed, after the first time, it allows to increase the vehicle speed without using the accelerator pedal.

ON - button:

- Pressed after the ON + button, it allows to decrease the vehicle speed.

RESUME button:

- Pressed while driving it recalls the last saved speed value setting. The vehicle will achieve the set speed depending on the selected transmission gear.

OFF button:

- It disables the CRUISE CONTROL function.

Tip function:

- By shortly pressing the ON + or ON - button, the vehicle speed varies by 1 km/h (i.e. by pressing ON + three times at the speed of 60 km/h, the vehicle reaches 63 km/h; by pressing ON - three times, the vehicle reaches 57 km/h).

Disabling the CRUISE CONTROL

The function is automatically disabled in the following cases:

- When the maximum rpm speed is reached.
- By applying the brake pedal.
- By applying the clutch pedal.
- When the minimum enabling speed is reached.

- By accelerating to reach a higher speed with respect to the set one:
 - a) If the action lasts less than 3 minutes, the function is temporarily disabled and the electronic unit takes the vehicle back to the speed previously set when the pedal is released;
 - b) If the action lasts more than 3 minutes the CRUISE CONTROL function is permanently disabled.

FOR PROPER USE OF THE ENGINE

- ❑ Do not leave the key turned to the start position **1C**, when the engine has been started.
- ❑ It is not efficient to leave the engine running at idle while waiting for it to reach the proper working temperature; it is preferable that, after approximately one minute from start-up, you gradually increase the engine load.
- ❑ Do not leave the engine running at minimum speed for a long time as this does not guarantee a smooth engine operation.
- ❑ The engine speed must be increased and decreased gradually, to allow a proper operation of all engine components.
- ❑ The running speed and power values must comply with the specifications of the technical and commercial documentation.

During use, check that:

1. The engine coolant temperature does not reach the alarm threshold.
2. The oil pressure remains within normal values.

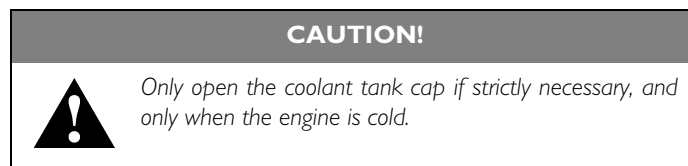
If the temperature is considered too high, reduce speed and stop to check the state of the cooling system circuits; also check and have checked:

- a) the tension of the auxiliary member drive belt;
- b) operation of the thermostatic valve;
- c) whether or not the heat exchanger is clean.

SPECIAL WARNINGS

Coolant circuit

When a state of “Coolant temperature high” is found, this triggers off the limitation of the maximum power of the engine. In these cases check the efficiency of the circuit components, remembering that when the engine is warm, a pressure liable to cause hot liquid to be expelled with extreme violence is created within the cooling circuits. This results in a danger of burning.



Lubrication circuit

When a state of “Oil pressure low”, is found, this triggers off the stoppage of the engine; in this case, check the oil level and top up if necessary, following the instructions given in the chapter on **INSPECTIONS AND MAINTENANCE**.

If the condition persists, contact a Service Centre.

Fuel circuit

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.

CAUTION!



When refuelling, always pay great care to ensure that no solid or liquid pollutants enter the fuel tank; you must also remember that smoking and live flames are prohibited when refuelling.

CAUTION!



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

Air intake and exhaust gas circuit

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; with respect to the indications provided in the chapter INSPECTIONS AND MAINTENANCE.

CAUTION!



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

Electrical system of the engine

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 INSPECTIONS AND MAINTENANCE. Remember that the engine Electronic control units are programmed to increase the running speed at idle if the voltage in the electrical system reaches values considered to be at the limits of efficiency. In this case, check the efficiency of the battery/ies and if necessary perform a check-up on the system components. Should it be necessary to replace the batteries, always respect the capacity and minimum discharge current intensity requirements.

WARNING!

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).

CAUTION!



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.

Emergency starting

If the battery is low, it is possible to start the engine using an auxiliary battery equivalent to the on-board battery as to electrical specifications. Observe the following instructions:

- ❑ Disconnect all the electrical devices that are currently not essential.
- ❑ Connect through an appropriate cable the positive pole of the auxiliary battery to the positive pole of the on-board battery.
- ❑ Connect through another appropriate cable the negative pole of the auxiliary battery to the negative pole of the on-board battery, preferably to an electrical ground of the vehicle located near the starter motor.
- ❑ Start the engine and remove the auxiliary cables within minutes, following the previous connection procedure in reverse order.
- ❑ If the engine does not start after various attempts, it is recommended contacting the Service Centre for adequate servicing.

The push-start is not advisable but possible if the battery can supply enough energy to the Electronic units, engine and vehicle actuators by enabling a smooth operation.

WARNING!

Connect the auxiliary battery without removing the connections of the on-board battery.

CAUTION!



It is forbidden to start the engine using "quick battery charger" in order to avoid damaging the Electronic units equipping the engine and vehicle.

Prescriptions for maintenance operations

In order to avoid damaging or demeaning the functioning of the Electronic units equipping the engine or the vehicle, observe the following prescriptions:

- ❑ Do not remove the vehicle battery connections when the engine is running or when the starter switch is on RUN.
- ❑ Do not disconnect the connectors of the Electronic units with the engine running or with the key switch in position RUN. If necessary, perform the operation within minutes after having set the key switch in position STOP and shut down the engine.
- ❑ Disconnect the battery from the on-board system in the event that a recharge is necessary.
- ❑ After every maintenance operation involving disconnection of the battery/ies, make sure that the terminals have been properly tightened onto the poles again.
- ❑ Carrying out arc welding operations by building or repairing the vehicle, disconnect the positive terminal from the battery and connect it to the electrical ground, remove the connections from the Electronic units observing the information supplied. If the welding operations involve parts in the proximity of Electronic units, disassembly them from the vehicle.

- ❑ Carry out direct current weldings being careful to connect the ground terminal in the proximity of the concerning point.
- ❑ Do not paint appliances, components and electrical connectors equipping the engine.
- ❑ Remove from the vehicle any Electronic units if it has to be exposed to temperatures above 80°C.
- ❑ It is desirable disconnect the negative pole of the battery before carrying out operations involving the electrical system of the vehicle.

CAUTION!



Never spray with detergents or wash the engine when equipped with the electronic systems or electrical components. For requests for information contact a Service Centre.

Safeguarding the anti-pollution devices

The proper operation of the anti-pollution devices ensures the protection of the environment and the best engine performance as well. Keeping them in good state is then essential for an economic and environment-friendly driving.

Particulate filter (if available)

The Diesel Particulate Filter (DPF) is a filter that enables the holding of fine particles produced during the combustion. It is maintenance-free as the Electronic unit controlling the engine triggers its regeneration process periodically. The regeneration process only starts when the Electronic unit detects an above-average speed for the duration of a few minutes.

The regeneration process ends when the Electronic unit detects a decrease of the solid particles quantity in the filter, or when a speed variation has occurred.

In order to achieve effective regeneration, it is necessary to comply with the maintenance schedule shown in this document and, every time oil is changed, one should make sure the "DPF regeneration time counter" of the engine control electronic unit is zeroed (for more information see the section ENGINE MALFUNCTIONS).

RUNNING-IN

Thanks to the engine construction advanced technology, non special running-in procedure is required. However it is recommended to avoid at least for the first 50 hours, using the engine at high speeds for extended periods of time.

REFILLING

Parts to be refilled	S23 ENT 4 litres (kg)	S30 ENT 4 litres (kg)
Cooling circuit ⁽¹⁾ Total capacity	4.0	6.9
Lubrication circuit ⁽²⁾ Total capacity ⁽³⁾	6.0 (5.4)	7.0 (6.3)
Periodical replacement:		
Oil sump at minimum level	3.0 (2.7)	4.2 (3.8)
Oil sump at maximum level	4.3 (3.9)	6.6 (5.9)
Power steering oil ⁽⁴⁾	(6)	(6)
Fuel tank ⁽⁵⁾	(6)	(6)

(1) The amounts indicated relate to the standard configuration of the engine only.

(2) Use a water and PARAFU 11 mixture at 50% also during summer. As an alternative to PARAFU 11, use a product complying with SAE J 1034 international standards.

(3) Use lubricants complying with the following international specifications: ACEA B5 (associated to fuels with a sulphide percentage of < 0,5%), MIL - L - 2104 F.

Using oil with different specifications reduces the replacement interval.

The grade of viscosity to be used in relation to environment temperature can be found in the table in the appendix.

The oil consumption is considered as acceptable up to a quantity equal to 0.5% of fuel consumption.

(3) The quantities shown refer to the first refilling and concern the refilling of engine, oil sump and filter.

(4) It is recommended the use of Tutela GI/A or product complying with the ATF DEXRON IID standard.

(5) Use STANDARD fuel compliant to the EN 590:1993 (maximum sulphur percentage of 0.2%). The use of additives is discouraged. A fuel known as BIO DIESEL is allowed only if it is compliant with the EN 14214 norm, mixed in standard fuel with a maximum percentage of 5%. KEROSENE-based fuel known as XF63, F63, F34, F35, JP8 is not allowed. Mixtures containing water as in a boiler are not permitted, as shown in the CUNA NC 637-01 (GECAM) and AFNORM 5-02 (AQUAZOLE) norms.

(6) Refer to the indications of the vehicle manufacturer.

WARNING!

Refuelling from drums or tanks may result in pollution of the diesel fuel, with the risk of damage to the injection system; if necessary, filter the fuel in a suitable manner or allow sedimentation of the impurities before refuelling.

Low temperature diesel oil

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 climatic and geographic conditions of the various Countries be distributed.

■ INSPECTIONS 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.

Inspections: by workshop technicians or the vehicle user if necessary.

Periodic maintenance: by qualified personnel equipped with suitable equipment and adequate means of protection. Operations marked by the spanner symbol.



Extraordinary maintenance: by qualified Service Centre personnel with specific technical information and equipment. Operations marked by the spanner symbol.



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

ACCIDENT PREVENTION

- Always wear safety shoes and overalls.
- Do not wear loose garments, rings, bracelets and/or necklaces near the engines or moving parts.
- Wear safety gloves and goggles when:
 - refilling batteries with acid solution

- refilling with inhibitors or deicers
- replacement or refilling of lubricants (hot engine oil can cause burns. 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 components at high temperature.
- Wear goggles when using 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 creams.
- Replace wet overalls immediately.
- 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.

FREQUENCY

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.

Checks	Frequency
Check oil level in engine	Every trip
Check coolant level	Every trip
Drain water from the fuel filter	Weekly
Check power steering oil	Weekly
Check/top up electrolyte level in batteries and clean terminals	Half-yearly



Periodic maintenance	Frequency
Check belt tension and conditions	40,000 Km / 800 hours
Engine oil replacement	40,000 Km / 800 hours ⁽²⁾ ⁽³⁾
Oil filter replacement	40,000 Km / 800 hours ⁽²⁾ ⁽³⁾ ⁽⁴⁾
Fuel filter replacement	40,000 Km / 800 hours ⁽¹⁾ ⁽²⁾ ⁽⁴⁾
Fuel pre-filter replacement	40,000 Km / 800 hours ⁽¹⁾ ⁽²⁾
Power steering oil replacement	40,000 Km / 800 hours ⁽²⁾
EDC system check-up	120,000 Km / 2400 hours
Various drive belt replacement	120,000 Km / 2400 hours ⁽⁶⁾
Air filter cleaning	Yearly
Check coolant density	Yearly
Air filter replacement and housing cleaning	3 years ⁽⁵⁾
Coolant replacement	3 years



Extraordinary maintenance

Frequency

Valve clearance adjustment:

first intervention	150,000 km
and then every	300,000 Km

Pre-heating glow plugs replacement	240,000 Km / 5 years
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Various drive belt tensioning device replacement	240,000 Km / 5 years
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Timing system belt and tensioning device replacement (F1A)	240,000 Km ⁽⁷⁾ / 5 years
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Timing system chain and tensioning device replacement (F1C)	400,000 Km
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Catalytic converter replacement or with particulate filter	400,000 Km
--	------------

- 1) Maximum period for using good quality fuel (EN 590 standard). It is reduced based on the dependency on fuel contamination and on the alarm signals for pre-filter/filter clogging and/or water in the filter. The filter clogging warning requires its replacement. If the water alarm is not disabled after draining, the filter needs to be replaced.
- 2) To be performed every year even if the operating hours expected are not met.
- 3) Frequency applicable to lubricants as provided in REFILLING table.

The replacement interval is halved when using oils that do not meet the specifications, and using fuels with a sulphide percentage exceeding 0.5%.

- 4) Use only filters with the following features:
 - filtering degree < 12 µm
 - filtering efficiency β > 200.
- 5) Frequency is based on ambient and efficiency/wear conditions of the product.
- 6) Using the vehicle in heavy conditions (dusty area or high temperatures), replace every 60,000 km or 1,200 hours.
- 7) Using the vehicle in heavy conditions (dusty area or high temperatures), replace every 120,000 km or 2,400 hours, but do not exceeds 5 years.

WARNING!



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

HOW TO

WARNING!

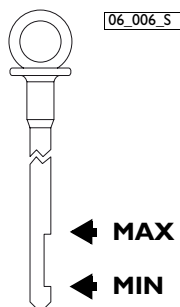
It is advisable that operators must observe the prescriptions described in the section SPECIAL WARNINGS.

Engine lubricant level inspection

To avoid risk of burns only proceed when the engine is not running and is cool.

For the dip-stick position refer to the illustrations on pages 5 and 7.

- ❑ Make sure that the vehicle is levelled.
- ❑ Using the dip-stick (1), that the oil quantity is between MIN and MAX limits.
- ❑ If the level is insufficient, remove the cap located on the top of the cylinder head and refill the lubricant through the filler.



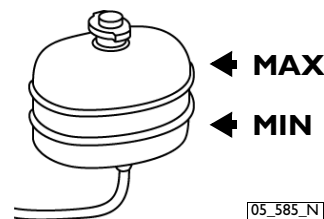
WARNINGS!

- ❑ After refilling make sure oil level does not exceed the limit "Max" on the stick.
- ❑ Insert the dip-stick all the way down and tighten the cap by turning it clockwise until it comes to a full stop.

Coolant level inspection

Proceed only with engine not running and at low temperature to avoid any risk of burns.

- ❑ With the engine at low temperature, make sure that the fluid level in the expansion tank is above the minimum level.
- ❑ Visually check that the fluid level is not more than 2/3 of the height of the tank in order to enable any increase in volume of the fluid caused by the temperature increase.
- ❑ Top up the tank if necessary, using clean water. Do not use distilled water; see the table REFILLING.



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

In the event that only the heat exchanger without the expansion tank is available on the vehicle, refill it if necessary, paying attention that the fluid does not saturate the internal volume of the exchanger in order to enable any increase in volume of the fluid caused by the temperature increase.

CAUTION!



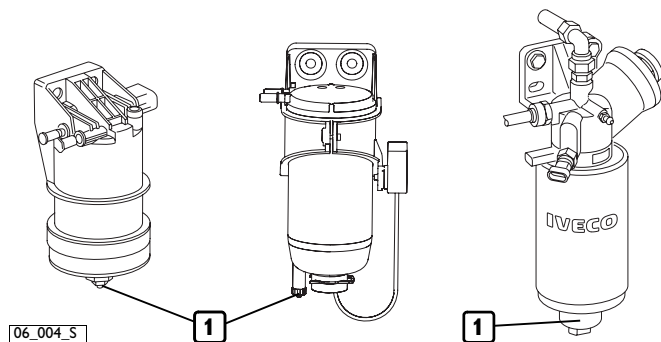
When the engine is warm, a pressure liable to cause hot liquid to be expelled with extreme violence is created within the cooling circuits. This results in a danger of burning.

Draining water from the fuel filter

Depending on its use, some vehicles adopt a fuel pre-filter as well. The high risk of refuelling with fuel that is polluted by foreign bodies and water makes it advisable to carry out this control every time you refuel.

Proceed with the engine not running.

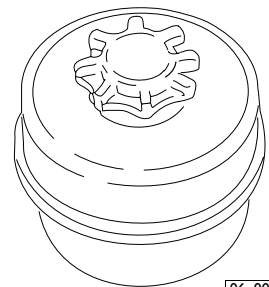
- ❑ Place a container under the filter or pre-filter to collect the fluid.
- ❑ Unscrew the tap plug (1) in the bottom part of the filter; in some lay-outs the plug includes a sensor to detect the presence of water in the fuel.
- ❑ Drain off liquid until only fuel can be seen.
- ❑ Close the plug again, tightening it completely by hand.
- ❑ Dispose of the drained fluids according to current regulations.



Checking power steering oil

(Only referred to components without level sensor)

- ❑ Open the cap of the storage tank. Only loosen it when the engine is not running.
- ❑ Check through the dip-stick located under the cap that the quantity of hydraulic oil is between the limits. If necessary, refill according to the table REFILLING.
- ❑ Start the engine and perform any steering operations.
- ❑ Close the plug again, tightening it completely by hand.



Checking/topping up electrolyte level in batteries

Place the batteries on a level surface, then proceed as follows.

- ❑ Visually check that the fluid level is between the "Min" and "Max" limits; in the absence of references, check that the fluid covers the Lead plates inside the elements for about 5 mm.
- ❑ Top up with distilled water only those elements in which the level is below the minimum.
- ❑ On this occasion, make sure that the terminals and clamps are clean, properly tightened and protected by Vaseline.

WARNING!

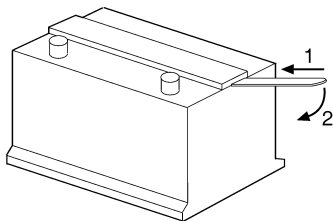


If all the elements of the battery need refilling with a considerable quantity of distilled water, contact specialised technical personnel in order to perform a diagnostic check on the efficiency state of the recharge system and battery.

CAUTION!



- The batteries contain sulphuric acid, which is extremely caustic and corrosive; always wear protective gloves and goggles when topping them up. Whenever possible it is recommended that this control be carried out by specialised personnel.*
- Do not smoke or use live flames near the batteries during the control, and make sure that the room you are working in is adequately ventilated.*



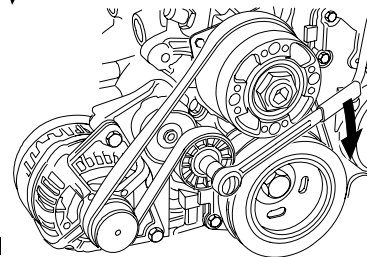
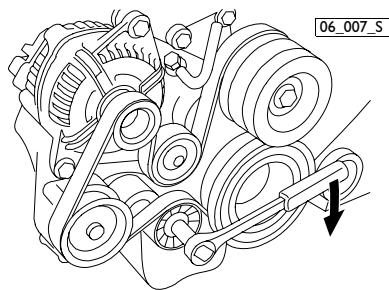
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Some types of battery have a single cover for all the inspection plugs. To access the elements, use a lever as shown in the figure.

Checking tension and state of the auxiliary member drive belt

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

- Remove any casing protecting the pulleys.
- Check that the belt is not torn or worn, and that there are no lubricants or fuel on it. If this is not the case, replace them.
- At the same time, make sure that the tensioning device is working properly, proceeding as shown in the figure.
- Replace the guard casing in its housing, and lock all the retaining elements.



Replacing the lubricant oil

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

For the location of the drain plug and oil filler refer to the illustrations on pages 5 and 7.

- ❑ Place a container under the drainage plug to collect the used oil (see illustrations in the chapter ENGINE TECHNICAL DATA).
- ❑ Unscrew the plug and wait until the sump has emptied completely, then fasten the plug in place again.
- ❑ Fill up through the feeder hole (1) on the timing system cover or (2) as shown in the figure, using the types and amounts of oil indicated in the table REFILLING.
- ❑ Using the dip-stick (3), check that the oil level is between the "Min" and "Max" levels.
- ❑ Dispose of used oil according to current regulations.
- ❑ Make sure the "DPF regeneration time counter" of the electronic unit managing the engine is zeroed (for more information see the section ENGINE MALFUNCTIONS).

WARNINGS!

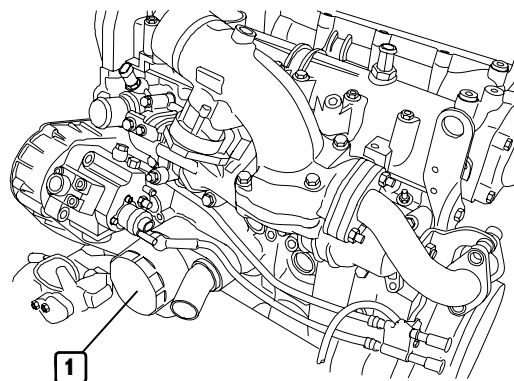
- ❑ After refilling make sure that the oil level is not above the MAX limit on the dip-stick.
- ❑ Make sure that the dip-stick has been fully inserted and the filler cap tightened clockwise up to a complete stop.

Replacing the engine oil filter

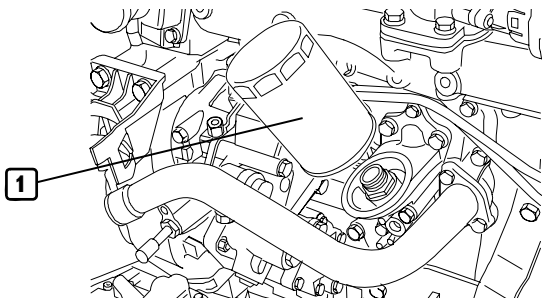
Only proceed with the engine stopped and at a low temperature, so as to avoid the risk of burning.

Only use filters with a filtration level equivalent to the ones you are replacing (see section FREQUENCY).

- ❑ Place a container under the filter support, to collect the used oil.
- ❑ Unscrew the filter and remove it (1).
- ❑ Carefully clean the surfaces of the support that are in contact with the seal (2).
- ❑ Moisten the new filter seal with a thin layer of oil.
- ❑ Hand screw the new filter into place until the seal gasket touches the support, then lock by a further 3/4 of a turn.
- ❑ Dispose of the old filter according to current regulations.



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06_010_S

Replacing the fuel filter

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

Refer to the illustrations on page 20.

Only use filters with a filtration level equivalent to the ones you are replacing (see section FREQUENCY)

- Remove the filter (1) by unscrewing it.
- Check that the new filter has performance levels that meet the needs of the engine.
- Moisten the new filter seal with diesel or engine oil.
- Hand screw the new filter into place until the seal gasket touches the support, then lock by a further 3/4 of a turn.
- Pay particular attention to the electrical fuel pre-heater and relevant electrical connection (1).

NOTE: The supply systems of the different engines do not require bleeding.

WARNING!

Do not fill up the new filter before it is fitted to the support, to avoid inserting harmful impurities into the injection system and circuit.

WARNING!

In the event that fuel pipings have to be disconnected, clean with the utmost care the fittings before connecting them again. Make sure that the seal is appropriate by starting the engine. If leakages occur take adequate countermeasures against this immediately.

CAUTION!



Never loosen the high pressure common rail injection circuit fitting in any way. Do not carry out unnecessary and dangerous bleeding attempt.

Replacing the power steering oil

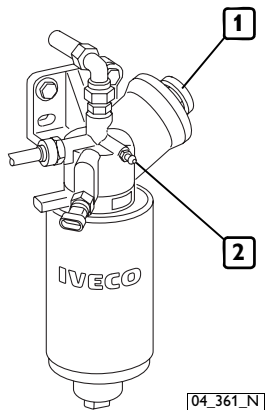
Only proceed with the engine stopped.

- Open the cap of the storage tank and remove the pipe from the fitting with the steering hydraulic actuator.
- After emptying, connect the pipe again being careful to use a new clamp and fill the circuit again.
- Check that the oil quantity is appropriate following the instructions described in the section dealing with the level check.

Replacing the fuel pre-filter (if available)

Only proceed with the engine stopped.

- ❑ Remove the pre-filter by unscrewing it.
- ❑ Check that the new filter has performance levels meeting the needs of the engine (e.g. by comparing them with the old one).
- ❑ Moisten the new filter seal with diesel or engine oil.
- ❑ Hand screw the new filter into place until the seal gasket touches the support, then lock by a further 3/4 of a turn.
- ❑ Loosen the bleeder screw (2) on the pre-filter support and activate the hand pump (1) until the supply circuit is full. Ensure that any fuel coming out is not dispersed into the environment.
- ❑ Lock the bleeder screw tightly.
- ❑ Start the engine and run it at minimum speed for a few minutes to eliminate any residual air.



EDC system check-up

The diagnostic inspection can be carried out by using the diagnostic tool supplied by the IVECO MOTORS-FPT Technical Service Network to the appropriate connector.

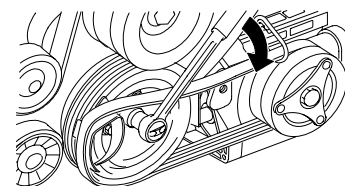
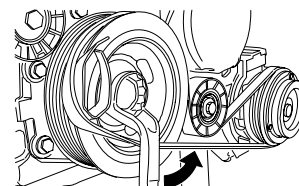
The inspection could underline that the system is operating even if some problems are present. In this case make provision to carry out an exhaustive check-up.

Replacing the various drive belt/s

For replacing the auxiliary member drive belt, refer to the information given in the section concerning the check of the belt tension. For replacing the A/C compressor drive belt, observe the following procedure:

- ❑ Remove the old belt from its seat.
- ❑ Install the new belt as shown in the illustration, being careful not to damage and tear it.

NOTE: The use of a special tool supplied by the IVECO MOTORS-FPT Technical Service Network is set out.

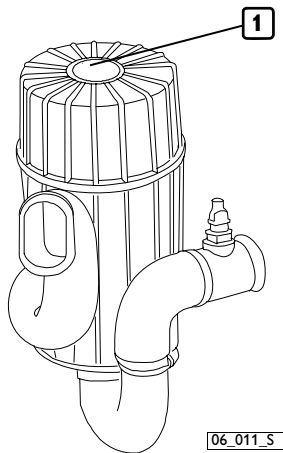


Cleaning or replacing the air filter

(For IVECO MOTORS-FPT component only)

Only proceed with the engine stopped.

- ❑ Remove the cover (1) of the filter housing and extract the cartridge paying attention that the dust does not get into the sleeve.
- ❑ Blow the filtering element by means of dry and compressed air, acting from the inside outwards (max. pressure: 200 kPa).
Avoid using detergents; do not use diesel oil.
- ❑ Never hit the filtering element by means of tools, and check its condition before reinstalling it.
- ❑ In the event that breakages or tears take place, or it is not possible to remove the impurities, replace it.
- ❑ Check that the gasket base is in good condition.
- ❑ Reassembly the filtering element and close the housing.



Checking coolant density or replacing coolant

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

In the event that a mixture of PARAFLO 11 and water is used, the density value is equal to $1,0675 \text{ g/cm}^3$ (at a temperature of 15°C).

For replacing the coolant, observe the following procedure:

- ❑ Provide suitable containers to ensure that no coolant is dispersed into the environment.
- ❑ Remove the cap of the expansion tank.
- ❑ Loosen the seal elements, remove the sleeves connecting the engine circuit to the heat exchanger and wait until it has emptied completely. When empty, repair the circuit making sure that the sleeves are perfectly sealed.
- ❑ Fill up the circuit as indicated in the table REFILLING.
- ❑ Bleed the circuit and top-up if necessary.

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 eyebolts 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 eyebolts provided simultaneously; the use of a single eyebolt only is not allowed.

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 transmission members that are coupled to it.

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; the laws in force in the various Countries foresee severe penalties for transgressors:

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

■ LONG ENGINE INACTIVITY

PREPARING THE ENGINE FOR A LONG PERIOD OF INACTIVITY

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

1. Drain the lubricant from the sump, after first warming up the engine.
2. Fill the engine with protective oil type 30/M (or alternatively oil that complies with MIL 2160B type 2 specifications), up to the "minimum" level indicated on the dip-stick. Start the engine and keep it running for approximately 5 minutes.
3. Drain the fuel from the injection circuit, from the filter and from the injection pump pipes.
4. Connect the fuel circuit to a tank containing CFB (ISO 4113) protective fluid, and feed in the fluid by putting the circuit under pressure and running the engine for approximately 2 minutes, after first disabling the injection system. This operation can be performed by polarising terminal 50 of the starter motor with a positive voltage equivalent to the rated voltage of the system, using a conductor provided for that purpose.
5. Nebulise approximately 10 g per litre displacement of 30/M protective oil into the turbocharger suction inlet, during the pressurised filling operation described in the previous point.
6. Close all the suction, delivery, ventilation and bleeder openings in the engine with suitable plugs, or seal them with adhesive tape.

7. Drain the residual 30/M protective oil from the sump. This oil can be used again for a further 2 preparation operations.
8. Fit signs reading ENGINE WITHOUT OIL to the engine and to the on-board control panel.
8. Drain the coolant, if it has not been mixed with suitable antifreeze and corrosion inhibitors, and affix a sign to indicate the fact.

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

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

Should you intend to protect external parts of the engine, proceed by spraying OVER 19 AR protective liquid on unpainted metal parts, such as the flywheel, pulleys and the like, avoiding belts, connector cables and electrical equipment.

RESTARTING THE ENGINE AFTER A LONG PERIOD OF INACTIVITY

1. Drain the residual 30/M protective oil from the sump.
2. Fill the engine, as prescribed, with lubricant of the type and amount indicated in the table REFILLING.
3. Drain the CFB protective fluid from the fuel circuit, carrying out this operation as indicated under point 3. of PREPARING THE ENGINE FOR A LONG PERIOD OF INACTIVITY.
4. Remove the plugs and/or seals from the suction, delivery, ventilation and bleeder openings in the engine, restoring it to a normal state of use. Connect the turbocharger suction inlet to the air filter.
5. Connect the fuel circuits to the vehicle fuel tank, completing the operations as indicated in point 4. of PREPARING THE ENGINE FOR A LONG PERIOD OF INACTIVITY. During filling operations, connect the fuel return pipe to a collection tank, so as to prevent any residual CFB protective fluid from flowing into the machine fuel tank.
6. Check the engine and fill it up with coolant as prescribed, bleeding it if necessary.
7. Start the engine and keep it running until the idling speed rate has stabilised completely.
8. Check that the instruments on the on-board control panel/s are showing plausible values, and that no alarms are shown.
9. Stop the engine.
10. Remove the ENGINE WITHOUT OIL signs from the engine and from the on-board control panel.

■ ENGINE MALFUNCTIONS

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

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

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

EDC anomaly signalling modes

The different switch-on modes of the EDC indicator light show different anomaly states:

Off

Regular operation or temporary data absence compensated by the safety strategy.

On

An anomaly has been recognised and a power limitation has occurred but it is possible to continue driving slowly. Contact the Technical Service Network and ask for instructions.

Blinking

A serious anomaly has been recognised and the engine must be stopped. It is possible an emergency stop generated by the electronic unit. Reach a safety condition, stop the engine, and call out the Technical Service Network.

Operation at reduced performances as a result of missed DPF regeneration

If, at every oil change, the DPF (Diesel Particulate Filter) regeneration time counter is not zeroed, when the maximum expected hour limit is reached, the electronic unit will start managing the engine at reduced performances.

As we do not have the information tools provided to the technical IVECO MOTORS-FPT Assistance Network, and if the electric set up of the vehicle has been suitably arranged, please proceed as indicated below:

1. Stop the engine and take the key switch on the RUN position or energize the electric system on board the vehicle as otherwise instructed.
2. Press the accelerator pedal/lever for at least 15 seconds, during which the actions described under point 3 must be carried out.
3. For 10 consecutive times, press the brake pedal to the bottom and then release it.
4. Take the key switch to the REST position.

Accelerator electronic circuit malfunction

When certain problems are recognised, the Electronic Unit controlling the engine adopts a strategy that will enable running/work to continue in emergency mode.

The possible operating modes of the strategy, known as “accelerated minimum speed running”, are as follows:

- A.** The accelerator does not “respond”: the running speed stabilises at a speed higher than the idle to allow the machine to proceed slowly and be manoeuvred simply by engaging the clutch on and off, **without accelerating.**

- B.** The accelerator “responds partially”: when the accelerator is moved to approximately half way, the speed gradually increases up to 2000 rpm; releasing the accelerator the speed rapidly decreases up to the idle.

CAUTION!



The engine electronic control unit can adopt safety strategies at any time during use of the machine or vehicle, should conditions arise that are considered to put the engine at risk.

When conditions of this kind occur, proceed only if necessary and with the greatest possible care and attention.

Malfunction in the recharging system

The Electronic engine control units are programmed to increase the minimum running speed if the voltage in the electrical system reaches values considered to be at the limits of efficiency. In this case, check the efficiency of the battery/ies and if necessary perform a check-up on the system components.

CAUTION!



Do not leave vehicles or machines with the engine running without first putting the parking lock or brake on

■ BEHAVIOUR IN AN EMERGENCY

The user of a vehicle 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.

Engine malfunctions

When operating with a malfunctioning engine, take the greatest possible care when manouevring and make sure that all those aboard are holding firmly to safe hand-holds (see section on ENGINE MALFUNCTIONS)

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

1. 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.

2. Do not attempt to remove pieces of clothing that may have stuck to the skin;
3. In the case of scalding, immediately but carefully remove any clothing that may be soaked in the hot liquid;
4. 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:

1. Ventilate the room immediately, to reduce the concentration of gas.
2. When entering the room, hold your breath, do not light flames, lights or ring electric doorbells or phones, to avoid the risk of explosion.
3. 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:

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

Injuries and fractures

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

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

Caustic burns

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

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

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

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

