TECHNOLOGICAL EXCELLENCE

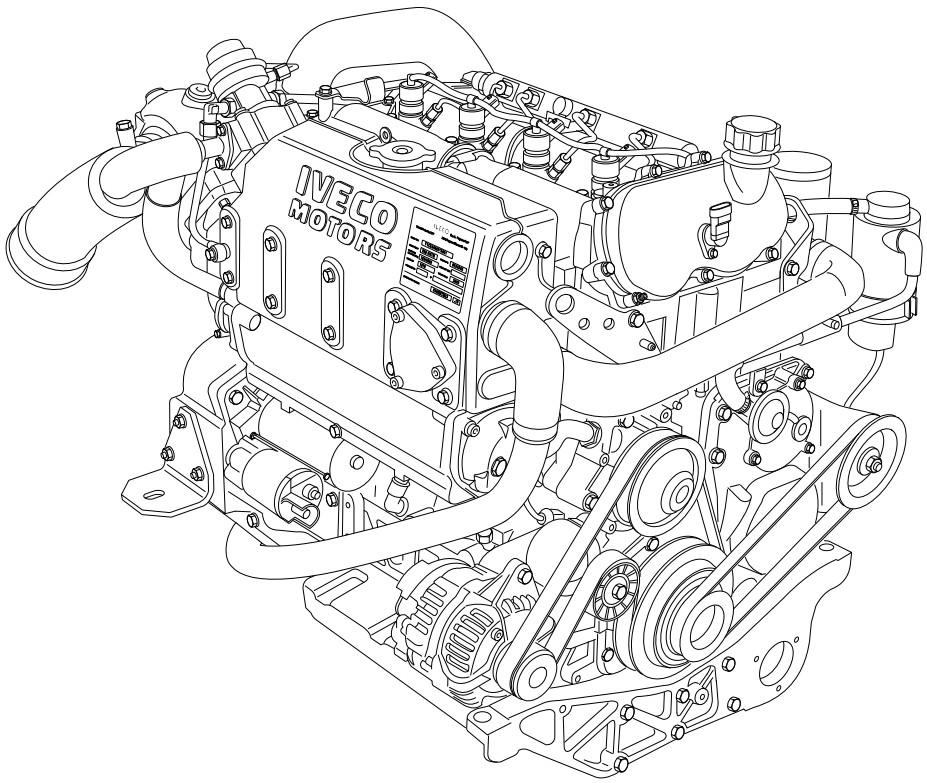
SOFIM

S30 ENT M23

4 CYLINDERS IN LINE
DIESEL CYCLE
FOR MARINE APPLICATIONS

INSTALLATION DIRECTIVE

MAY 2006 EDITION



IVECO MOTORS

FPT POWERTRAIN TECHNOLOGIES

FOREWORD

We strongly recommend that you carefully read the indications contained in this document: compliance with them protects the engine against irregular operation and assures its reliability, safeguarding sea-going and maintenance personnel against accident hazards.
The indications contained in this directive pertain to the S30 ENT M23 engines and complement the IVECO MOTORS publication "Guide to the Installation of Marine Engines" the reader should refer to, for anything that is not explained herein.
For more complete information about the engine, please refer to the appropriate technical brochure.
Use of fuels and oils with different characteristics from those set out in the operation and maintenance manual may compromise the regular operation of the engine, limiting its performance, reliability and working life.

Exclusive use of IVECO Original Parts is a necessary condition to maintain the engine in its original integrity.

Tampering, making modifications and using non original parts can jeopardize the safety of boat engineers and users.

To obtain spare parts, you must indicate:
- Commercial code, serial number and indications shown on the engine tag;
- Part number of the spare as per spare part catalog.

The information provided below refer to engine characteristics that are current as of the publication date.
IVECO MOTORS reserves the right to make modifications at any time and without advance notice, to meet technical or commercial requirements or to comply with local legal and regulatory requirements.

We refuse all liability for any errors and omissions.

The reader is reminded that the IVECO MOTORS Technical Assistance Network is always at the Customer's side with its competence and professionalism.

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CONTENTS

1. WARNINGS AND CAUTIONS

To obtain the best engine performance, it is essential not to deviate from the mission profile for which it was produced and set up. The engine must not be used for purposes other than those stated by the manufacturer. IVECO MOTORS is willing to examine any need for particular installations beforehand. Use of an electronically controlled injection system, in providing the engine with performance benefits, requires that the installer and maintenance specialist comply with some fundamental rules, which will become more and more commonplace as use of such equipment becomes progressively more widespread. Boat outfitters and maintenance specialists are invited to closely follow the instructions contained herein. No modifications to the engine, its accessories and components, are allowed.

Failure to comply with the instructions that follow shall void the warranty and relieve IVECO MOTORS of all liabilities.

For personnel safety

Specialists and installers are cautioned to comply with workplace safety rules and to adopt prescribed individual protection devices when working.

- ❏ Drain the cooling, lubrication and fuel lines only after the fluids have duly cooled. The pressurized cap of the water line may be opened only after the engine has duly cooled.
- ❏ Batteries contain a highly corrosive sulfuric acid solution: must never be upset and must be handled with the utmost caution to prevent spillage. Ensure that the battery compartment is adequately ventilated.

Handling

The engine must be handled by experienced personnel, using the prescribed tool or a rocker arm that keeps the lifting lines parallel and with adequate equipment in terms of capacity and size. The two eyebolts provided for lifting the engine alone must always be used simultaneously.

Installation

- ❏ Knife switches or battery breakers may be used on the power supply line of the engine electronic unit, provided they are not used to shut the engine off.
- ❏ Do not modify the wiring harnesses; their length may not be modified: use only available extensions.
- ❏ Do not use electronic device wiring harnesses not compliant with the IVECO MOTORS directive, in terms of length, type of conductor, location, clamping, connection of the shielding and earth braids.
- ❏ To avoid any interference, the wiring harnesses of the different on-board electronic devices must follow different paths from those of the engine electronic systems.
- ❏ Do not connect any extraneous user device to the engine electrical equipment.
- ❏ Do not place voltage across the boat's on-board electrical system without first verifying that there are no short circuits.
- ❏ Do not branch pipes off to draw fuel from the engine supply lines.
- ❏ Do not make any change to the engine's hydraulic circuits and components.
- ❏ Do not execute arc welding operations before removing the electronic units from their seating, placing them at an adequate safety distance.
- ❏ Do not subject electronic units to temperatures exceeding 80 °C.
- ❏ Do not paint electrical components and their connections.
- ❏ Do not alter the data contained in the engine control electronic unit.
- ❏ Comply with prescribed procedures and torque values when tightening threaded elements.

Start-up

- ❏ Ready the engine following the procedure set out in Chapter 15.
- ❏ When starting the engine the first time, have suitable means available to cut off air intake in case of a runaway condition.
- ❏ Start the engine after ensuring that it is complete with every part specified by the manufacturer and required by the installation, without attempting to start it with caps and occlusions to the lubrication, cooling and fuel feed lines.
- ❏ Check that the fluid lines are perfectly sealed, especially lines for fuels and lubricants, which may cause fires and consequent harm to persons and equipment.
- ❏ Make sure that the various pipelines are not in contact with warm surfaces or moving parts.
- ❏ The installing yard is required to carry out tests to verify the functional compatibility between the electrical-electronic equipment of the engine and the other electronic equipment present on the boat.

Tests and tuning up

- ❏ Never disconnect the batteries when the engine is running.
- ❏ Remove the electrical connections from the batteries before any operation on the electrical system.
- ❏ Ensure that the battery terminals comply with the exact polarity, are properly tightened and protected against accidental short circuits and corrosion phenomena.
- ❏ Do not connect or disconnect electrical connections when electrical power supply is present.

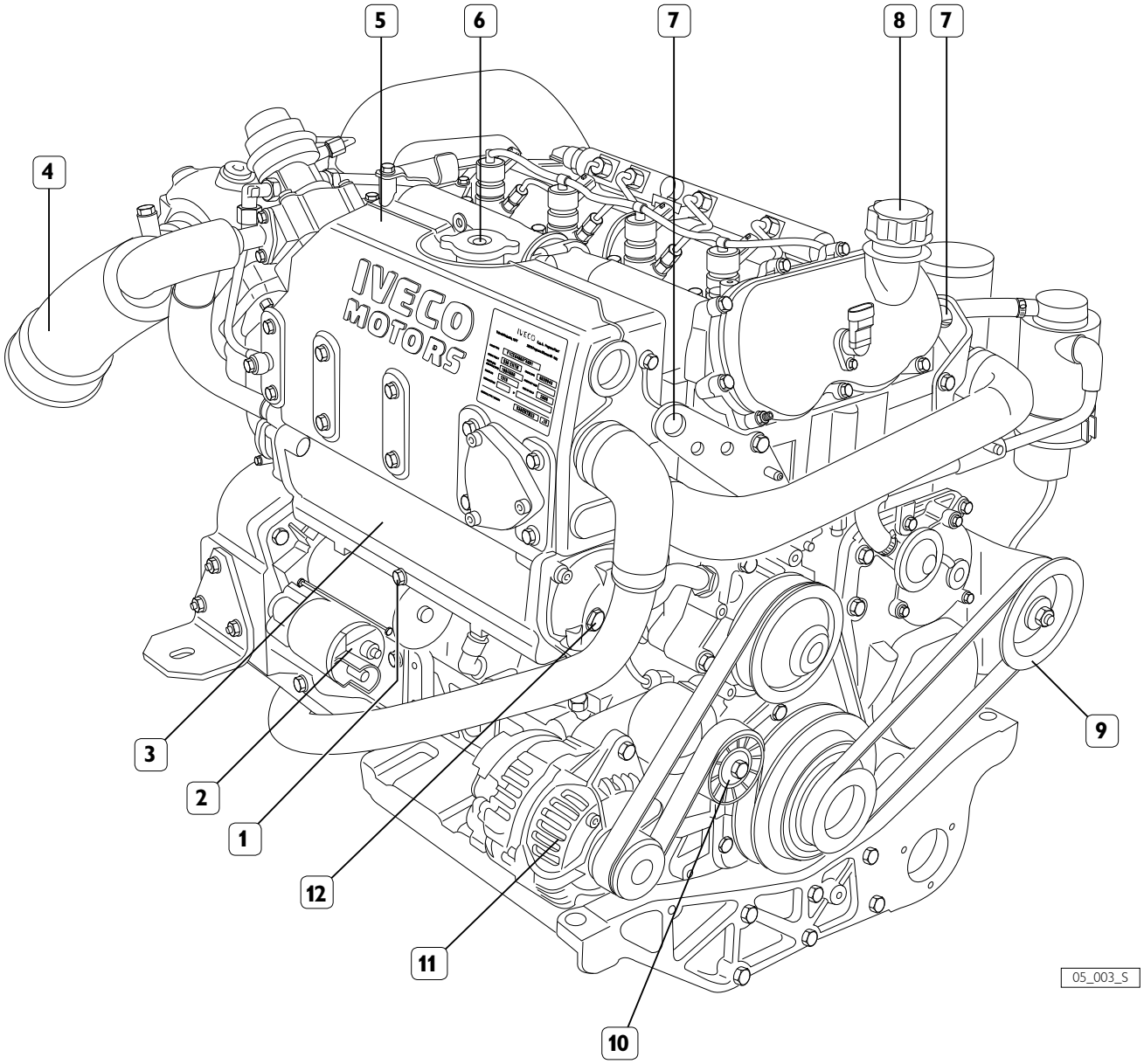
- ❏ Do not cause sparks in the attempt to verify the presence of electrical voltage.
- ❏ Do not draw fuel through unfiltered lines.
- ❏ Do not clean the engine and its parts with corrosive or abrasive detergent substances, to avoid compromising the integrity of electrical connections.
- ❏ The engine fluids and air, water, and oil filters discarded after use must be properly stored and delivered to appropriate collection centers.

Long engine inactivity periods

Before long periods of inactivity, ready the engine following the procedure set out in Chapter 21.

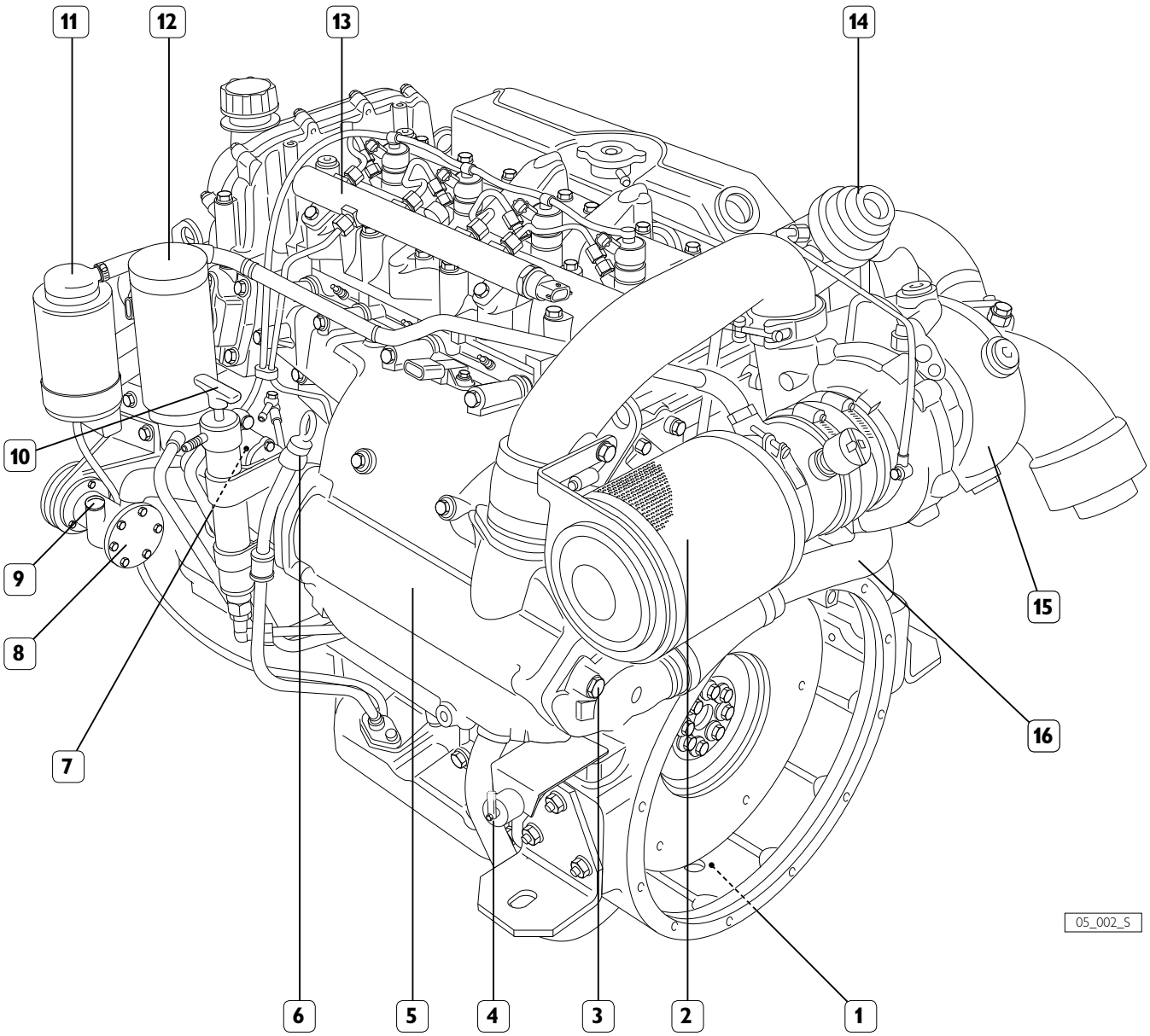
2. ENGINE PARTS AND COMPONENTS

Figure 1



1. Engine coolant discharge cap - 2. Electric starter motor - 3. Tube bundle engine coolant/sea water heat exchanger - 4. Exhaust gas and sea water discharge pipeline - 5. Engine coolant tank - 6. Coolant refill cap - 7. Lifting eyebolts - 8. Oil refill cap - 9. Sea water pump actuation pulley - 10. Auxiliary belt automatic tensioner - 11. Alternator - 12. Location of sacrificial anode.

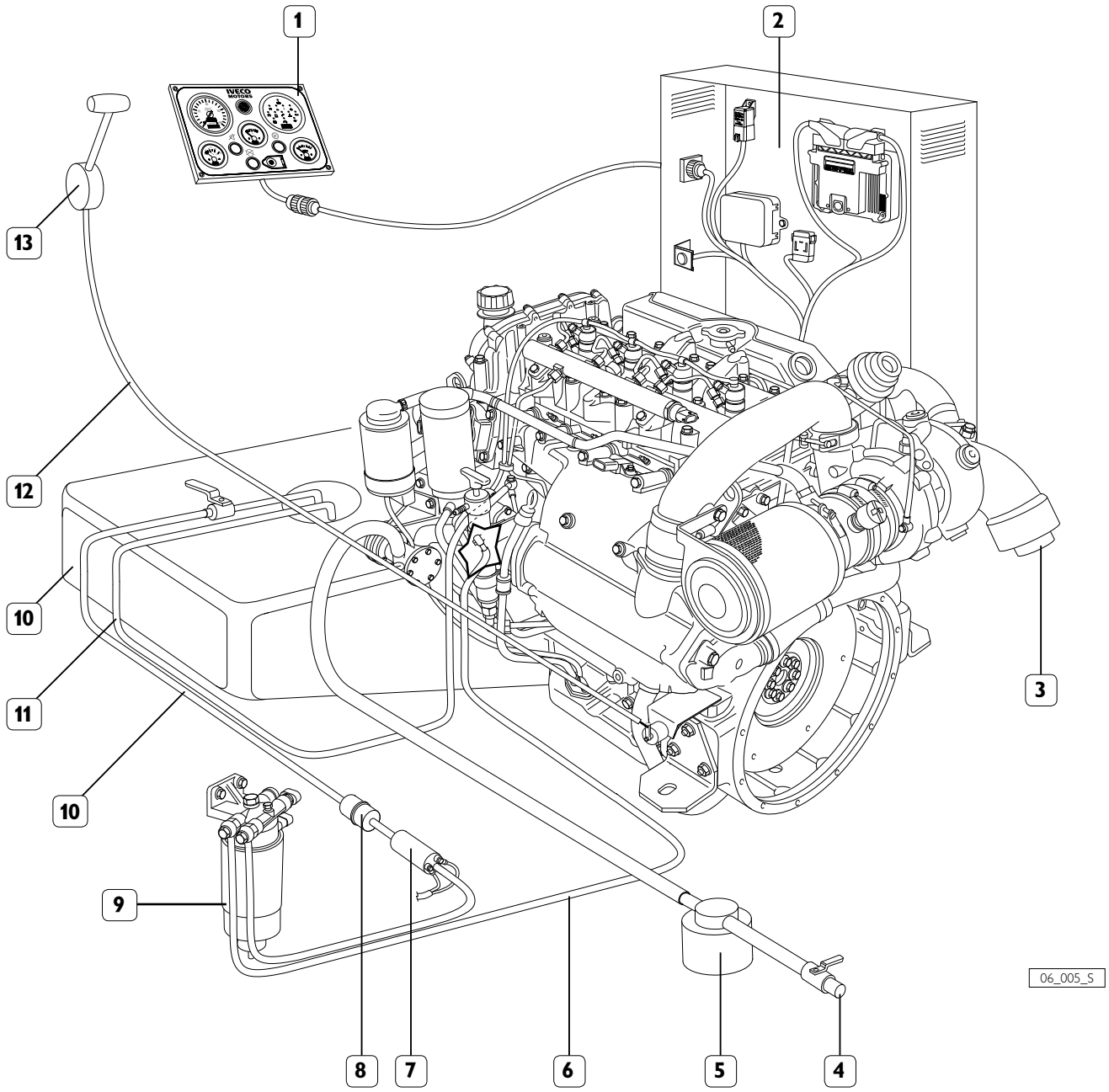
Figure 2



1. Engine coolant discharge cap location - 2. Combustion air filter - 3. Sacrificial anode - 4. Throttle potentiometer - 5. Combustion air-sea water heat exchanger - 6. Oil dipstick - 7. Location of common rail high pressure injection pump - 8. Sea water pump - 9. Sea water inlet - 10. Manual lubricating oil extraction pump - 11. Oil vapor separator - 12. Lubricating oil filters - 13. Common rail distributor - 14. Waste-gate actuator - 15. Cooled turbocharger - 16. Sea water junction pipe from after-cooler to engine coolant/sea water heat exchanger.

3. INSTALLATION OVERVIEW

Figure 3



1. Indicator and control panel - 2. Electrical panel with relay box and EDC electronic unit - 3. Exhaust gas and sea water discharge - 4. Filtered sea water intake - 5. Decanter filter - 6. Fuel feed pipe to the high pressure pump - 7. Fuel electric pump - 8. Fuel pre-filter - 9. Fuel filter - 10. Fuel priming pipe - 11. Fuel return pipe to the tank - 12. Accelerator Bowden cable - 13. Accelerator lever.

The figure shows the set of components of an installation, including those supplied with the engine equipment, standard or optional, and those supplied or produced by the yard.
It provides a comprehensive picture of the operations required to install the engine.

Components arrangement and illustrations are not binding but merely indicative, subject to the choices made by yard engineers according to their skills, available spaces and the prescriptions set out herein.

4. GENERAL INSTALLATION CRITERIA

Accessibility

The engine must be located in such a way as to allow filling and draining engine liquids when doing servicing operations.

Anchoring

If anchoring is accomplished by interposing shock mounts, they must be able to support the engine's mass and the longitudinal thrust exerted by the propeller shaft in motion.
If rigid mounting is adopted, particular care must be given to support alignment and co-planarity.
Information on dimensions and fastening values are provided in the "Installation Diagram".

Combustion and ventilation air

Compliance with prescriptions on the quantity of air required for combustion and ventilation assures a regular operation of the engine even in adverse conditions and it enables to deliver its maximum design power (1).

Sea water line

It must be provided with an intake capable of preventing the entry of foreign bodies into the suction pipes. Between the intake and the pump, it is best to interpose a gate to be closed in emergencies or for extended idle periods and a filter to stop the smaller impurities; it is also recommended to install a suitably dimensioned and easily replaced zinc anode.
The engine sea water line was provided by the manufacturer with protection anodes to be replaced periodically.
The rubber hoses positioned along the pipeline shall be sufficiently rigid not to create choked areas caused by crushing (1).

Engine pre-heating

If the engine usage profile requires immediate delivery of power at the highest rpm's, it is recommended to install an auxiliary pre-heater on the closed cooling loop.

Exhaust gas discharge

The exhaust gas discharge conduit shall be compliant with the guidelines contained in the IVECO MOTORS publication "Guide to the installation of marine engines"; it also provides indications to compute the dimensions of the exhaust pipelines, which is the Yard's responsibility.

Electric - electronic equipment

Provide a suitable arrangement of the engine control electronic unit, of the relay box and of the possible optional electronic units, referring to the dimensions and position of the wire harnesses and their connectors.
Both units must be anchored in such a way as to dampen the vibrations and stresses undergone by the hull while underway and/or induced by the engine's operation.

(1) The EDC engine electronic control is programmed to reduce maximum deliverable power if the operating parameters measured by the sensors show that critical conditions have been reached, and if exceeded the engine could be damaged.

5. TECHNICAL DATA FOR INSTALLATION

Combustion and ventilation air when underway		
Static vacuum allowed downstream of the air filter	kPa mm H_2O	≤ 3,5 ≤ 350
Combustion air flow rate	m^3/h	≥ 710
Engine room ventilation air flow rate (excluding combustion air)	m^3/h	≥ 3590
Static vacuum allowed in the engine room	kPa mm H_2O	≤ 0,1 ≤ 10
Temperature allowed in the engine room	°C	≤ 45
Temperature increase in the engine room to ext. temperature	°C	≤ 15

Exhaust gas discharge		
Allowed static back pressure	kPa mm H_2O	≤ 10 ≤ 1000
Exhaust gas temperature at maximum power (turbocharger inlet)	°C	700
Flow rate at maximum power	kg/h	875
Outer diameter of exhaust mixed with sea water	mm inches	100 4

Fuel supply		
Transfer pump delivery at maximum rpm	l/h	≤ 190
Flow rate return to tank	l/h	≤ 185
Fuel temperature to allow maximum power	°C	≤ 70
Inner diameter, intake pipe	mm	≥ 8
Inner diameter, return pipe	mm	≥ 8
Thread on pre-filter junctions	M	14 x 1,5
Electric pump approved intake vacuum	kPa mmH_2O	≤ 15 ≤ 1500
Approved intake pressure at the low pressure mechanical pump	kPa mmH_2O	20 to 120 2000 to 12000
Allowed on tank return pipe back pressure	kPa mm H_2O	≤ 40 ≤ 4000

Open sea water cooling line		
Intake pipeline diameter	mm inches	32 1,26
Pump delivery at maximum rpm	l/h	9000
Sea water pump height above sea level	m	≤ 2
Allowed intake vacuum	kPa mm H_2O	≤ 20 ≤ 2000
Dry exhaust outer diameter	mm inches	Not foreseen

Allowed engine inclination angles		
Maximum longitudinal in continuous operation (static + dynamic)	degrees/360	+20
Maximum transverse in continuous operation (static + dynamic)	degrees/360	± 22°30'
Longitudinal for oil level check with standard dipstick	degrees/360	0 to +6

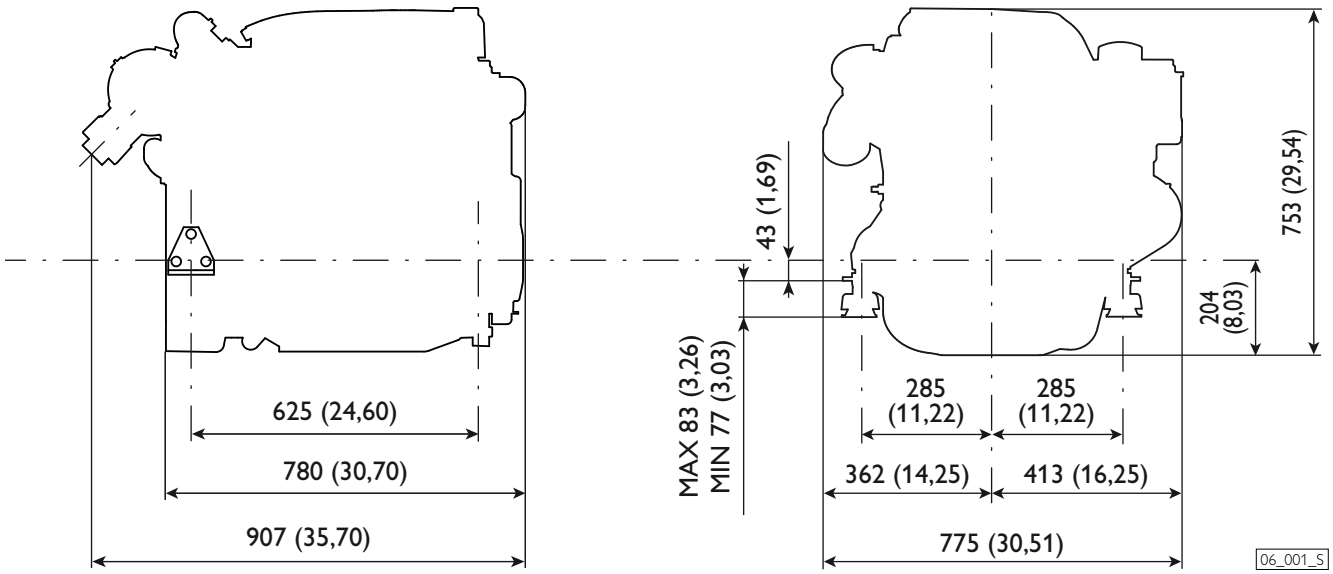
Power takeoffs (optional)

1-race front pulley for "V" belts		
Reference diameter	mm	83
Race dimension	mm	10
Power available at 1000 rpm (*)	kW	≤ 1
Power available at 2000 rpm (*)	kW	≤ 2
Radial force resulting from belt tension (*)	N	≤ 400

(*) These values are valid for driving to the side opposite to that of the sea water pump

Dimensions

Figure 4



Measurements in: millimeters (inches).

6. IDENTIFICATION DATA

Figure 5

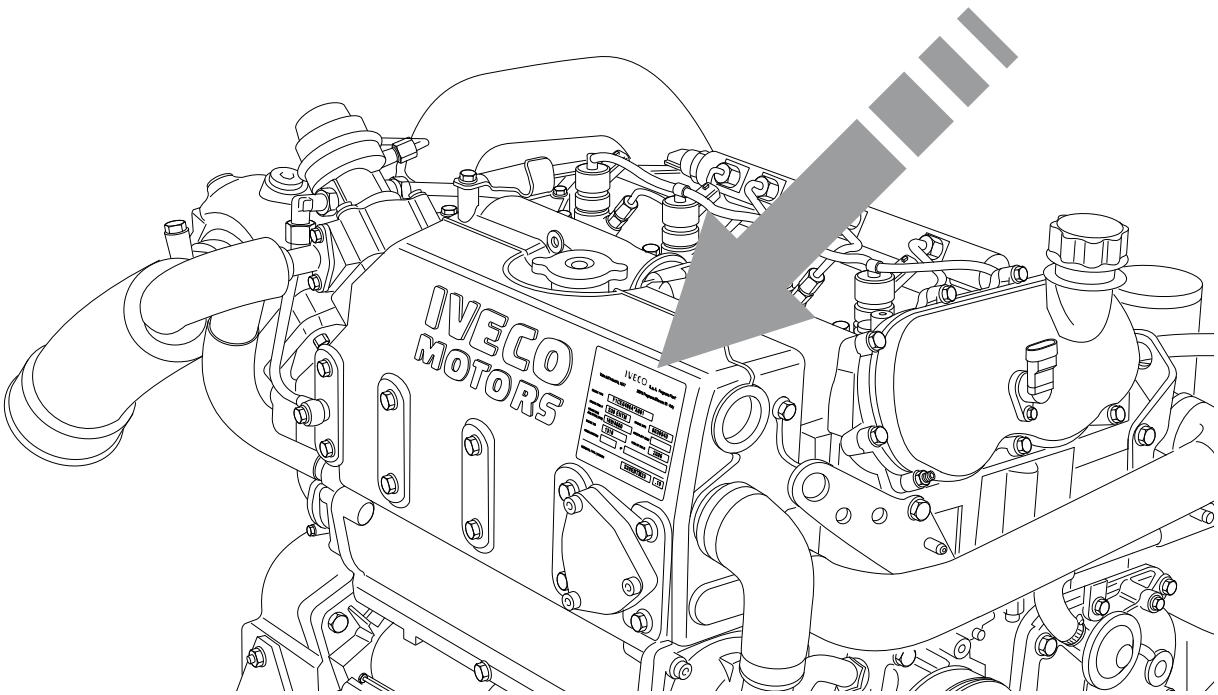
IVECO S. p. A. Pregnana Plant

Viale dell'Industria, 15/17 20010 Pregnana Milanese MI - Italy

ENGINE TYPE	F1CE0486A*A001		
ENGINE FAMILY	S30 ENTM	ENGINE DWG	8039943
POWER (KW) AND SPEED (RPM)	169/4000	POWER SET CODE	
ENGINE S/N	1318	YEAR OF BUILD	2006
HOMOLOGATION		Nº	
COMMERC. TYPE / VERSION	S30ENTM23	.10	

06_004_S

Figure 6

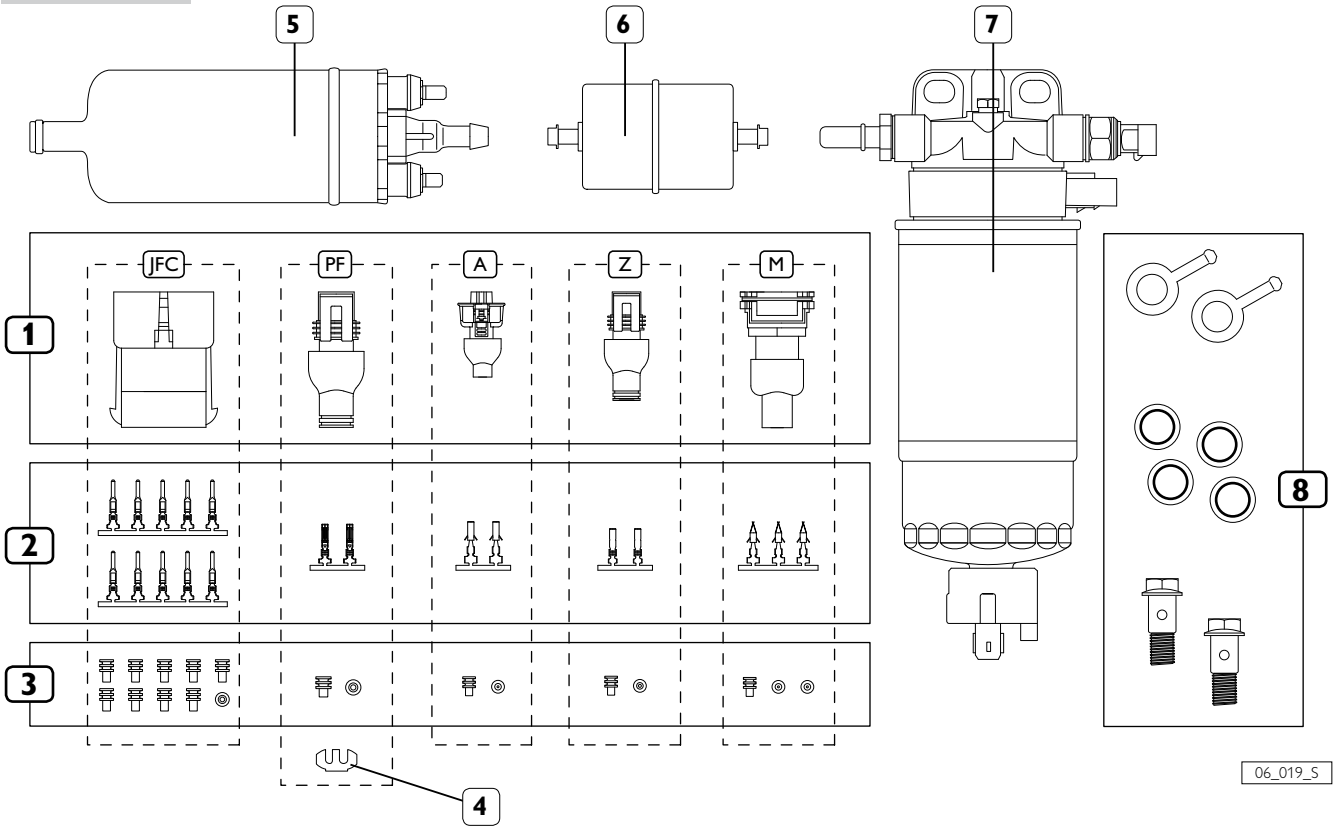


05_003_S

The engine identification data are stenciled on a tag positioned over the engine coolant tank

7. COMPONENTS SUPPLIED WITH THE ENGINE

Figure 7



1. Connectors to be assembled - 2. Conductor terminals - 3. Gaskets to be fitted on individual wires - 4. PF connector rear cover - 5. Fuel electric pump - 6. Fuel pre-filter - 7. Fuel filter - 8. Components to replace fittings mounted on the fuel filter.

The engine is supplied with a box containing the parts showed in the pictures, as well as spring supports to allow keelson anchoring.

Electric connectors

As shown in pictures 1, 2, 3, 4, they must be used to set up the cabling connecting them to the components located on the fuel filter.
Individual electric connectors are each one sealed in see-through bags, together with small parts required to complete them. In order to avoid connection errors, connectors are different from one another; each one of them must be exclusively mounted by using the small parts contained in the relevant plastic bag

Connection function

- ❏ A. Fuel temperature sensor for EDC
- ❏ M. Sensor designed to detect the presence of water in the fuel pre-filter
- ❏ Z. Fuel filter clog sensor
- ❏ PF. Heating element on the fuel filter
- ❏ JFC. Connection to the JFC connector on the engine harness

Chapter 9 shows the instructions to be followed to perform connections.

Mechanical components

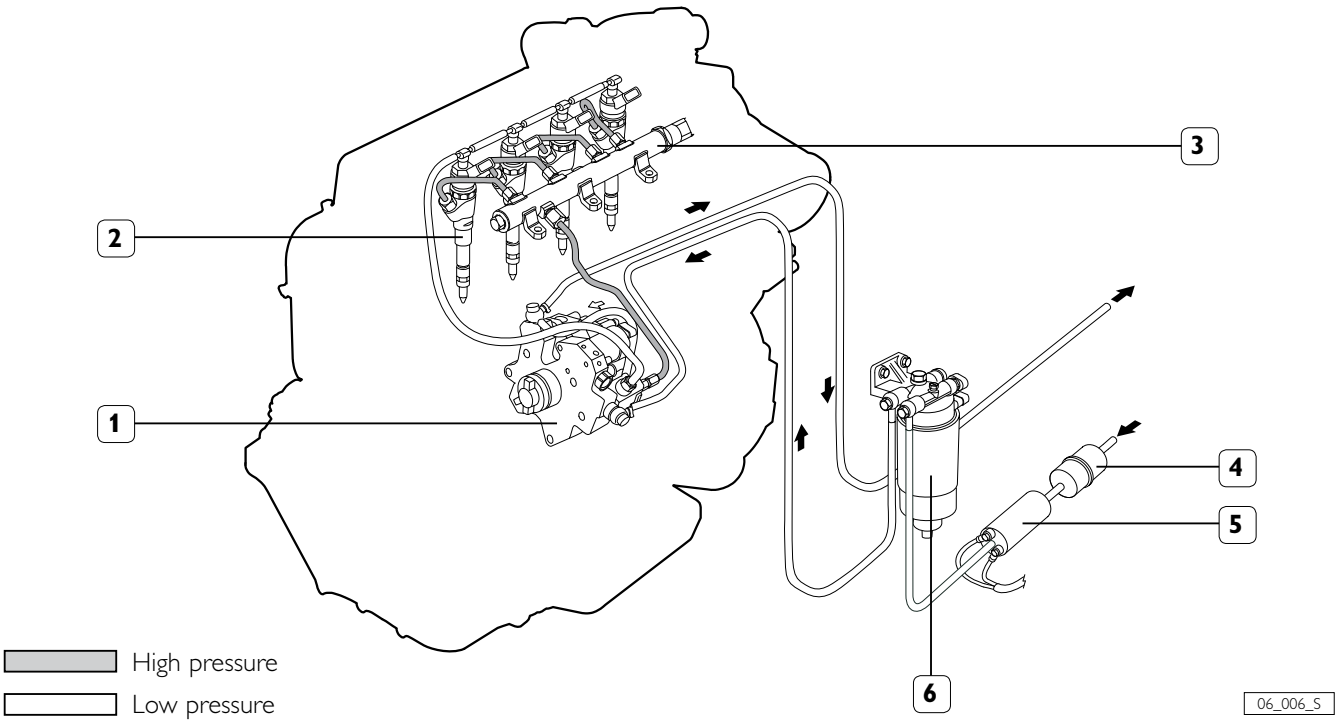
As shown in picture 8, they must be used to replace the fittings mounted on the fuel filter support.
Chapter 8 shows the instructions to be followed in order to carry out assembly operations.

Hydraulic components

Identified in the picture by numbers 5, 6, 7, hydraulic components must be used to set up the fuel feeding system.
Chapter 8 shows the instructions to be followed in order to perform connections.

8. FUEL LINE

Figure 8



1. Low pressure mechanical feeding pump and high pressure common rail injection pump - 2. Electro-injector - 3. Common rail - 4. Pre-filter - 5. Fuel electric pump - 6. Filter.

For the installation, the following connections are required:

- from the tank to the pre-filter
- from the pre-filter to the pump inlet
- from the electric pump to the filter inlet
- from the filter outlet to the low pressure mechanical feeding pump
- from the fuel discharge outlet to the tank.

Components

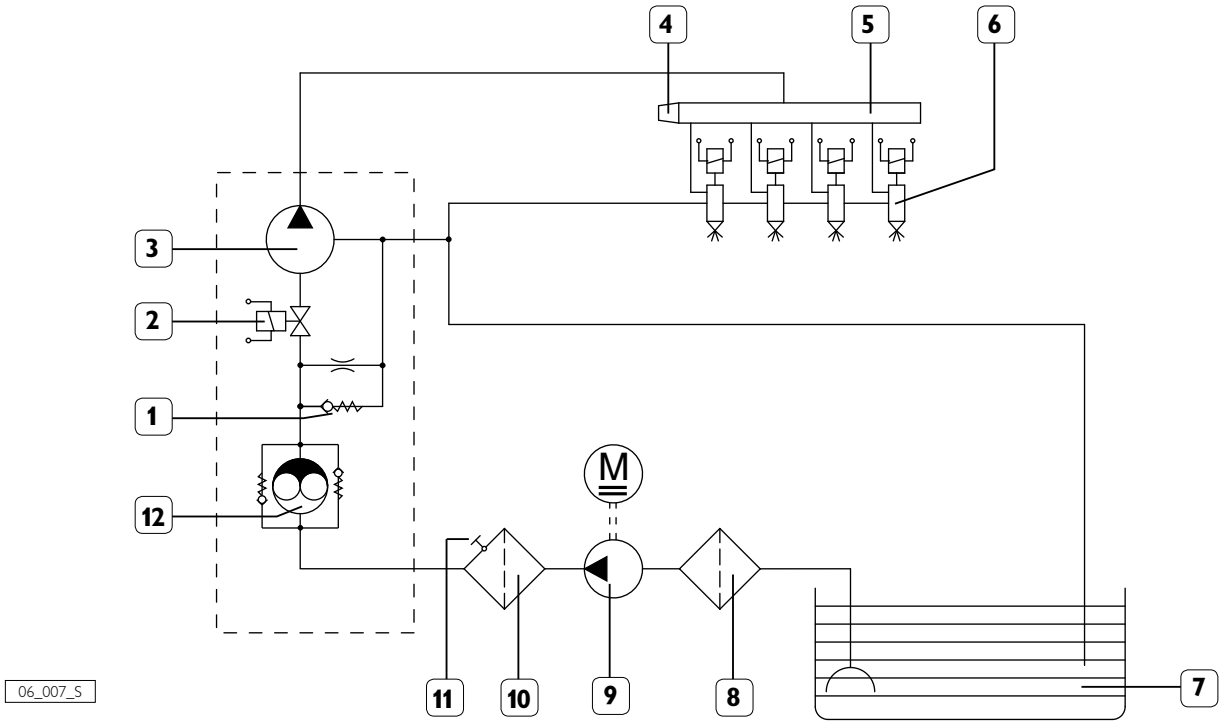
Pre-filter, electric pump and filter, supplied with the engine, must be fitted in proximity of the tank, in a relatively low point of the system. The filter must be prepared as indicated here below and fastened in such a way to allow easy replacement of the filtering cartridge.
Avoid the use of additional mesh or paper filters along the feed lines between pre-filter and engine. To avoid introducing impurities in the feeding lines inside the engine, do not place filter cartridges pre-filled with fuel in the system.

Materials' Characteristics

The fuel tank and the suction and return assembly must withstand the continuous abrasion caused by a flow of fuel oil of 200 l/h at a temperature of 120 °C without noticeable deformation or wear or release of material. Use of metal tanks, preferably made of iron alloys, is allowed, provided they are connected to the negative terminal of the battery to prevent the accumulation of electrostatic charges.
Tanks must be provided with vents to avoid exceeding an internal pressure of ± 5kPa (± 0.5 m of H_2O column); their shape and the suction assembly must be such as to assure a suction at the maximum longitudinal and transverse inclination allowed for the boat, with a residual quantity of fuel oil considered "reserve".
The suction inlet should be positioned in such a way as to avoid taking in sludge. The return flow must be in such a way as to facilitate the mixing of the returning fuel with the fuel in the tank. If the tank is lower than the filter, then the return pipe must always be submerged. The pipes and union fittings of the fuel line must withstand a fuel oil flow rate of 200 l/h at a temperature of 120 °C and a pressure of 3 bar (300 kPa) without noticeable deformation, wear or release of material. Metal tubes, preferably made of iron alloys, are recommended, taking care to connect each individual segment to engine ground to avoid the accumulation of electrostatic charges and inserting a vibration damper elastic joint on each segment. The pipes used must be certified according to the relevant Countries' rules or to the standards issued by classification Bodies.

Fuel supply system scheme

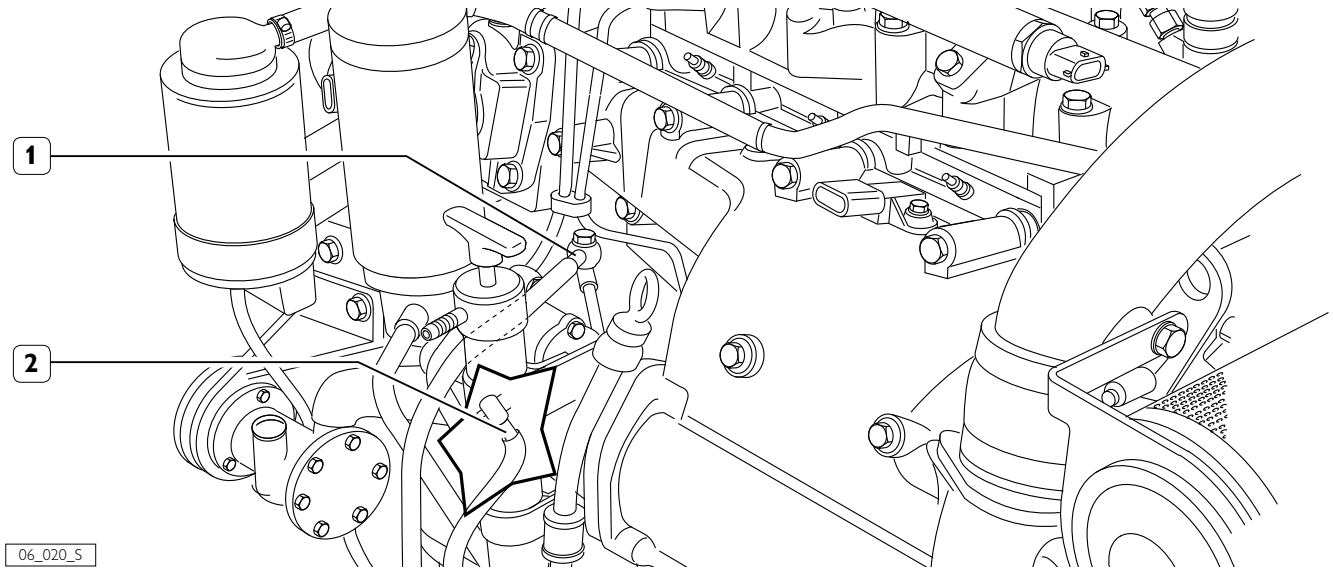
Figure 9



1. Low pressure limiter valve - 2. Pressure regulating electric valve - 3. High pressure radial pump - 4. Pressure sensor - 5. Common rail - 6. Electro-injector - 7. Fuel tank - 8. Pre-filter - 9. Fuel electric pump - 10. Filter - 11. Vent fitting - 12. Low pressure mechanical feed pump.

Hydraulic connections

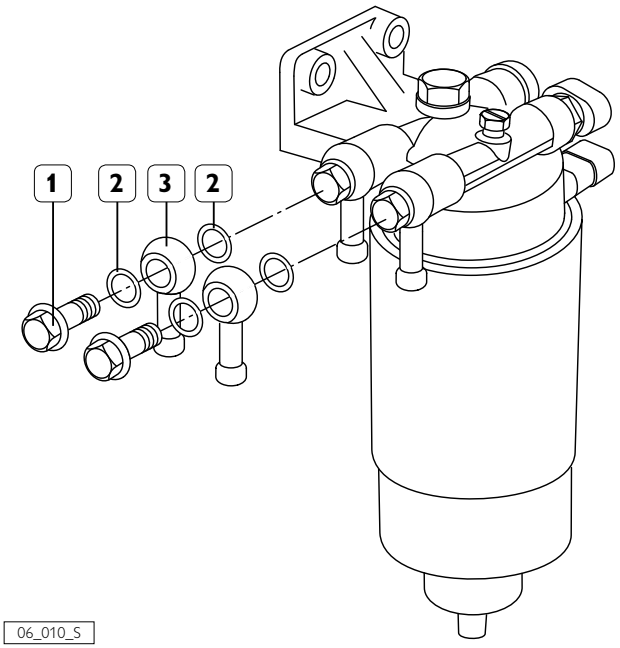
Figure 10



1. Rubber holder fitting for fuel inflow into the low pressure mechanical feeding pump - 2. Rubber holder fitting to allow fuel outflow towards the tank.

Preparation of the fuel filter support

Figure 11

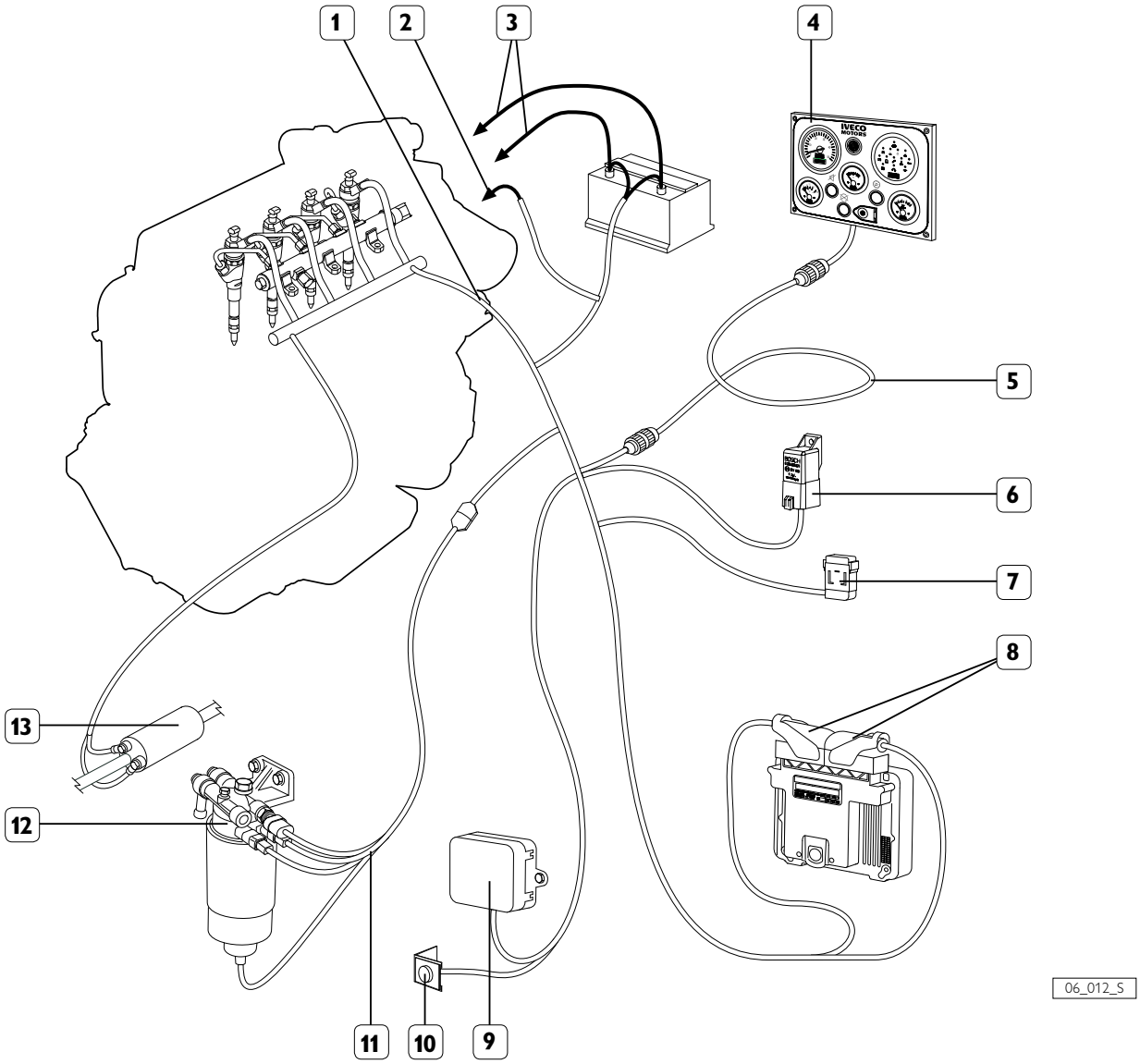


1. Screw - 2. Seal washers - 3. Rubber holder fitting.

The filter support must be prepared by replacing fuel inlet and outlet fittings with the supplied ones.
Following the removal of the fittings on the support, Rubber holder fitting must be mounted on the screws by fitting seal washers as shown in the picture. Tighten the screws.

9. ELECTRICAL EQUIPMENT

Figure 12



1. Engine wiring - 2. +BATT/CC terminal - 3. Power line for electric starter motor and alternator - 4. Indicator and control panel - 5. Extension harness - 6. Engine pre-heating glow plugs electronic control unit - 7. Fuse holder for the engine pre-heating glow plugs electronic control unit - 8. ECU EDC connectors - 9. Relay box - 10. Diagnostic tool connector - 11. Harnessing to be made by construction site personnel - 12. Fuel filter support - 13. Fuel electric pump

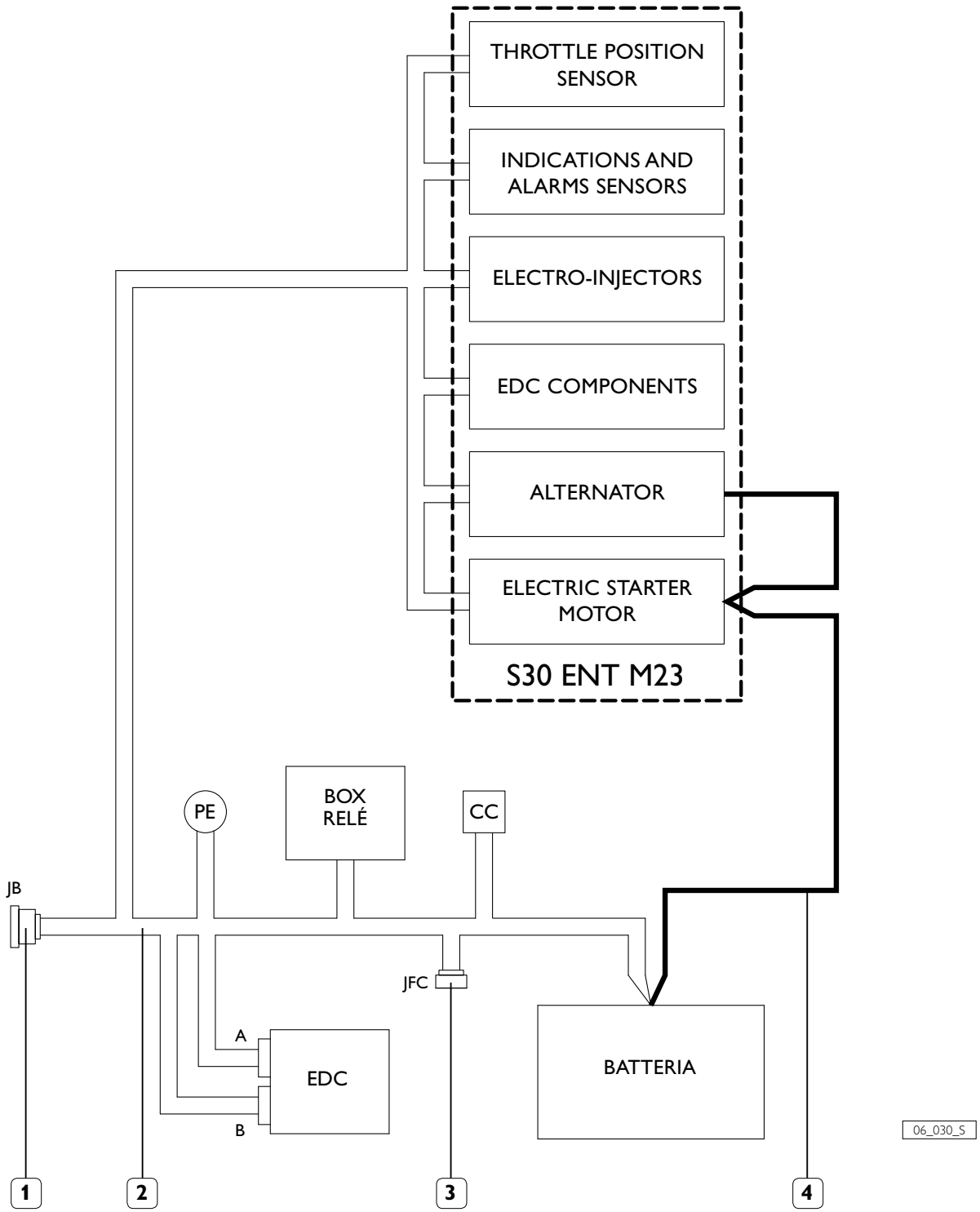
The electrical equipment of the engine comprises a series of components provided separately from the engine to enable an easy and diversified installation, according to the Yard's design choices. The need to make accessible, at sea or underway, the controls to the electrical components and to the connector for diagnostics contained in the relay box may be met through different installation arrangements.
Along with the coupling of all connectors provided in the wire harnesses, completing the installation also requires the connecting wire harness to the connector JFC (11) for the fuel filter, to complete the power line and to connect the accumulator to the engine wire harness.

NOTE

The two general power supply terminals identified as +BATT and −BATT must be connected to the accumulator, while the terminal identified as +BATT/CC must be connected to the +30 pole of the starter motor.

Synoptic

Figure 13

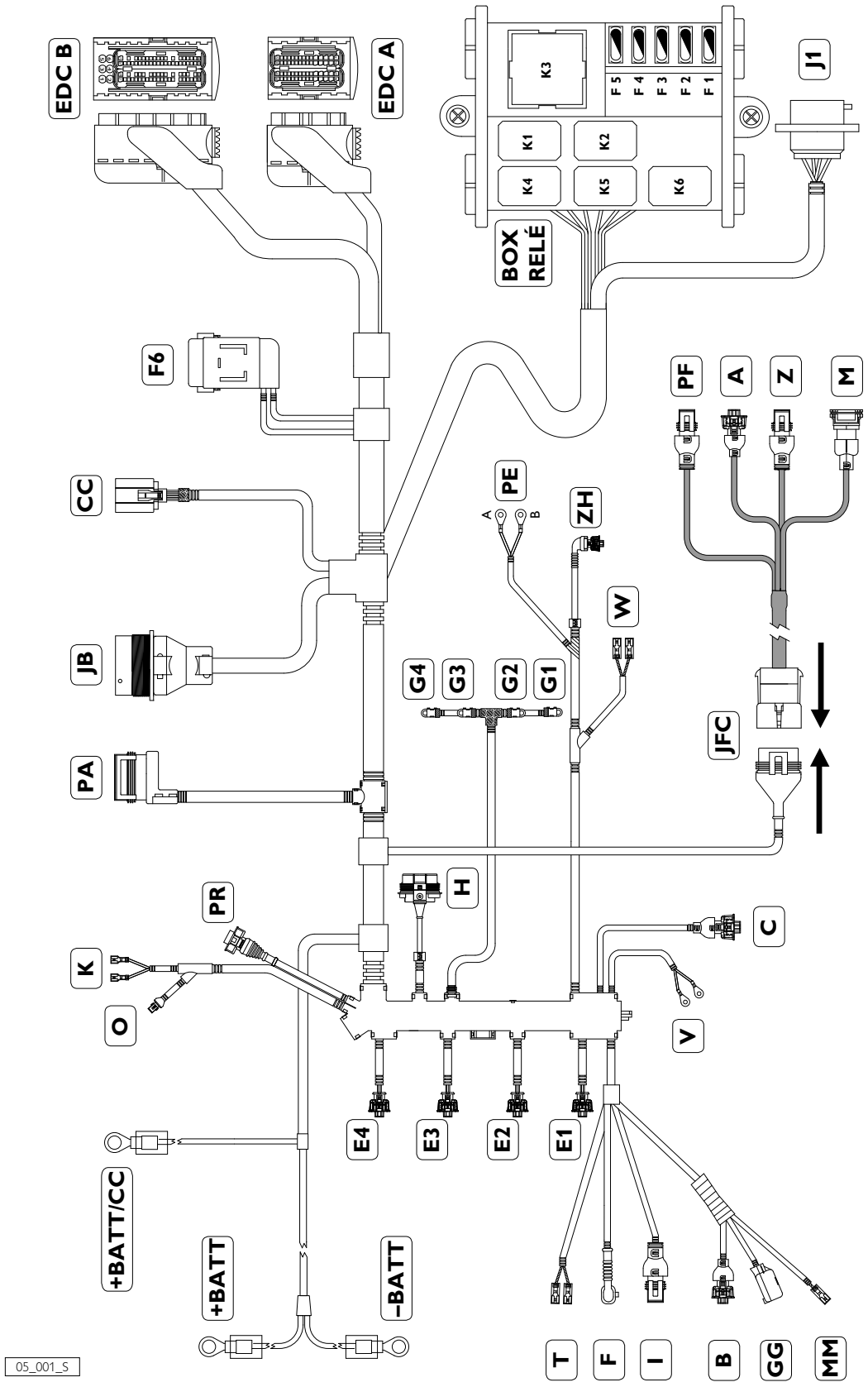


1. Connector for instrument panel connection wire harness - 2. Engine wire harness - 3. Connector for fuel filter wiring - 4. Power line.

Wires supplied with the engine include connectors for all concerned components, connector JB to ensure connection to the warning and control panel, and the JFC connector to allow the connection to the components located on the fuel filter.

Wire harness

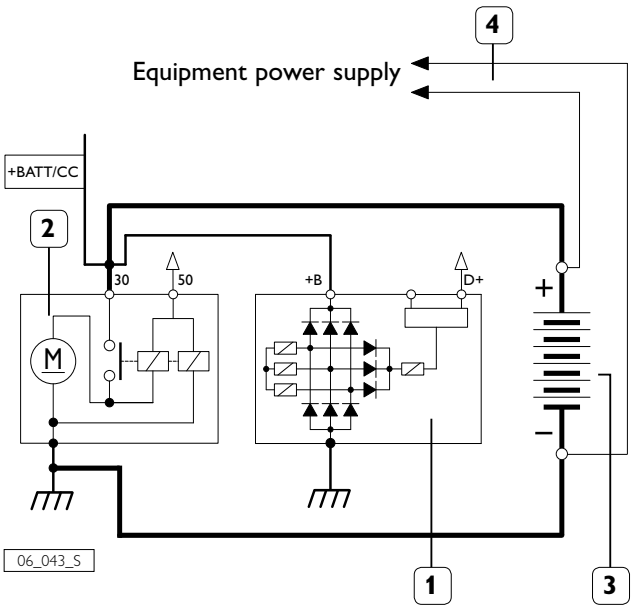
Figure 14



A. Fuel temperature sensor for EDC - B. Drive shaft sensor for EDC - C. Camshaft sensor - F. Engine coolant temperature sensor for EDC - ECF. Connector for the engine stopping functions if stressed - ECM. Connector for the engine stopping function if stressed - H. Combustion air pressure/temperature sensor for EDC - K. Air filter clogging sensor (for alarm) - M. Sensor for detecting the presence of water in the fuel pre-filter (for alarm) - O. Exhaust gas temperature sensor (for gauge) - T. Coolant temperature sensor (for gauge) - V. Oil pressure sensor (for gauge) - E1. Cylinders 1 and 2 electro-injectors - E2.-Cylinders 3 and 4 electro-injectors - E3. Cylinders 5 and 6 electro-injectors - GG. Alternator - JB. Instrument panel connection wire harness - JF1,JF2. Relay box - MM.-Electric starter motor - PA.-Throttle position sensor - PF. Heating element on fuel filter - PR. Rail pressure sensor - SI. Gear box oil temperature sensor - VE. Engine oil pressure/temperature sensor for EDC - VI. High gear box oil pressure sensor (25 bar) - WI. Low gear box oil pressure sensor (7 bar) - ZH. Pressure control solenoid valve.

Power supply line

Figure 15



1.Alternator - 2. Electric starter motor - 3. Battery - 4. Engine wire harness.

The connection of terminal +B of the alternator to the positive terminal +30 of the electric starter motor consists of a 25 mm² diameter conductor or bigger. The connection of the positive +30 terminal of the electric starter motor to the positive pole of the battery, achieved with a conductor having a cross section of at least 70 mm², allows to obtain, as shown in the figure, the simultaneous connection of the alternator to the battery. The simultaneous connection of the alternator to the accumulator; on the same terminal, one will have to connect the cable terminal to an eyelet marked as +BATT/CC of the engine harness. The connection between the engine ground and the negative pole of the battery must be achieved according to the guidelines provided in the Engine electrical ground paragraph.

CAUTION

If magneto-thermal protecting breakers are inserted, they must not be used to stop the engine and in any case they must be activated only a few seconds after shut-down.

Supplementary services battery

To assure that the engine can be started with a sufficient quantity of energy, it is advisable to provide for the installation of a supplementary battery, dedicated to supplying power to the on-board electrical services. The power line to recharge it may be constructed according to the indications provided in Chapter 22.

If one engine is installed

The battery used for services may be recharged interposing on the power supply line a relay actuated by the recharge signal of the alternator's electronic regulator (D+).

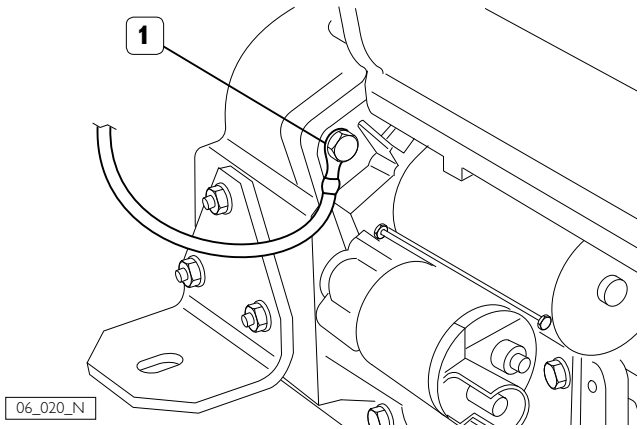
If two engines are installed

The presence of two generators allows to keep the recharging functions separated: the generator (G1) recharges the battery (AC1) dedicated to starting both engines and powering both electrical/electronic control circuits, whilst the generator (G2) recharges the battery (AC2) used to power the services. In two-engine applications, it is essential to connect the engine grounds to a common potential; the solution proposed in Chapter 22 fully complies with this need, assuring the full functionality and independence of the two circuits.

Engine electrical ground

The connection of the engine electrical ground is achieved by connecting with a cable of at least 70 mm^2 cross section to the negative pole of the battery to the tightening point of the electric starter motor as shown in the following figure.

Figure 16



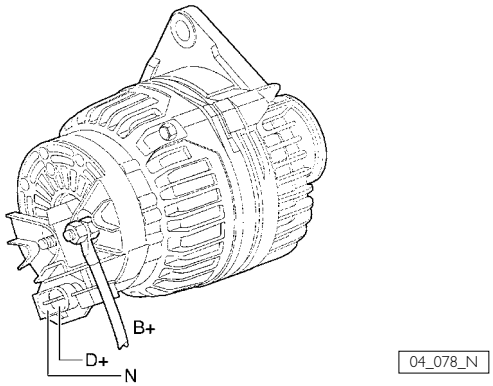
1. Point of connection of the engine electrical ground.

To anchor the grounding terminal to the engine, proceed as follows:

- ❏ Completely remove the conducting paint from both parts constituting the connection, using mechanical means or suitable chemical product; if the anchoring operation is to take place on superficially treated parts, completely remove the anaphoretic paint with mechanical means, obtaining a smooth support surface.
- ❏ Apply a uniform layer of BH44D paint (IVECO standard 18-1705) with a brush or spray gun.
- ❏ Join the parts constituting the grounding note within 5 minutes from the time the paint was applied.

Battery recharging

Figure 17

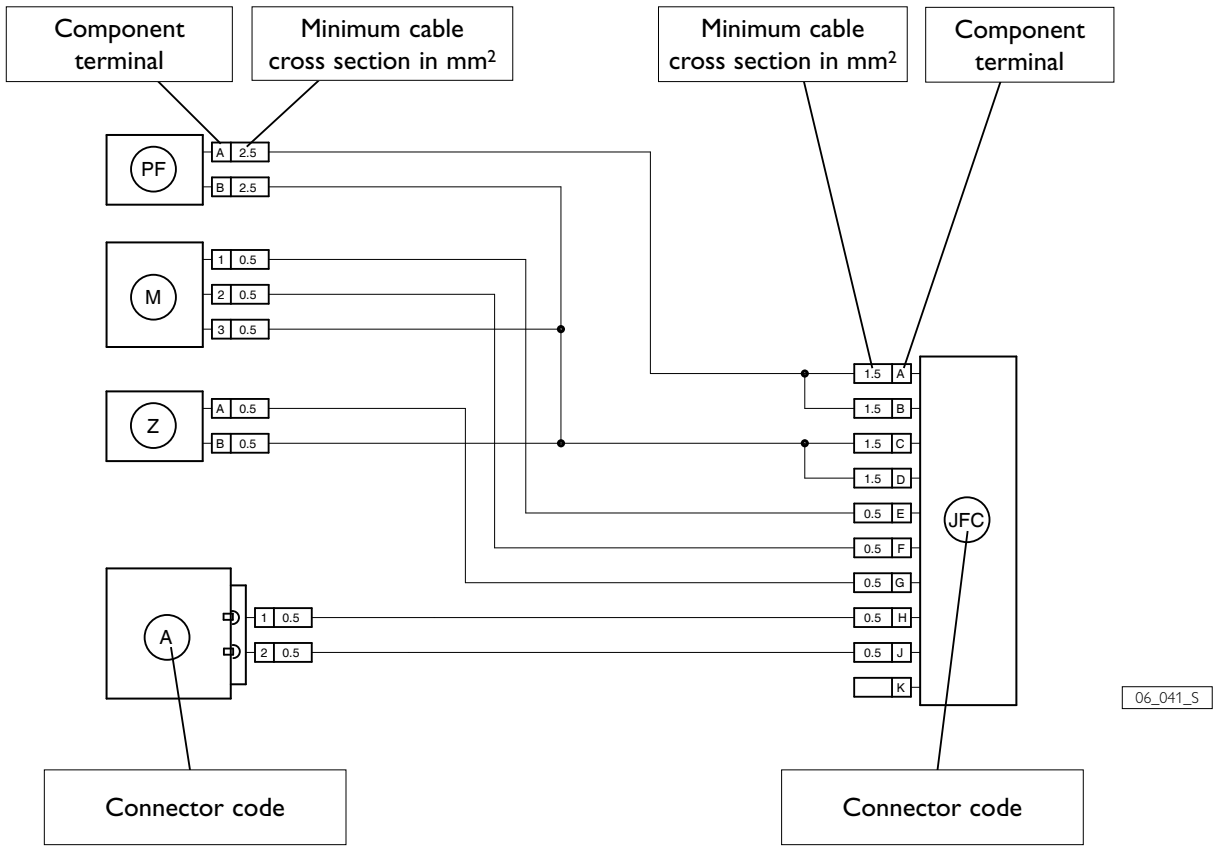


B+. Connected to the +30 of the electric starter motor - D+. Excitation - N. Not connected.

This is accomplished through the power supply line of the electric starter motor and connection to the +B of the alternator. The electronic regulator of the alternator that equips the engine allows an effective control over the battery recharging operation.
If, due to installation requirements, the batteries need to be positioned at a distance from the engine, we recommend increasing the cross section of the power line conductors and verifying recharging effectiveness by measuring voltage across the battery poles.

Wiring to the JFC connector

Figure 18



By stabilizing the fuel filter assembly position, it will be possible to set up the wiring to connect the components located on the fuel filter.
The diagram in the picture shows the connections to be performed on connectors.

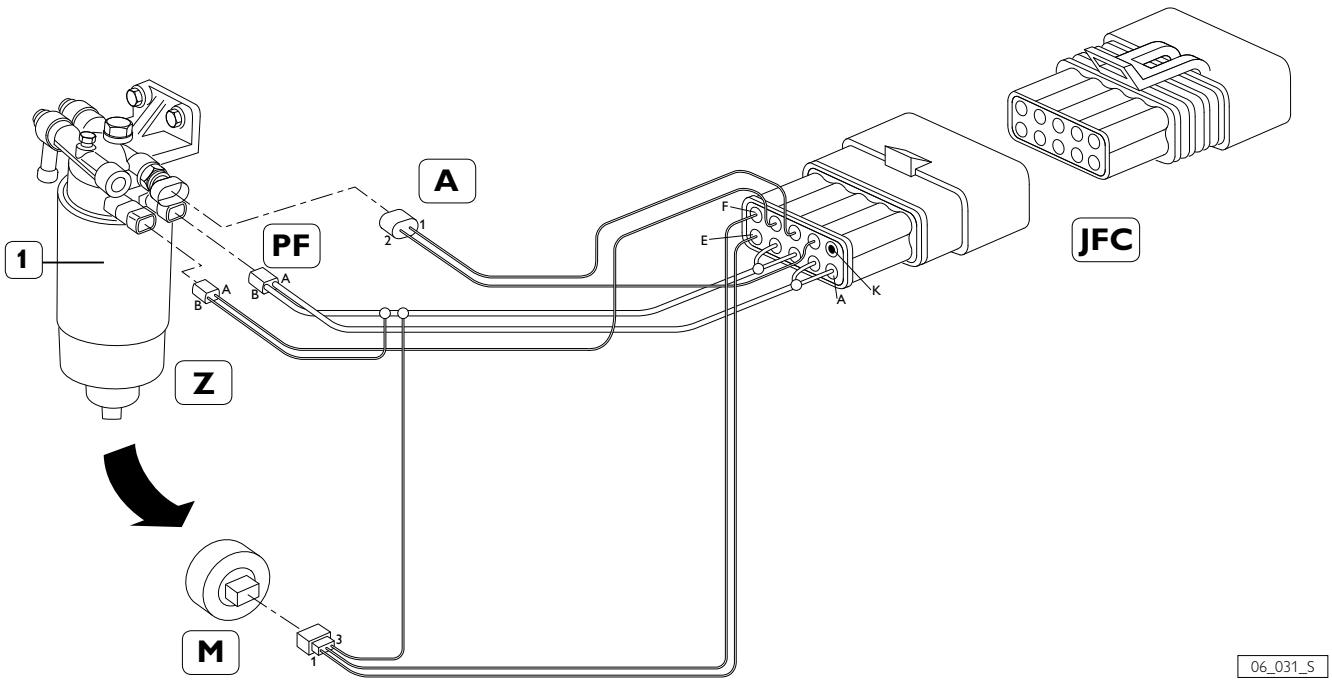
Connection function

- A. Fuel temperature sensor for EDC
- M. Sensor designed to detect the presence of water in the fuel pre-filter
- Z. Fuel filter clog sensor
- PF. Heating element on the fuel filter
- JFC. Connection to the JFC connector on the engine harness

NOTE

Comply with conductors' minimum diameters indicated in the diagram in order to avoid voltage drops which would endanger the system operation.

Figure 19



1. Fuel filter

The picture shows 5 connectors and the position that conductors must have in order to ensure correct connections. Wiring must be performed to ensure minimum diameters of conductors, as indicated in the electric diagram.

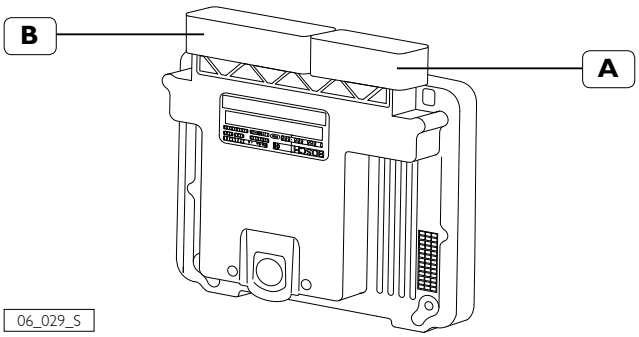
CAUTION

Wrong connections of conductors can generate malfunctions and damage electric components.

The wiring must be made with the JFC connector, not connected to the engine harness. Coupling of the two JFC connectors will have to be done with the power supply switched off.

Connections of the central electronic unit (ECU) EDC 16C8

Figure 20



A. 60 pole connector - B. 94 pole connector.

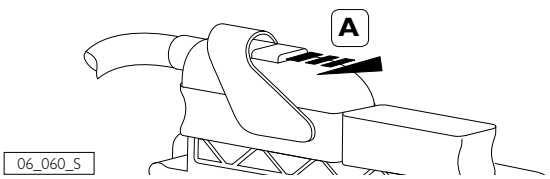
The connection of the central electronic unit, ECU, to the components of the EDC system is achieved by means of three connectors to subdivide the wiring harnesses, thereby favoring a quicker identification of the lines during testing operations.

- ❑ B for engine mounted components
- ❑ A for boat side connections

The different connectors are polarized and provided with levers to favor the connection and disconnection operations and assure proper coupling.

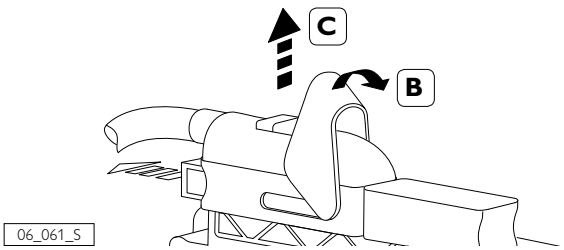
The sequence of operations allowing the removal of connectors from their housing is as follows:

Figure 21



A) Extract the extraction lever retaining device;

Figure 22

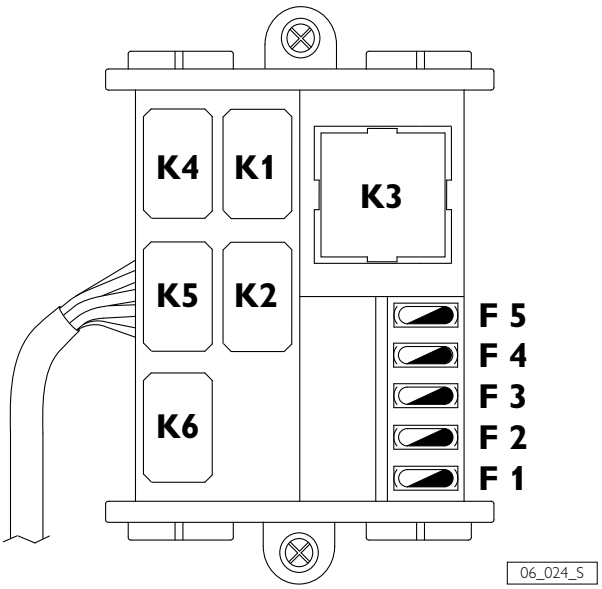


B) Lift the extraction lever, make sure the anchoring slide is extracted from its housing;

C) Lift the connector without causing any fluctuation which would jeopardize the integrity of electric terminals.

Relay box

Figure 23



It represents the main interconnection point and it performs multiple interfacing functions between the various system components.
It is the seat of remote control switches and fuses; components are mounted on a base and thus it is possible to extract them to set up verification or replacement operations.

Remote control switches (relays) depend upon the following components:

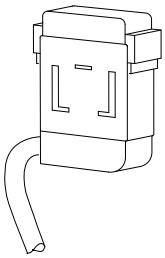
K1	key switch electric discharge
K2	emergency engine shut-down provision
K3	EDC main (power supply
K4	power supply to terminal 50 of the electric starter motor
K5	Electric fuel pump power supply
K6	fuel filter heater element power supply

The components to which fuses depend upon are as follows:

F1	electric fuel pump
F2	heating element on fuel filter
F3	power supply to the heater plug control unit (15 A)
F4	EDC (10 A)
F5	EDC (25 A)

Heater plug fuse

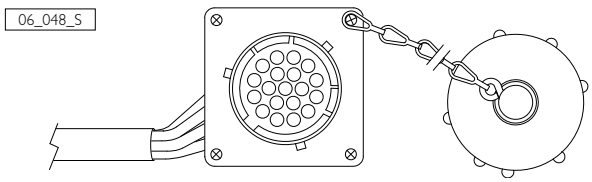
Figure 24



A maxi 60 A fuse is located in serial connection with the electric network of heater plugs.

Diagnostic connector

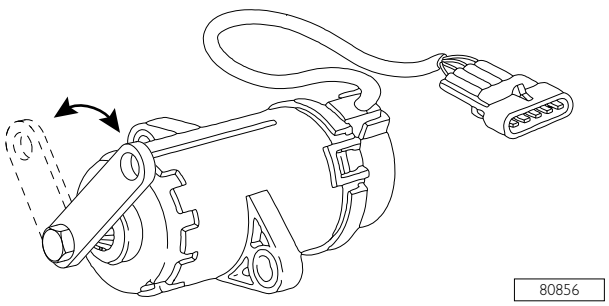
Figure 25



A multipolar plug is located in proximity of the relay box, to which an IVECO MOTORS diagnostic tool can be connected to.
The diagnostic tool allows the processing of data recorded during the engine operation phase and memorized in the ECU; data interpretation will provide useful indications to better schedule maintenance interventions.

Throttle lever position sensor

Figure 26

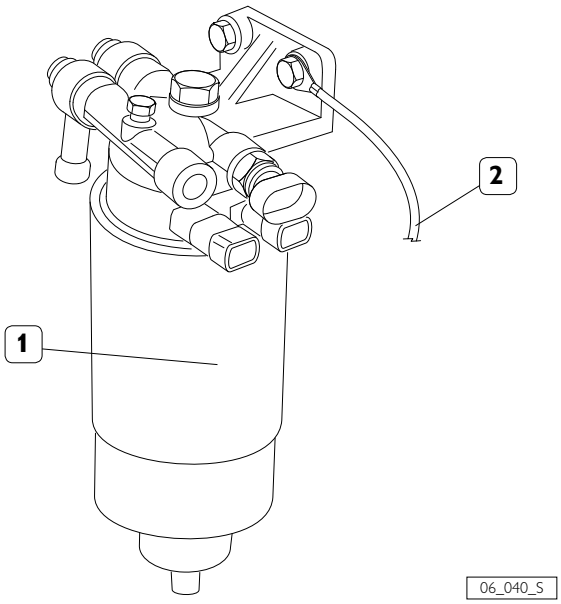


After testing the working condition of the linkage, adjust the run of the servo components (see Chapter 18).

- ❏ With the throttle at idle setting, the potentiometer rod has to be in the resting position.
- ❏ With the throttle at the stop, the potentiometer rod has to be in the position of maximum run out.

Water presence in the filter sensor

Figure 27



1. filter - 2. Conductor to be connected with the negative battery terminal.

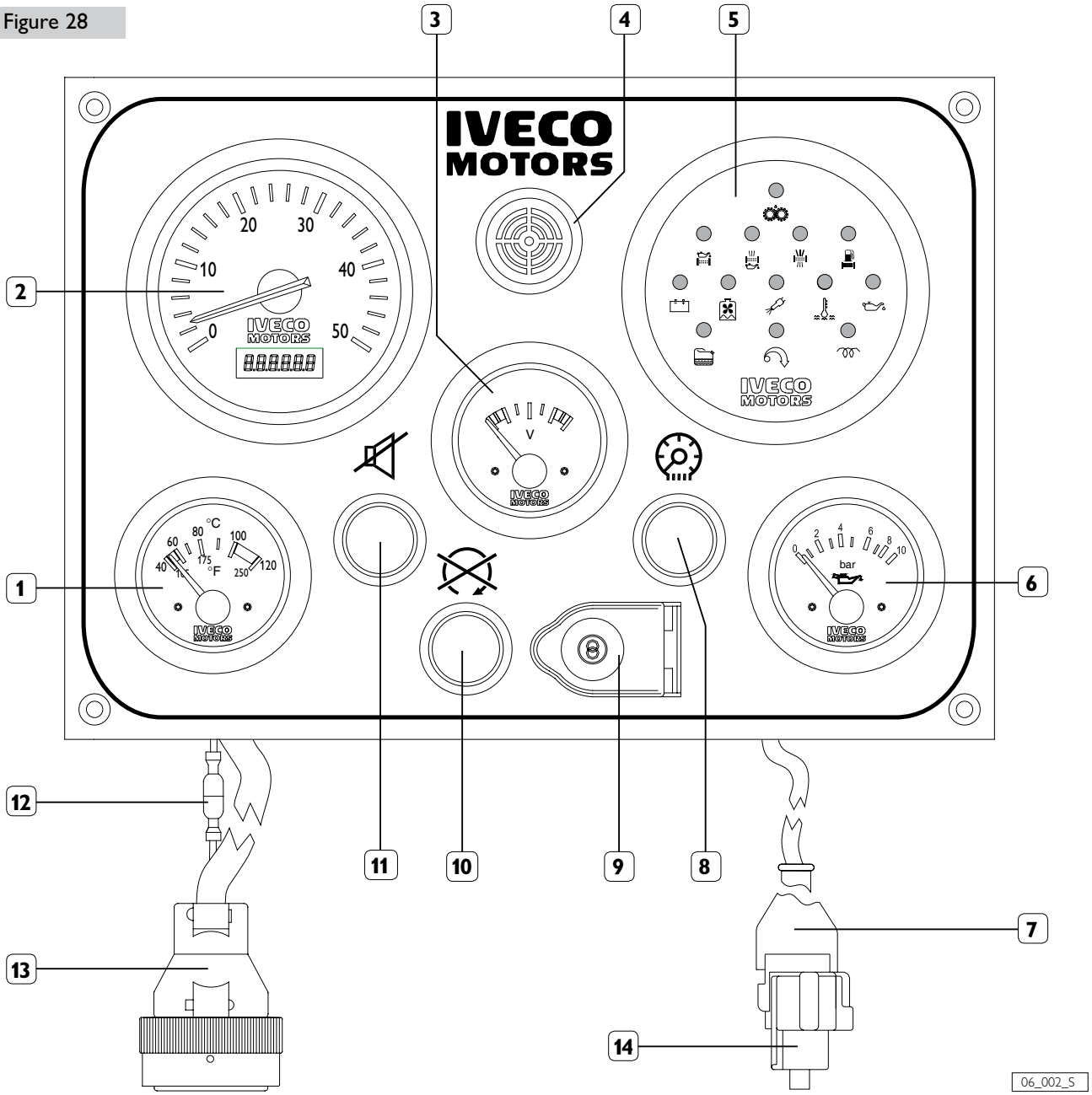
CAUTION

In order to enable the proper working of the sensor to detect water in the fuel, it is necessary that the filter support is connected electrically to the negative battery terminal.

In the engine models which use parts with insulated poles it is necessary to electrically insulate the filter support from the boat mass and then connect the support with the negative battery terminal.

10. MAIN ANALOG INSTRUMENT PANEL

Figure 28



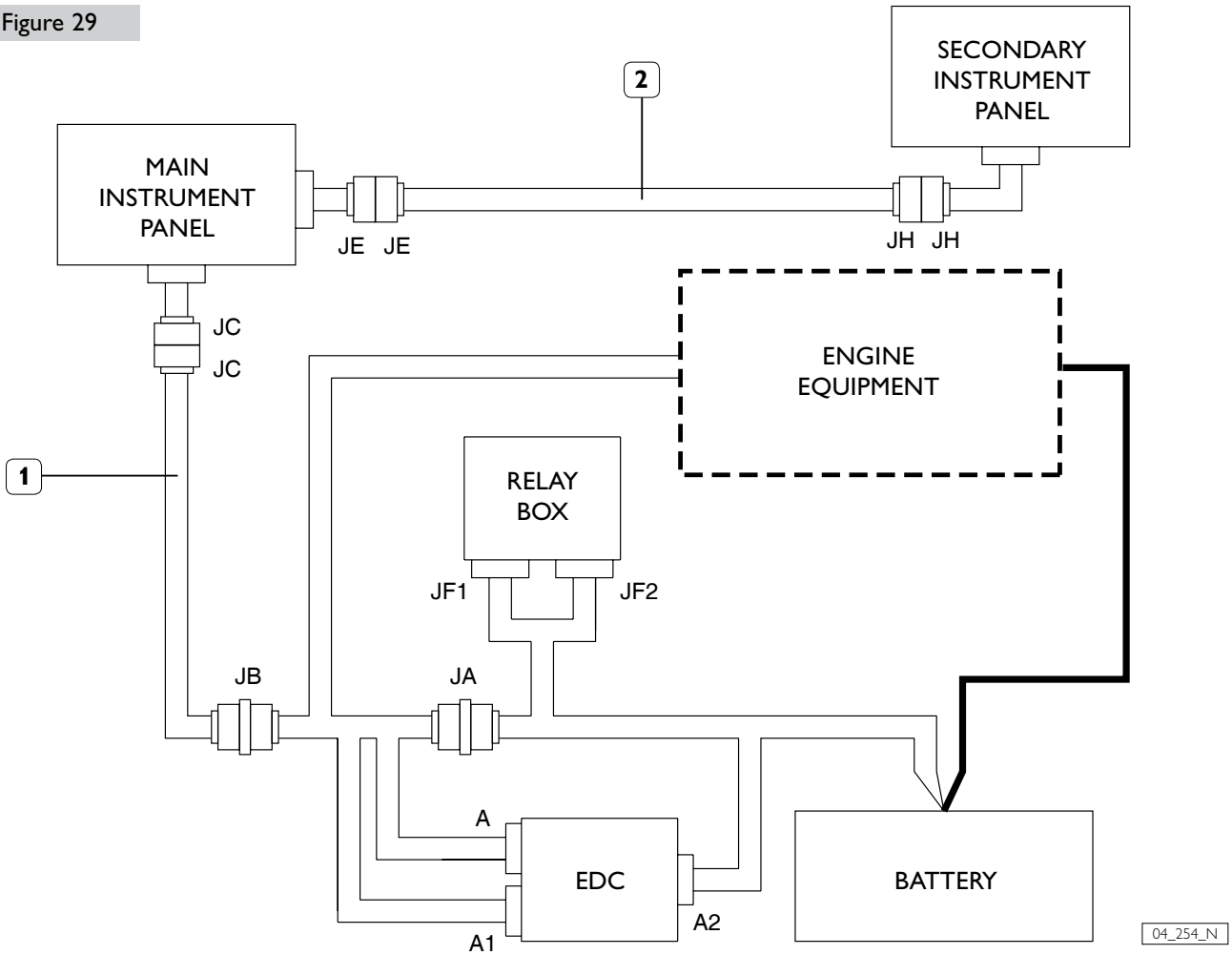
1. Coolant temperature gauge (TA) - 2. Revolution counter and hour counter (CG) - 3.Voltmeter (V) - 4. Buzzer (SA) - 5. Indication and alarm module (MS) - 6. Engine oil pressure gauge (MO) - 7. Connector for secondary instrument panel (JE)- 8. On board panel instrument light switch (L) - 9. Engine start/stop key switch (CA) -10. Engine stop push-button (usable only with electric harness versions with excitation engine stop) - 11. Sound alarm inhibition push-button (P1) -12. SIFC Alarm abilitation connector - 13. Connector for main panel wiring (JC) - 14. Cap with electrical continuity connection.

Installation of the IVECO MOTORS onboard panel with analog indicators entails connecting the panel's JC connector to the JB connector on engine wire harness, interposing the appropriate extension wire harness available in 3, 5 and 7 meter-long versions. The JC-JB wire harness comprises 47 lines, each connected to the terminal identified on both connectors by the same number.

To the main panel is connected the JE connector, provided for connection to the secondary panel; in installations with no secondary panel, do not remove the cap of the JE connector to avoid compromising the electrical continuity of the systems' power supply circuit.
To allow the work of the fuel filter clogging alarm (SIFC), in the indication alarm module, it has to disconnect the connector (12) fitted close to JC.

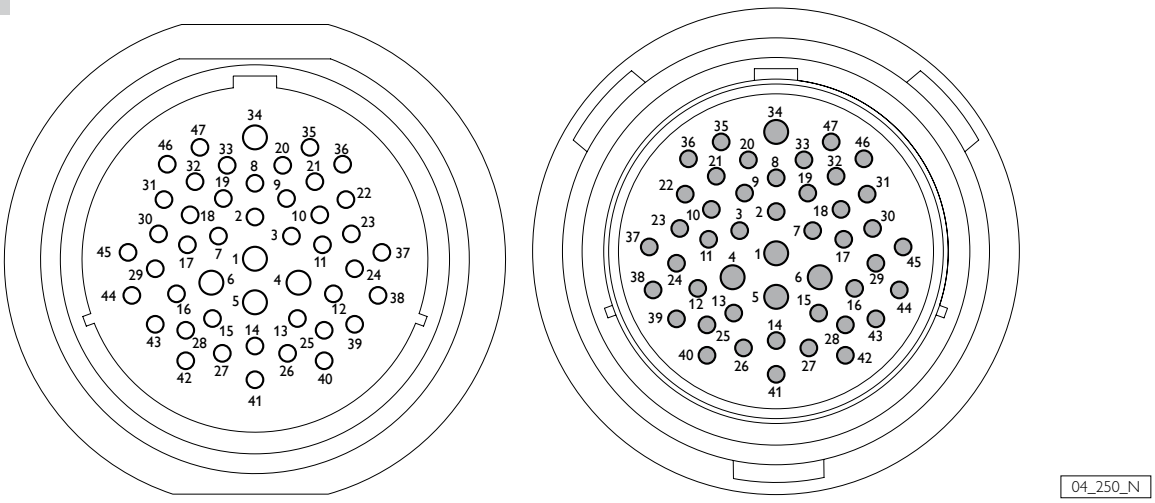
Synoptic of the connections of the analog panels

Figure 29



1. JB-JC extension wire harness - 2. JE-JH extension wire harness.

Figure 30



JC JB

CONNECTORS OF THE JB - JC EXTENSION WIRE HARNESS, SEEN FROM THE COUPLING SIDE

To identify the functions served by the individual lines, refer to the electrical diagrams in Chapter 22.

Installation

In order to drill holes on the area where the panel is to be mounted, refer to the dimensions indicated in Chapter 12.

Operation of the panel

After completing the electrical connections and engine preparation, perform the tests required for the first start, as described in Chapter 17.
Verify the proper operation of the panel, proceeding as follows:

- ❑ Make sure that the "ENGINE ROOM / BRIDGE" switch of the Relay Box is in the "BRIDGE" position, then turn the key switch to the first position and verify that the instruments are powered and the indications and alarms module runs the alarm test for about 5 seconds according to the procedures set out below.
- ❑ Once the test is complete, only the indications prescribed for the engine not running must remain lighted: e.g. "alternator charge" and "low oil pressure"; the analog instruments must provide values consistent with the relevant physical parameters.

Testing the engine start function

Turn the key switch to the second position and keep it in it until the engine has started, then release the switch, which will stably return to the first position; after releasing the key, the switch may be brought back to the starting position only after the switch is returned to the resting or zero position.

Checking indications

After starting the engine, verify whether the operating modes of the indications and alarms module are similar to those set out below.
Using appropriate measuring instruments, verify the consistency of the indications provided by the analog instruments.

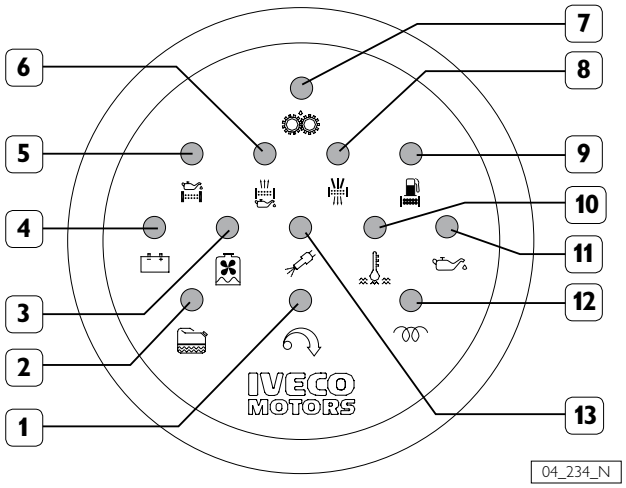
Verify the indication of the panel revolution counter, comparing it with the one measured by a reference instrument; if the indication is different, proceed as described below.

Testing the engine stop function

The engine is stopped and the panel is disabled by returning the key switch to the resting or zero position.
If the engine stopping function if stressed is present, press the stopping button situated on the board.

Indications and alarms module

Figure 31



1. Runaway engine (SSV) - 2. Presence of water in fuel prefilter (SAC) - *3. Low coolant level (SBLA) - 4. Alternator fault (SS) - *5. Clogged oil filter (SIFO) - *6. Clogged oil vapor filter (SIFB) - *7. Pre-lubrication (SP) - 8. Clogged air filter (SIFA) - 9. Clogged fuel filter (SIFC) - 10. High coolant temperature (SATA) - 11. Low oil pressure (SBPO) - 12. Pre-post heating (SCP) - 13. EDC malfunction (EDC).

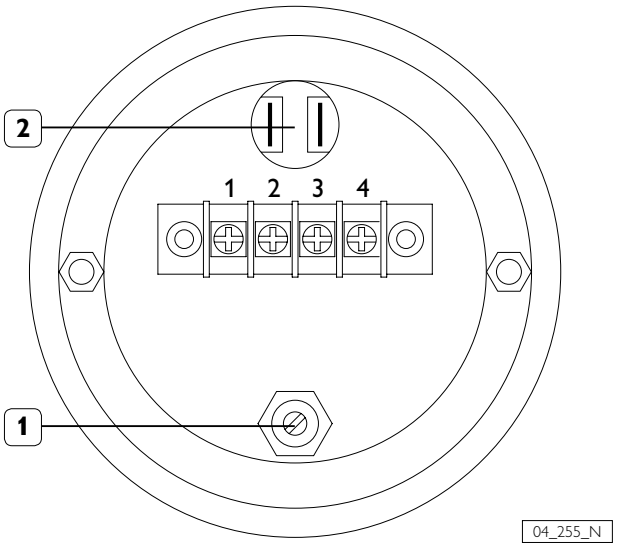
* Unavailable functions on S30 ENT M23 engines.

The indications and alarms module comprises the indicator lights and the electronic alarm interface, timing and storage circuit. It is programmed in such a way that when it is powered, all indicator lights are lighted, with the exception of those for "pre-lubrication", "pre-post heating" and "EDC" failure and a sound signal is emitted by the buzzer.
The sound alarm may be silenced before the end of the test, acting on the appropriate control.
During the starting phase and for the subsequent 15 seconds, needed to stabilize the low oil pressure signal, all the module's functions are inhibited; once this time interval has elapsed, every alarm state detected by the sensors will cause the associated indicator to be lighted and the buzzer to be powered; the exceptions are the "pre-lubrication" and "pre-post heating" indicators, given only visually.
When a new alarm state is detected, the indicator light will flash to highlight the occurrence with respect to any others which may be ongoing at the time. When the sound alarm is shut off, the light indicator will remain lighted and the alarm will be stored until the engine is stopped.

The standard set-up of the S30 ENT M23 provides for use of the indicators SAC, SS, SIFA, SATA, SBPO, EDC.

Revolution-counter calibration

Figure 32A



1. Adjustment screw -
2. Panel lighting lamp.

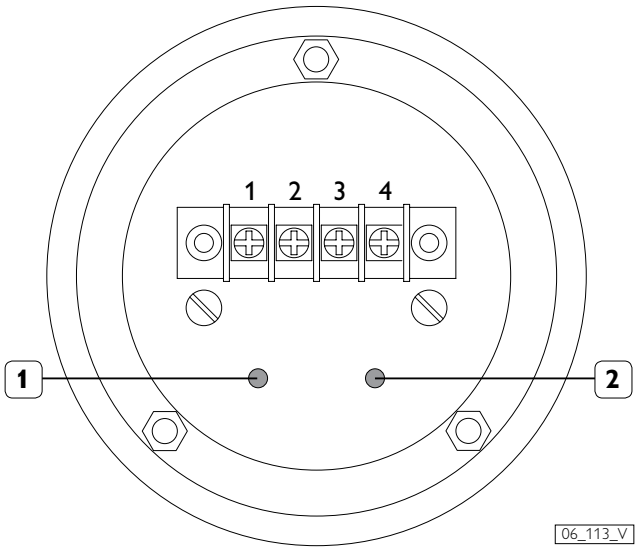
Verify the indication of the panel revolution counter by comparing it with the one measured with a reference instrument; if it differs, operate the adjustment screw (1), located in the rear part of the instrument, until consistency is achieved; repeat the operation for different engine rpms.

Maintenance

Should it become necessary to replace a panel light, remove the lamp holder from the rear part of the instrument (see Figure 32A).

Revolution-counter calibration

Figure 32B



1. Calibration increasing button -
2.Calibration decreasing button.

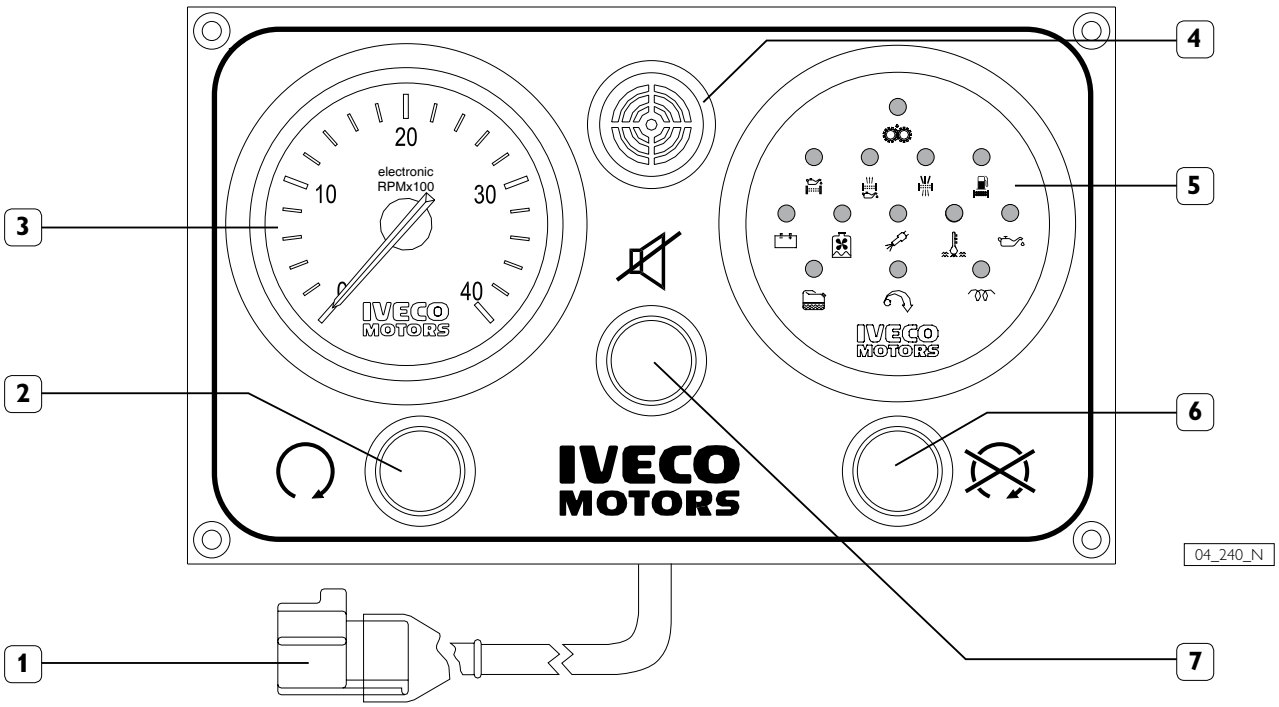
Verify the indication of the panel revolution counter by comparing it with the one measured with a reference instrument; if it differs, press the button 1 and 2 situated on the rear of the tachometer, until consistency is achieved; repeat the operation for different engine rpms.

Maintenance

The board is illuminated by not-replaceable internal LEDs.

11. SECONDARY ANALOG INSTRUMENT PANEL

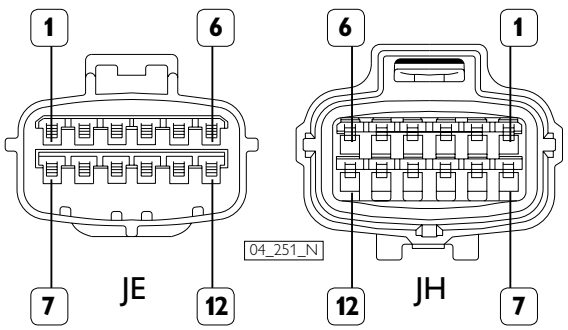
Figure 33



1.Connector for secondary panel wire harness (JH) - 2. Engine start push-button (CS) - 3. Revolution counter (CG) - 4. Buzzer (SA) - 5. Indications and alarms module (MS) - 6. Engine stop push-button (AS) - 7. Sound alarm inhibition push-button (P1).

The connection is achieved by removing the cap on the JE connector of the main panel, and connecting the JE connector to the JH connector on the secondary panel, interposing the extension wire harness, available in 3, 5 and 7 meter-long versions (see Figure 29). The JE-JH wire harness comprises 12 lines, each connected to the terminal identified on both connectors by the same number (see Figure 34).

Figure 34



CONNECTORS OF THE JE-JH EXTENSION WIRE HARNESS, SEEN FROM THE COUPLING SIDE

Installation

In order to drill holes on the area where the panel is to be mounted, refer to the dimensions indicated in Chapter 12.

Operation of the secondary panel

After completing the electrical connection to the main panel and engine preparation, and performing the tests required for the first start (as described in Chapter 17), verify the proper operation of the panel, proceeding as follows:

- ❏ Make sure that the "ENGINE ROOM / BRIDGE" switch of the Relay Box is in the "BRIDGE" position, then turn the key switch to the first position, thus enabling the operation of both panels.
- ❏ Carry out the same tests for the secondary panel as were carried out for the main panel.
- ❏ Disable the secondary panel by bringing the key switch on the main panel to the resting or zero position.

Testing the engine start and stop function.

With the panel enabled, press the green push-button until the engine starts, then release it; wait for engine rpm to stabilize before stopping it by pressing the red push-button. The starting and stopping operations can be performed several times and consecutively from the secondary panel

Checking indications

Proceed in the same way as for the main panel.

12. DRILLING PLANS FOR ANALOG PANELS

Figure 35

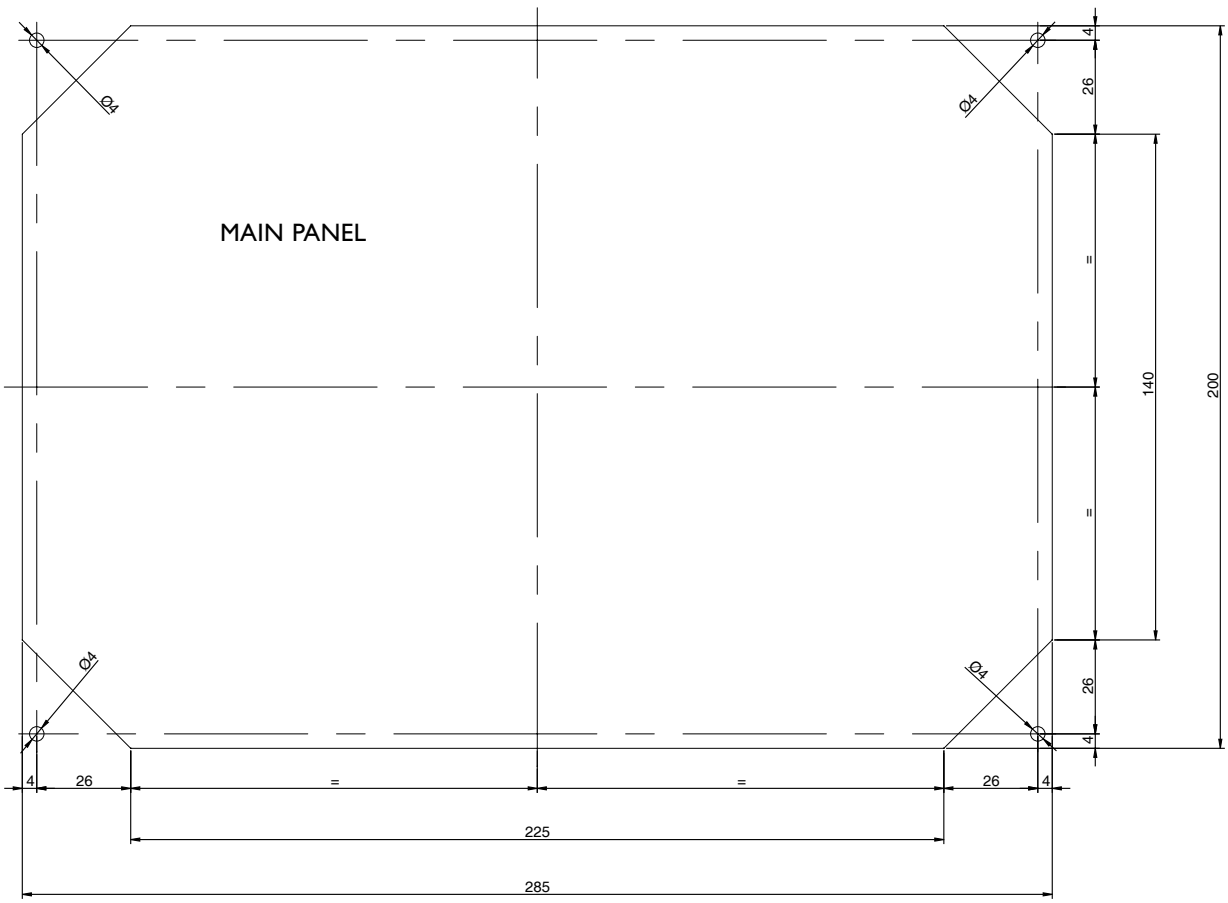
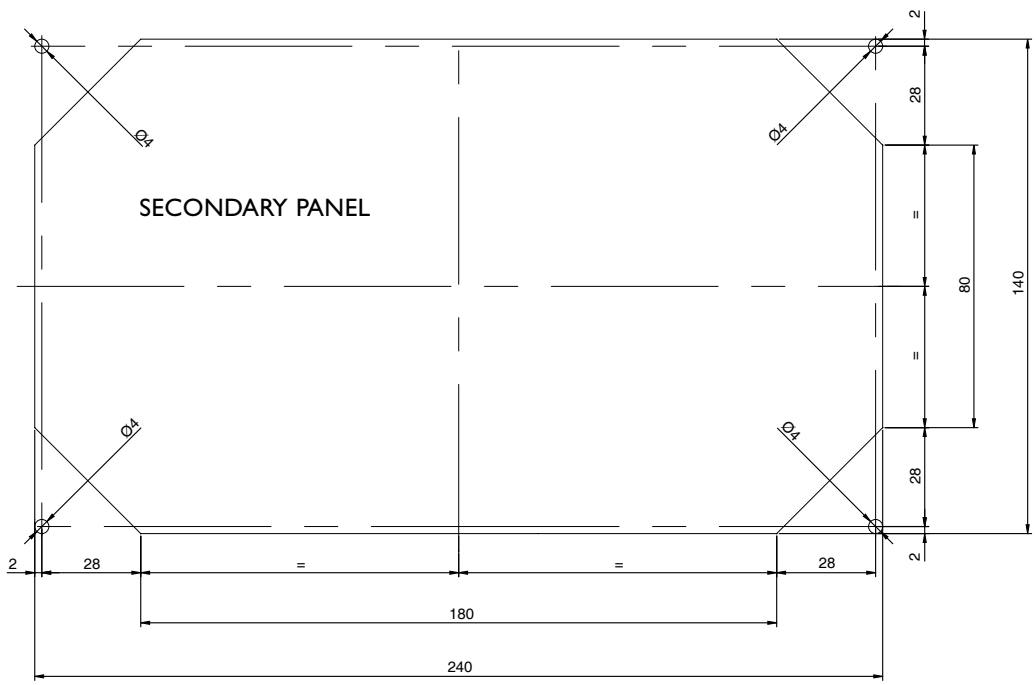


Figure 36



Measurements in: millimeters.

13. CUSTOMIZED INSTRUMENT PANEL

Using only the components of the panel that are not wired to allow for panel customization, they will have to be wired using the 10 meter long wire harness, set up at one end for coupling to the JB connector and at the opposite end with conductors with free terminals with identifying numbering on each wire. The conductors will have to be connected to the individual components as indicated in the electrical and wiring diagrams in Chapter 22.

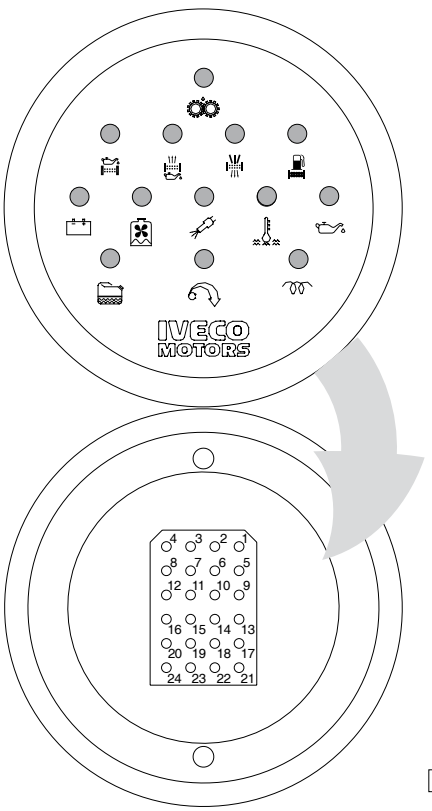
CAUTION

To assure the functionality of the safeties pertaining to the engine start/stop commands from the instrument panel or engine room, it is mandatory to wire the key switch strictly as shown in the electrical diagrams in Chapter 22.

The wiring details of the indications and alarms module alone are provided below; indications for IVECO MOTORS indicator instruments, are shown in the related wiring diagrams in Chapter 22.

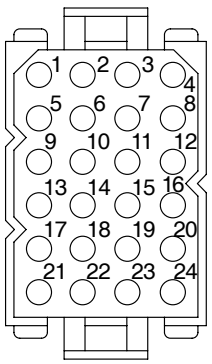
JD Connector for indications and alarms module

Figure 37



VIEW FROM THE INTEGRATED SIDE
IN THE REAR PART OF THE MODULE

Figure 38



VIEW FROM THE TERMINAL SIDE
OF THE COUPLING SIDE WIRING

Connector	TRIDENT - ITT Cannon	part # TST 24PA00
terminal	female	part # 192990-0050
lid	rear	part # TST24AH00

JD connects the indications and alarms module to the electrical system of the engine (sensors, power supply, etc.).
The terminal part of the wire harness, supplied with the module, must be completed using female terminals, as described in the electrical diagram of Chapter 24.
For standard-equipped engines, to have the essential indications available, the following ways must be wired: 1, 2, 3, 7, 8, 9, 10, 13, 14, 15, 17, 18, 19 with the female terminals supplied as standard equipment.

Functions of the JD terminals

PIN	Description	Electric level	
		OFF Indication	ON Indication
1	Module power supply	Positive (+B)	
2	Not connected	-	
3	EDC Fault indication	High (+B)	Low (ground)
4	Not connected	-	
5	Pre-heating indication	High (+B)	Low (ground)
6	Pre-lubrication indication	Open circuit	High (+B)
7	Engine start	Power supply positive (+B) while starting	
8	Sound alarm inhibition	Negative (ground) during the request	
9	Module power supply	Negative (ground)	
10	Buzzer power supply	Negative (ground) during the emission of sound	
11	Clogged oil filter indication	Open circuit	Low (ground)
12	Clogged oil vapor filter indication	Open circuit	Low (ground)
13	Clogged air filter indication	Open circuit	Low (ground)
14	Clogged fuel filter indication	Low (ground)	Open circuit
15	Alternator fault indication	High (+B)	Low (1 to 3 V)
16	Low engine coolant level indication	Open circuit	Low (ground)
17	High coolant temperature indication	Open circuit	Low (ground)
18	Low engine oil pressure indication	Open circuit	Low (ground)
19	Presence of water in fuel indication	Open circuit	Low (ground)
20	Overloaded or runaway engine indication	Open circuit	High (+B)
21	Not connected	-	
22	Not connected	-	
23	Reception of data from main panel	NMEA communication protocol (0 to 5 V)	
24	Transmission of data to secondary panel	NMEA communication protocol (0 to 5 V)	

CAUTION

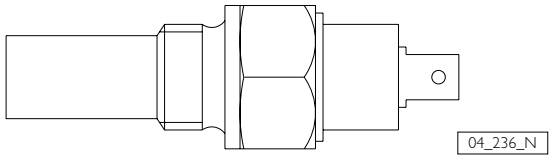
To assure the utmost reliability and safety while underway, all installations must be provided with the following alarm indications:
(EDC) EDC failure
(SATA) high coolant temperature
(SBPO) low oil pressure

It is also recommended that the following indications be present:
(SAC) presence of water in the fuel pre-filter
(SIFA) clogged air filter
(SIFC) fuel filter indication
(SS) alternator fault

14. SENSORS FOR DETECTION AND PANEL SIGNALING

Coolant temperature sensor

Figure 39

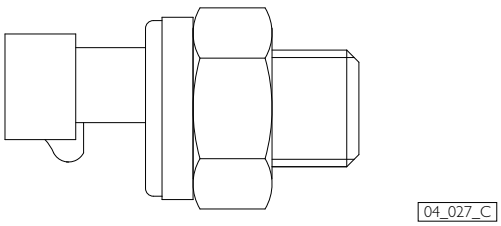


Resistor with negative temperature coefficient, providing the signal for analog temperature indication.

Operating voltage:	from 6V to 24 V
Calibration range	from 0 °C to 120 °C
Resistance value at 90 °C	51,2 ± 4,3 Ω
Electrical poles	isolated

High coolant temperature sensor

Figure 40

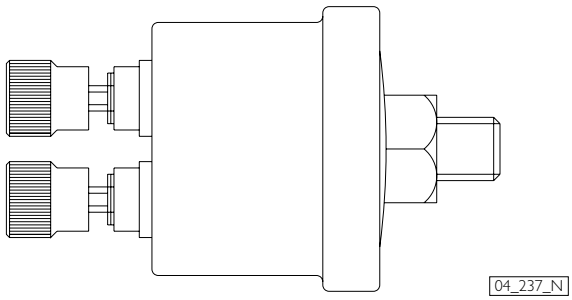


Switching coolant temperature sensor, providing the signal for the related indicator.

Operating voltage:	from 6 to 24 V
Condition at ambient temperature	normally open
Closing temperature:	100 ± 3 °C
Electrical poles	isolated

Oil pressure sensor

Figure 41

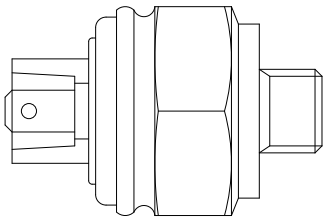


Rheostat component providing the signal for the analog indication of pressure.

Operating voltage	from 6V to 24 V
Calibration range	from 0 bar to 10 bar
Resistance value at 0 bar	10 Ω +3/-5 Ω
Resistance value at 2 bar	52 ± 4 Ω
Resistance value at 4 bar	88 ± 4 Ω
Resistance value at 6 bar	124 ± 5 Ω
Maximum value of resistance	184 Ω
Operating temperature	from - 25°C to 100°C
Electrical poles	isolated

Low oil pressure sensor

Figure 42

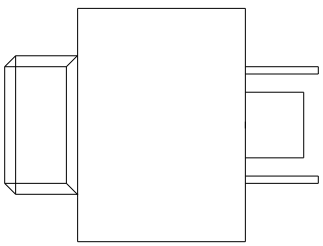


Pressure switch, providing the signal for the related indicator.

Operating voltage:	from 6 to 24 V
Condition at ambient pressure	normally closed
Calibration range	0.5 - 0.8 bar
Closing pressure:	0.5 bar
Opening pressure:	0.8 bar
Maximum current	15 A (not inductive)
Electrical poles	isolated

Air filter clogging sensor

Figure 43

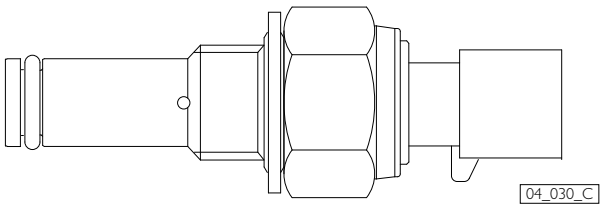


Vacuum switch, providing the signal for the clogged air filter alarm indicator.

Operating voltage	from 6V to 24 V
Condition at ambient pressure	normally open
Closing vacuum	≥ 52 mbar
Operating temperature	from -20 °C to +80 °C
Maximum current	0,1 A (not inductive)
Electrical poles	isolated

Fuel filter clogging sensor

Figure 44

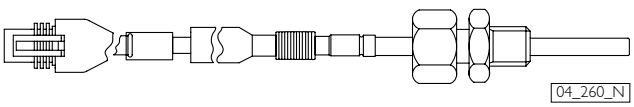


Pressure switch, providing the signal for the related indicator.

Operating voltage:	from 6 to 24 V
Condition at ambient pressure	normally closed
Opening pressure:	1.5 ± 0.1 bar
Maximum current	0,1 A (not inductive)
Electrical poles	isolated

Exhaust gas temperature sensor

Figure 45



NiCr-Ni thermocouple sensor with insulated poles, providing the signal for the analog indication of exhaust gas temperature.

Temperature	Voltage
°C	mV
100	4.10
200	8.13
300	12.21
400	16.40
500	20.65
600	24.91
700	29.14
800	33.30
900	37.36

15. PREPARING THE ENGINE FOR FIRST START-UP

1. Drain the residual 30/M protective oil from the sump.
2. Pour into the lubricating loop only lubricating oil of the type and in the quantities set out in the Refilling Table.
3. Drain the CFB protective liquid from the fuel loop, completing the operations as indicated under item 3. of Chapter 21.
4. Remove the caps and/or seals from the engine intake, exhaust, aeration and venting ports, restoring normal conditions of use. Connect the inlet of the turbocharger to the air filter.
5. Connect the fuel loops to the boat tank, completing the operations set out in item 4. of Chapter 21. During filling operations, connect the pipe returning fuel to the tank to a collecting container, to prevent residues of CFB protective liquid from ending up into the boat tank.
6. Verify and refill engine coolant as prescribed.
7. Remove from the engine the labels with the inscription "ENGINE WITHOUT OIL".

16. TESTS BEFORE THE FIRST START-UP

Although they are extremely important, "common sense" checks such as the exposure of sensitive parts (plastics, wire harness, electronic units, etc...) to heat, and those that for years have characterized the quality of the work performed in the yard, are not mentioned herein.
Tests of the proper operation of the engine and the components of the electronic control system may be performed rapidly and with the utmost reliability using specific diagnostic tools, available from IVECO MOTORS Technical Assistance Centers.

Fuel tank suction

Verify the fuel suction at the maximum allowed longitudinal and transverse inclination, with the residual quantity of fuel considered "RESERVE", such as to cause the reserve indicator light to be permanently lighted.

Throttle lever position sensor

In the positions of minimum and maximum travel, verify the correlation between the position of the throttle control valve on the bridge and the position of the sensor rod, checking:

Instrument panel

Verify the efficiency of all light indicators, as described in the related Chapters.

17. FIRST ENGINE START

Before starting the engine, please make sure the sea water gate valve is open, check the levels of the lubricating oil and of the engine coolant, and complete venting the air from the fuel feed loop:

- ❏ Turn the key on "ON"; so that the ECU EDC feeds the fuel electric pump for a few seconds, thus pressurizing the low pressure feeding circuit.
- ❏ Loosen the vent fitting on the pre-filter.
- ❏ Newly turn the key on "ON" to feed the electric pump until air-free fuel flows out of it.
- ❏ Tighten the vent fitting.

Make sure that the fuel that flows out of the fitting is not dispersed in the environment.

CAUTION

Never attempt to vent the high pressure system, as this is useless and extremely dangerous.

NOTE

A few moments after engine start, make sure sea water is correctly expelled out of the system.

Once the first start-up phase is complete, verify that:

- ❏ There are no liquid leaks from the coolant loop pipeline junction hoses.
- ❏ There are no exhaust gas leaks into the hull.
- ❏ Complete the instrument panel operation tests as described in the related Chapters.
- ❏ Verify that the power supply voltage across the battery, after about 15 minutes with the engine running, is no less than about 13 V.
- ❏ Stop the engine and delete any "errors" which may have been stored in the injection system ECU during the stabilization phases. For the deletion procedure, refer to Chapter 20.

18. EDC ANOMALIES INDICATION

Anomalies indicator light

The ECU continuously monitors, with complex self-testing routines, its own operating conditions as well as those of the components connected to it and of the engine.
When anomalies are detected, the alarm indicator light on the indicator and control panel is lighted in manners that provide a first indication on the severity of the problem.

Light off: no anomaly detected or slight anomaly that does not compromise operating safety

Light on: significant anomaly, allowing to proceed to a service center

Blinking light: severe anomaly requiring immediate repairs. If possible, shut the engine down.

Recovery

The recognition of significant or severe anomalies causes the adoption of strategies that allow to use the engine with complete safety, guaranteed by limiting performance within pre-set thresholds according to the severity of the case.

These strategies cause the reduction of the maximum values of torque and power delivered by the engine.
In the case of intermittent anomalies, i.e. recognized by the ECU and subsequently no longer present, performance reduction will continue until the engine is shut down.

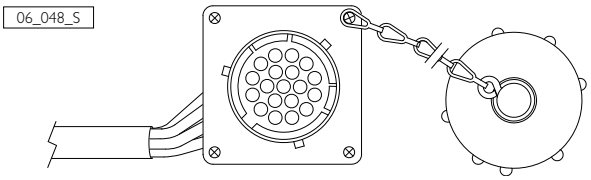
Normal operation will be restored only the next time the engine is started, while the anomaly data will be "saved" in the failure memory.

NOTE

Identification of severe anomalies of the accelerator position sensor, causes the ECU to increase the engine rpm from about 800 rpm to about 1050 rpm, in order to achieve a minimum engine thrust and allow manoeuvers.

Error deletion procedure

Figure 46



It will be possible through the IVECO PT01 device connected to the dedicated J1 diagnostic connector.

CAUTION

The mistake deleting procedure is intended to eliminate the information relating to the mistakes from the ECU memory, which happened during previous working periods. The mistakes will not be deleted unless the relating cause has been removed. Please remember that some anomalies can be detected by the ECU self-diagnosis only during a complete engine working cycle.

19. BLINK CODE TABLE (software version P315 V4.B)

Blinking code	EDC indicator light	Indicated fault	Max power reduction	DTC code
		Control area		
11	(on)	not significant in marine applications	-	117 - 119
13	(off)	not significant in marine applications	-	78
14	blinking	throttle position sensor (line 1 o line 2)	x	8 - 9
17	off	not plausible accelerator position sensor signals	-	11
18	off	EDC anomalies warning light control	-	108
		Engine Area 1		
21	blinking	water temperature sensor	x	20 - 21
22	off	air temperature sensor	-	57
23	on	fuel temperature sensor	-	40
24	blinking	supercharge air pressure sensor	x	17 - 131
25	off	ambient pressure sensor (inside the unit)	-	10
27	on	electric fuel pump control relay exication circuit	-	94
28	off	coil relay fuel heater	-	42
		Engine Area 2		
35	off	battery voltage value	-	18
36	off	pre-heating warning light control circuit	-	48
37	off	engine heater plugs feeding relay	-	47
38	off	not plausible signal "15", power supply from key	-	109
39	off	engine heater plugs control unit	-	49
		Injectors		
51	blinking	cylinder 1 electro-injector	x	66 - 67
52	blinking	cylinder 2 electro-injector	x	68 - 69
53	blinking	cylinder 3 electro-injector	x	70 - 71
54	blinking	cylinder 4 electro-injector	x	72 - 73
57	blinking	electro-injector cylinder 1-2-3 power driver 1-4	x	60 - 61
58	blinking	electro-injector cylinder 4-5-6 power driver 1-4	x	62 - 63
59	blinking	cylinder electroinjector unit power stage (A o B chip internal error)	x	64 - 65
		Engine RPM sensor		
61	blinking	driving shaft sensor signal	x	37
62	blinking	timing shaft sensor signal	x	36
63	blinking	not plausible driving and timing shifts sensors signals	x	38

(continue to next page)

Blinking code	EDC indicator light	Indicated fault	Max power reduction	Code DTC
		Interface		
72	on	CAN lines error	-	87 - 88- 45
73	on	CAN lines error	-	43 - 44 - 46
74	off	CAN lines error	-	29 - 126 - 128 129 - 130
75	off	CAN lines error	-	125 - 127
		Fuel pressure		
81	blinking	fuel pressure control deviation	STOP	98 - 99
81	blinking	rail pressure too low value	STOP	100
81	blinking	rail pressure too high value	STOP	101
81	blinking	fuel pressure control management	-	102 - 103
82	blinking	fuel pressure sensor signal	STOP	95
82	on	fuel pressure sensor signal deviation	**x**	96
83	blinking	pressure adjustment solenoid valve	STOP	82 - 83 - 84
		Electronic unit		
91	blinking	internal errors	-	50 - 52 - 54 - 55 56 - 86 - 121
92	blinking	EEPROM memory error	-	51
93	(on)	not relevant for marine applications	-	58
94	on	main relay	-	80
96	blinking	initialization error (inside control unit)	**x**	104
97	blinking	analogical-digital converter	-	3
97	blinking	control unit/sensors feeding	**x**	105
97	blinking	control unit/sensors feeding	STOP	106
98	blinking	internal errors	-	90 - 91
99	on	internal errors	-	110

20. UNDERWAY CHECKS

ECU Temperature

Verify that the temperature of the surface of the electronic engine control unit, after 30 minutes underway at full engine power, is less than +70 °C.

Engine compartment vacuum

Verify that value of ambient air pressure in the engine room with the engine(s) at full load and maximum power output complies with the value specified herein.

Combustion air temperature

Verify that the temperature in the engine room, after 30 minutes underway at full engine power, does not exceed 45 °C and, in any case, does not exceed the value of external temperature by more than 15°C.

Exhaust back-pressure

Verify that the value of back-pressure present at the inlet of the exhaust gas conduit, with the engine(s) at full load and maximum power output, complies with the value specified herein.

Exhaust temperature

Verify that the temperature of the exhaust gases under maximum engine power output conditions is close to the prescribed value. To determine the propeller power absorption curve, it will also be possible to obtain the fuel injection values from the ECU parameters by using the IVECO MOTORS tool.

Fuel temperature

Verify that the temperature of the fuel in the low pressure line, while underway at full power and with a stable quantity of fuel in reserve, does not exceed 70 °C. A higher value would entail a reduction in engine performance. If the tendency to reach the maximum allowed temperature is noted, install a heat exchanger for the fuel.

Pressure in the fuel supply line

To assure the regular operation of the engine and the reliability of the components of the fuel supply and injection system, you need to verify that:

- ❏ Diesel feeding pipe pressure to low pressure mechanical pump should range between 0.2 and 1.2 bar (2000 to 12000 mm H_2O);
- ❏ pressure in the fuel oil return line to the tank is less than 0.4 bar relative (4000 mm H_2O).

Measures are carried out inserting a "T" junction near the fuel inlet and outlet, taking care to avoid any air suction. Values are read at variable rpm, from idle to maximum, at 200 rpm intervals.
If there are any symptoms indicating the possible presence of air in the fuel supply line, a check may be made by inserting a clear tube, arranged as an inverted U, before the engine inlet junction.

21. PREPARING THE ENGINE FOR LONG IDLE PERIODS

To prevent oxidation to the internal parts of the engine and to some components of the injection system, if idle periods exceeding two months are expected, the engine needs to be prepared with **six-months periodicity**, proceeding as follows:

1. Drain the lubricating oil from the sump, after heating the engine.
2. Pour 30/M protective oil (alternatively, oil conforming with MIL 2160B Type 2 specifications) into the engine to the "minimum" level marked on the dipstick.
   Start the engine and let it run for about 5 minutes.
3. Drain the fuel from the injection line and from the filter, taking care to avoid letting the fuel come in contact with the auxiliaries belt.
4. Connect the fuel line to a tank containing CFB protective liquid (ISO 4113) and assist the inflow of the liquid by pressurizing the line and turning the engine over for about 2 minutes, after excluding the operation of the injection system. The required operation may be carried out by directly polarizing the terminal 50 of the electric starter motor with positive voltage 12 V, using a conductor prepared for the occasion.
5. Nebulize 30/M protective oil at the rate of about 70 g (30 g per liter of displacement) into the turbocharger intake, while the engine is turning over as described above.
6. Close with suitable stoppers or seal with adhesive tape all engine intake, exhaust, aeration and venting ports.
7. Drain the residual 30/M protective oil from the sump; it may be re-used for 2 more engine preparation operations.
8. Apply tags with the inscription "ENGINE WITHOUT OIL" on the engine and onboard panel.
9. Drain the coolant, if it has not been mixed with anti-freeze and corrosion inhibiting agents, affixing tags to indicate that the operation has been carried out.

If external parts of the engine are to be protected, spray protective liquid OVER 19 AR onto unpainted metal parts, such as flywheel, pulleys and others; avoid spraying belts, connector cables and electrical equipment.

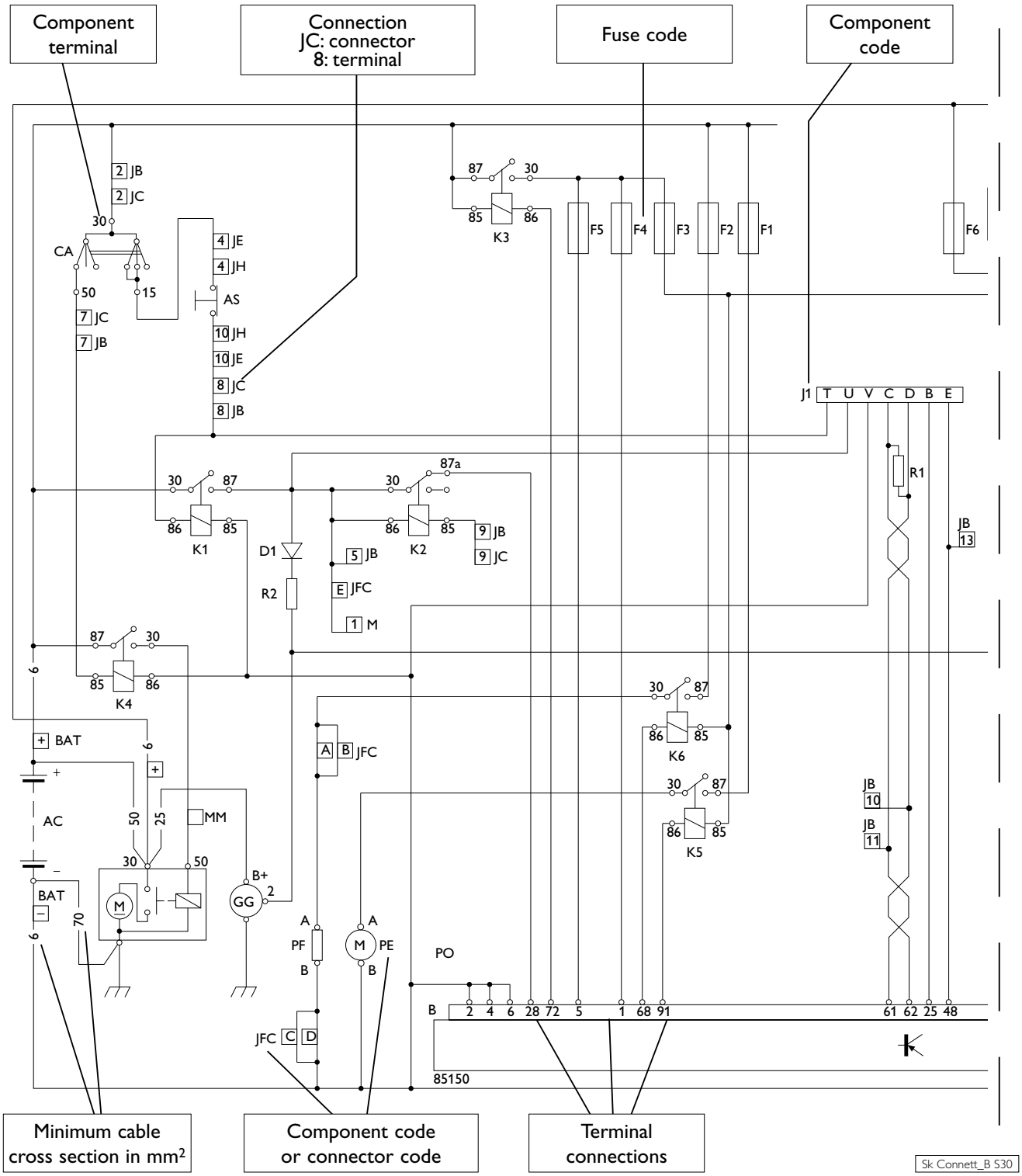
22. WIRING DIAGRAMS

Wiring diagram key

General conditions for the preparation and interpretation of wiring diagrams

- ❏ Key switch open
- ❏ Engine not running
- ❏ Liquids at efficient levels and pressures

Figure 47



Electrical equipment component code

A	fuel temperature sensor for EDC
B	drive shaft sensor
C	camshaft sensor
F	engine coolant temperature sensor for EDC
H	combustion air pressure/temperature sensor for EDC
I	coolant high temperature sensor
K	air filter clogging sensor (for alarm)
L	instrument panel light switch
M	sensor for detecting the presence of water in the fuel pre-filter (for alarm)
O	exhaust gas temperature sensor
T	coolant temperature sensor (for gauge)
V	oil pressure sensor (for gauge)
W	engine oil low pressure sensor
Z	fuel filter clogging sensor
P1	sound alarm inhibition push-button
R1	120 Ω resistor for CAN line balancing
R2	alternator pre-excitation resistor
AC	battery
AQ	engine shut-off push-button on main panel
AS	engine shut-off push-button on secondary panel
CA	key switch
CC	engine pre-heating glow plugs electronic control unit
CS	engine start push-button on secondary panel
E1, E2, E3, E4	electro-injector
G1, G2, G3, G4	engine pre-heating glow plugs
GG	alternator
MM	electric starter motor
MS	IVECO MOTORS indications and alarms module
PA	throttle position sensor
PE	fuel electric pump
PF	heating element on fuel filter
PR	rail pressure sensor
QP	main analog instrument panel
QS	secondary analog instrument panel
SA	buzzer
WI	low gear box oil pressure sensor (7 bar)
ZH	pressure control solenoid valve
85150	ECU of the EDC system

(continues on next page)

Electrical equipment component code (follows)

Connectors	
A	60 pole EDC engine components
B	94 pole EDC electro-injectors
J1	external diagnostic tool (on the relay box panel)
JB ON ENGINE WIRE HARNESS	set for connection to the main analog instrument-panel or to the interface wire harness for converter module
JC ON MAIN ANALOG INSTRUMENT PANEL	set for connection to the engine wire harness
JD	IVECO MOTORS indications and alarms module
JE ON MAIN ANALOG INSTRUMENT PANEL	set for connection to the secondary analog instrument panel
JH ON SECONDARY ANALOG INSTRUMENT PANEL	set for connection to the main analog instrument-panel

vIndicator lights	
EDC	EDC malfunction
SAC	presence of water in fuel pre-filter
SATA	high coolant temperature
SBLA	low coolant level
SBPO	low oil pressure
SCP	pre-post heating
SIFA	clogged air filter
SIFB	clogged oil vapor filter
SIFC	clogged fuel filter
SIFO	clogged oil filter
SP	pre-lubrication
SS	alternator fault
SSV	runaway engine

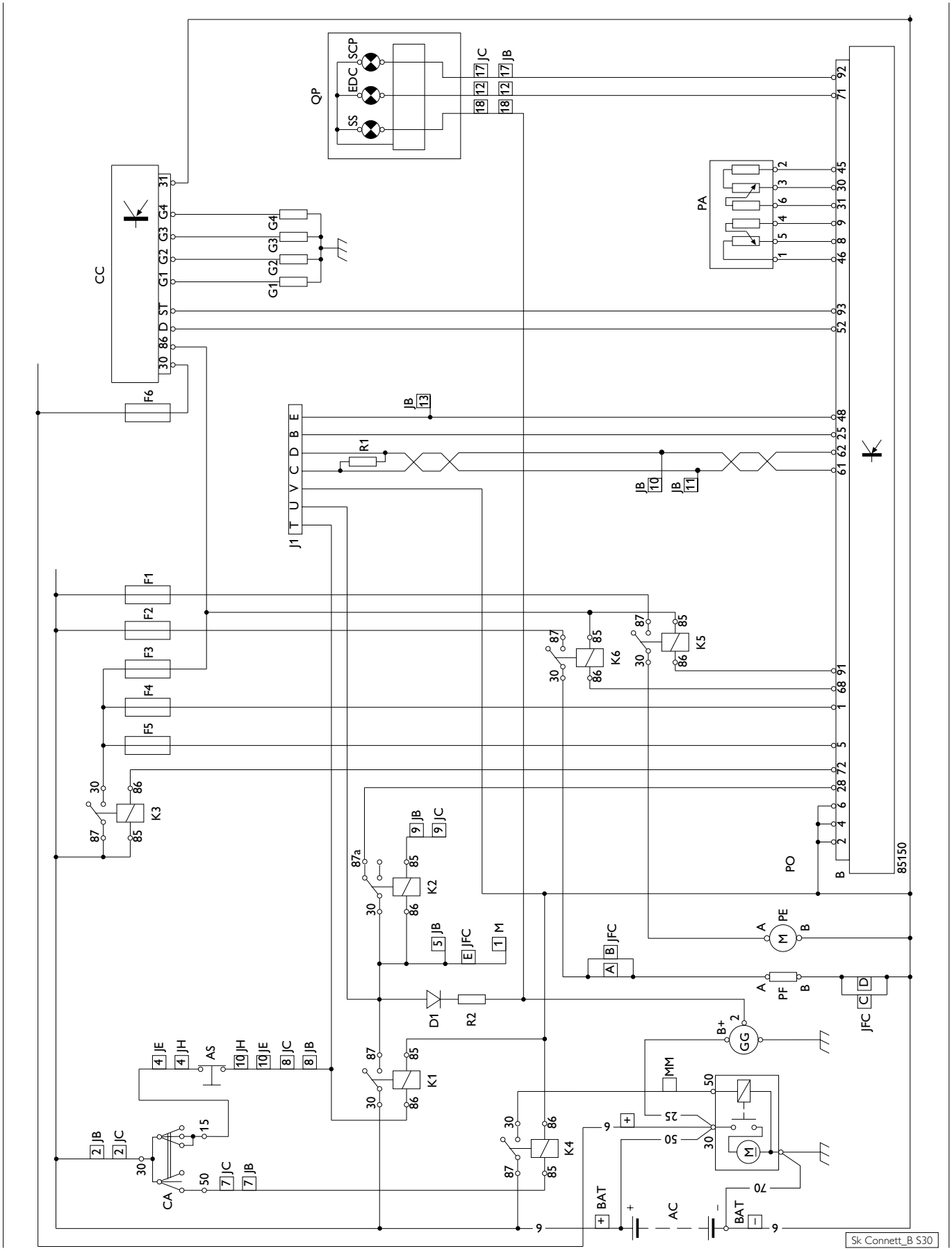
Gauges	
CG	revolution-counter
MI	gear box oil pressure gauge
MO	engine oil pressure gauge
TA	engine temperature
TI	gear box oil temperature
TS	exhaust gas temperature
V	voltmeter

Remote control switches mounted on the relay box	
K1	key switch electric discharge
K2	emergency engine shut-down provision
K3	EDC main (power supply
K4	power supply to terminal 50 of the electric starter motor
K5	fuel electric pump power supply
K6	fuel filter heater element power supply

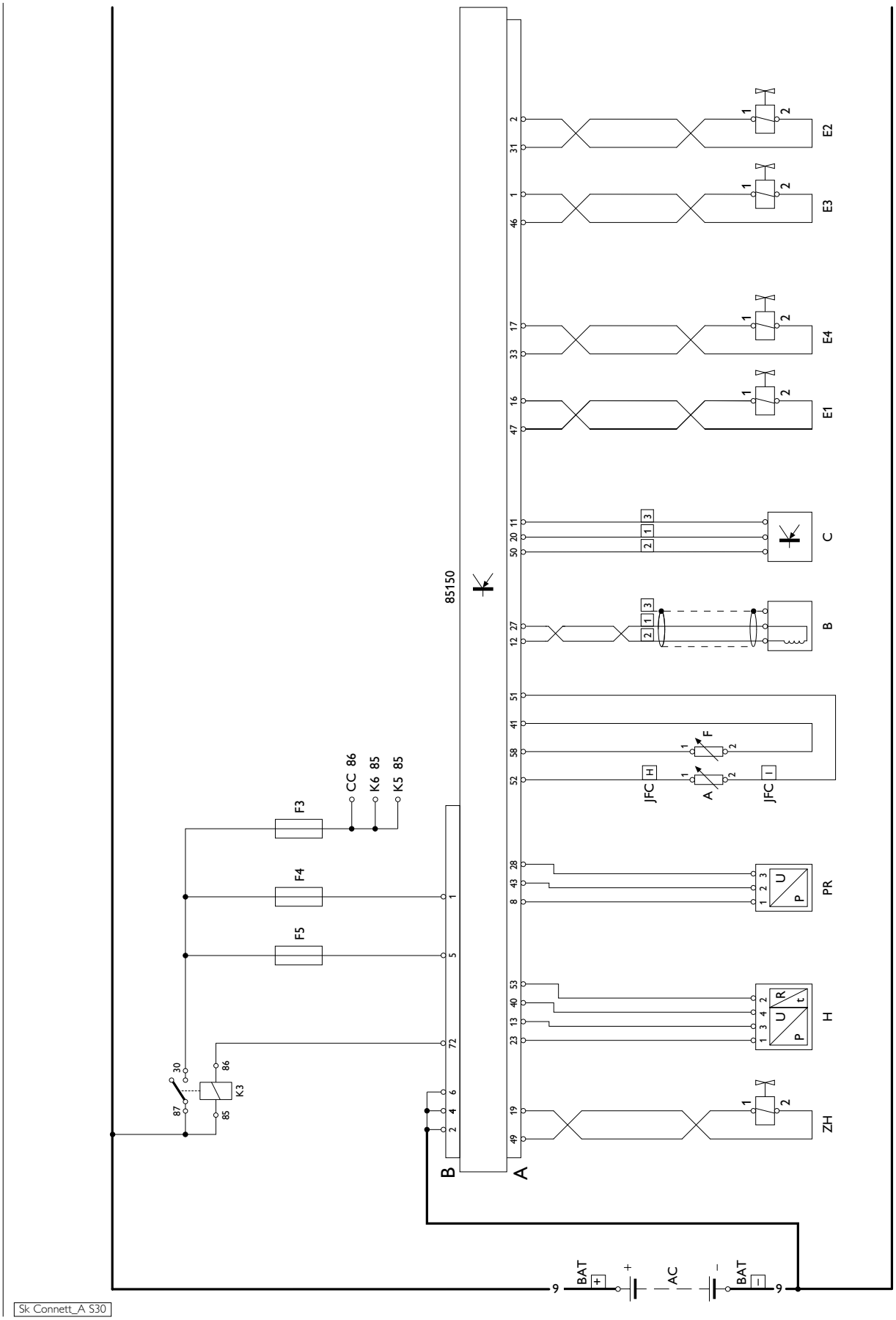
Fuses mounted on the relay box	
F1	fuel electric pump
F2	heating element on fuel filter
F3	power supply to the heater plug control unit (15 A)
F4	EDC (10 A)
F5	EDC (25 A)

Maxi fuse	
F6	heater plug power circuit

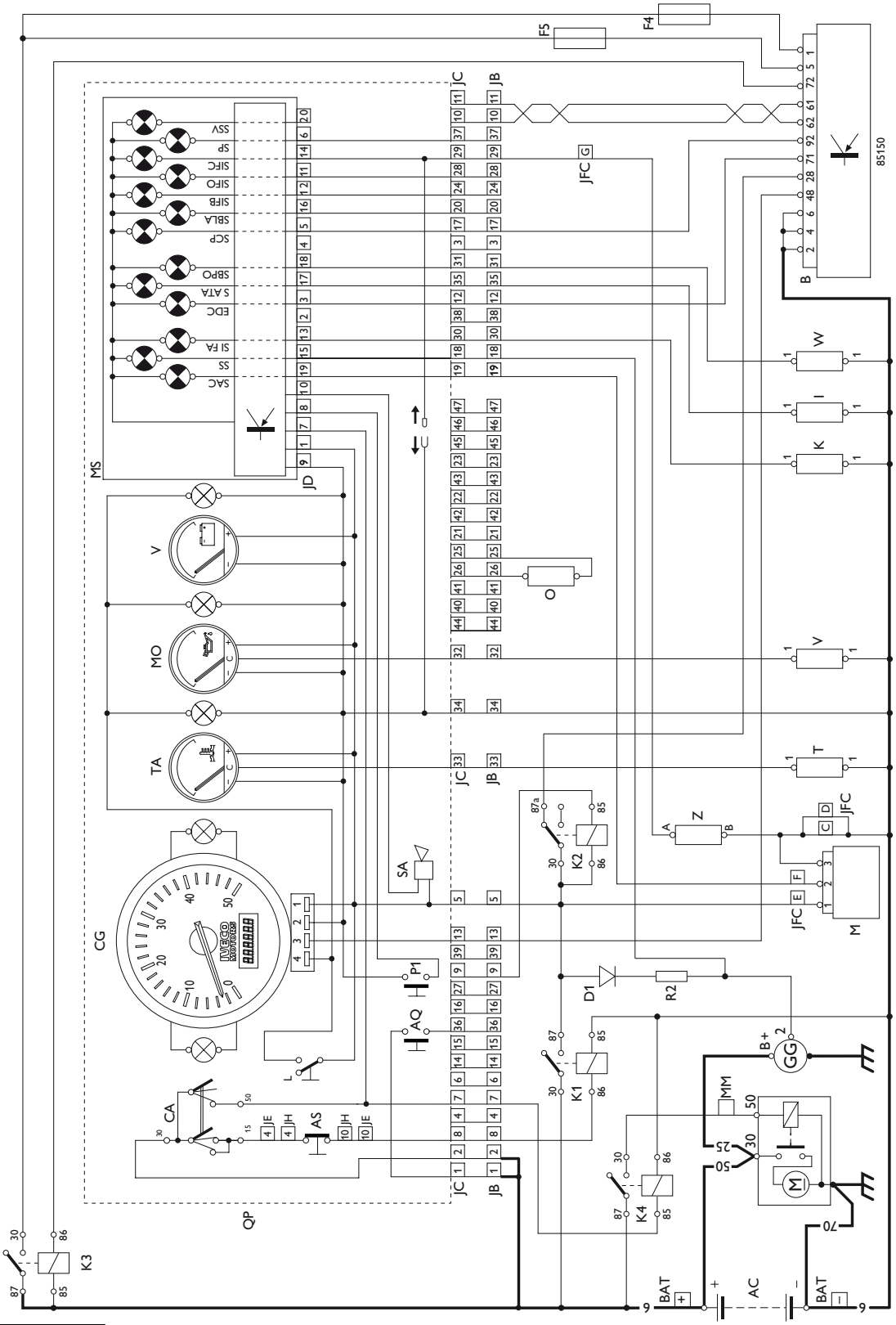
EDC connector B



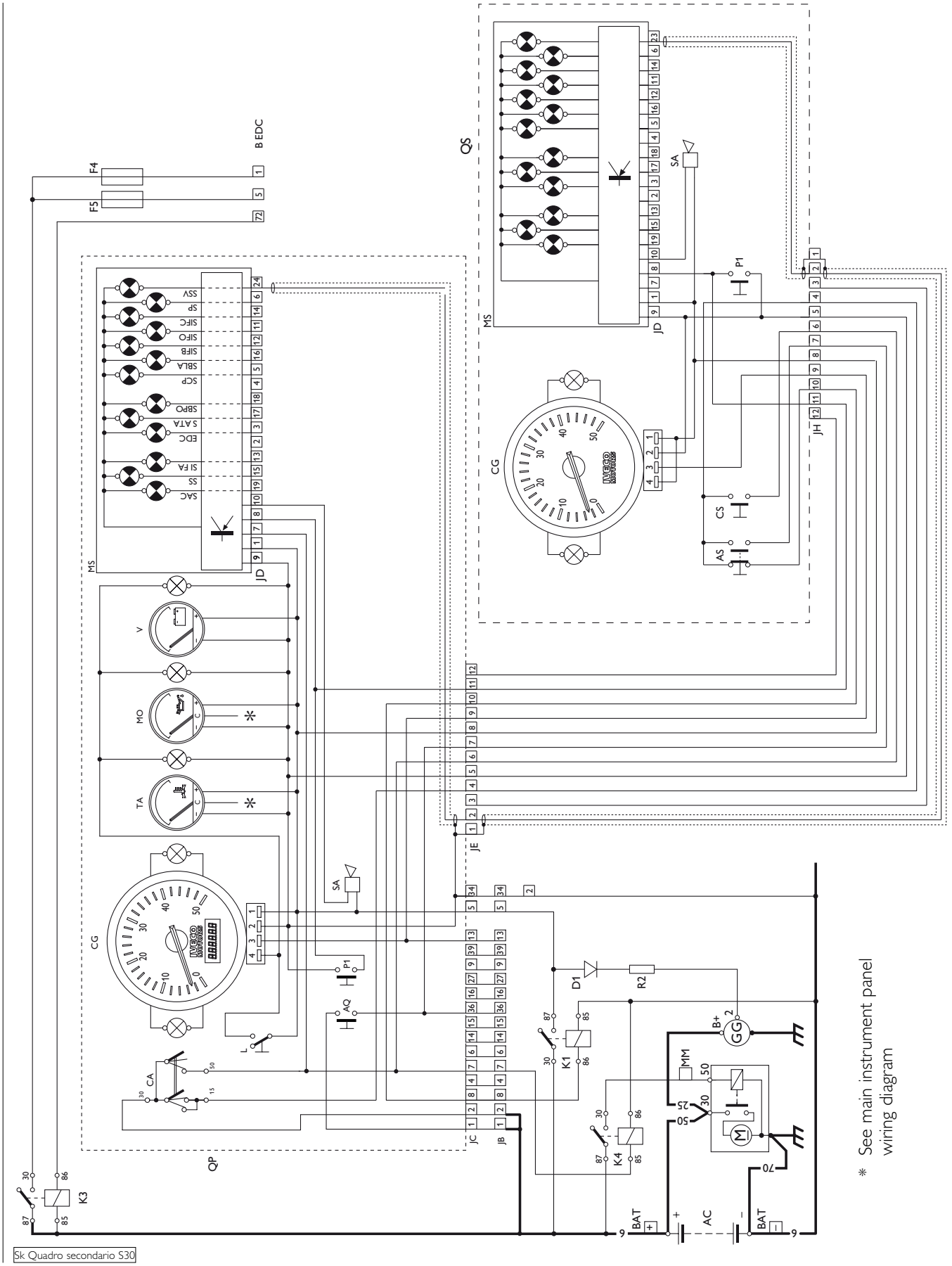
EDC connector A



Main analog instrument panel

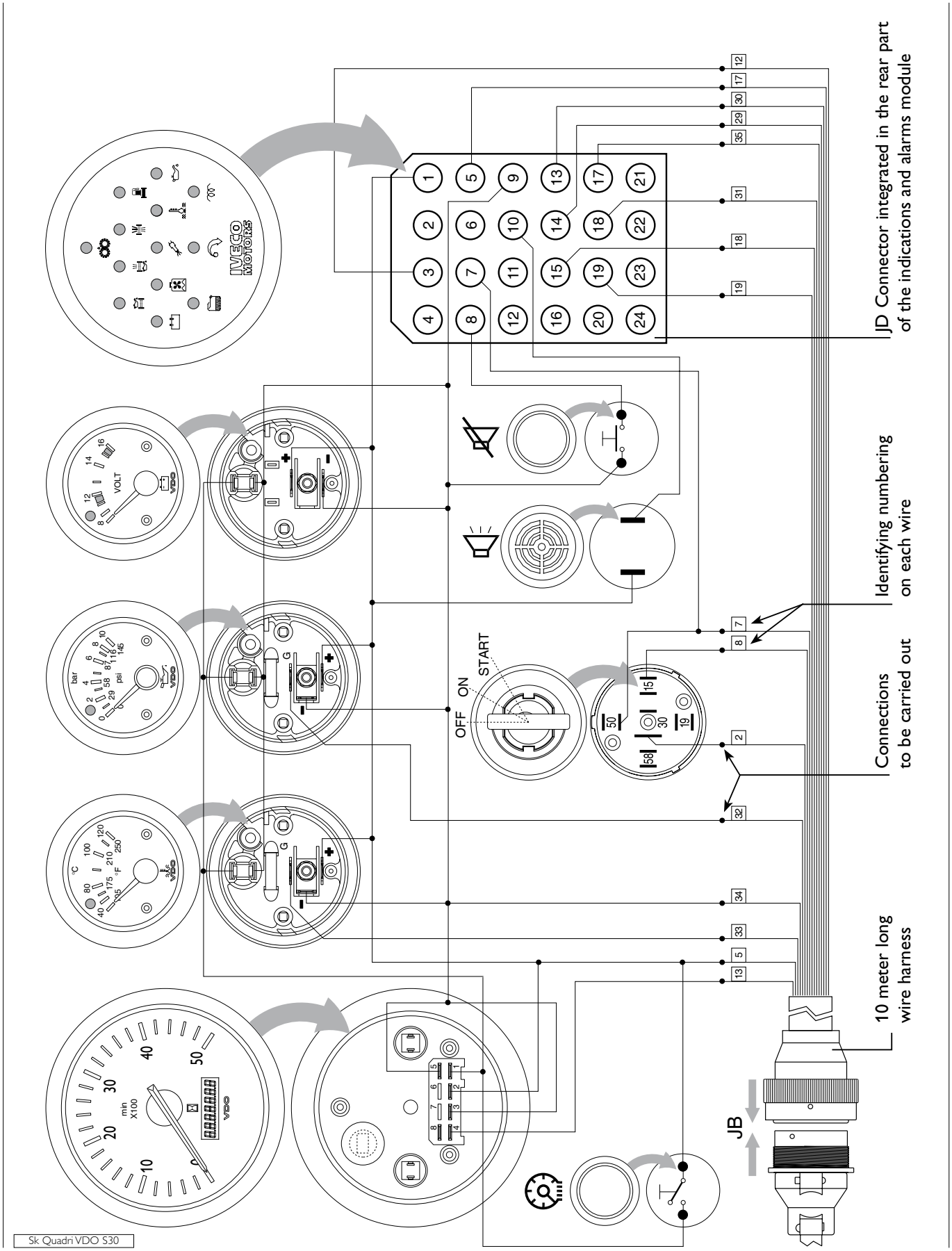


Secondary analog instrument panel

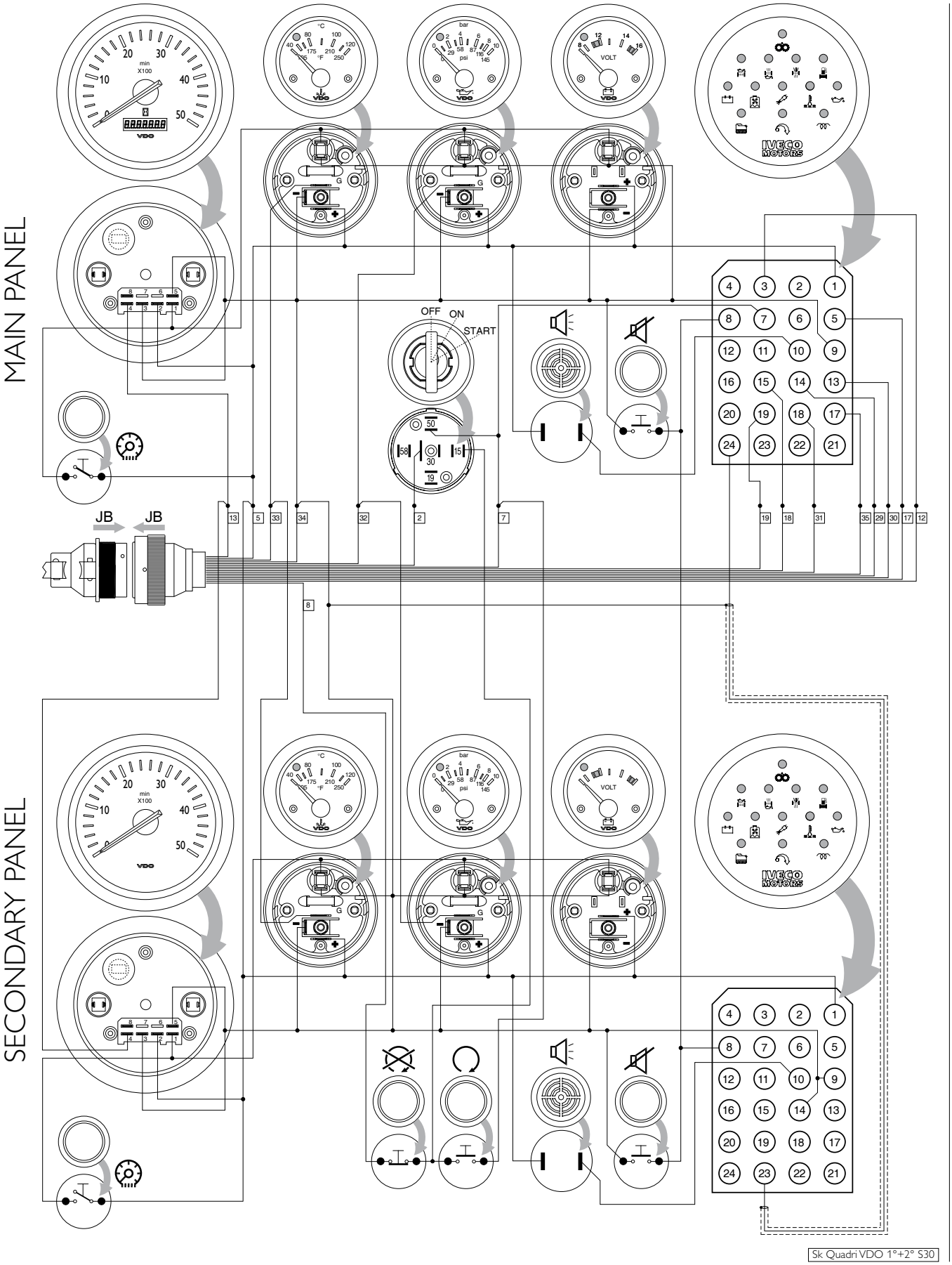


Sk Quadro secondario S30

Wiring of a specific personalised instrument board

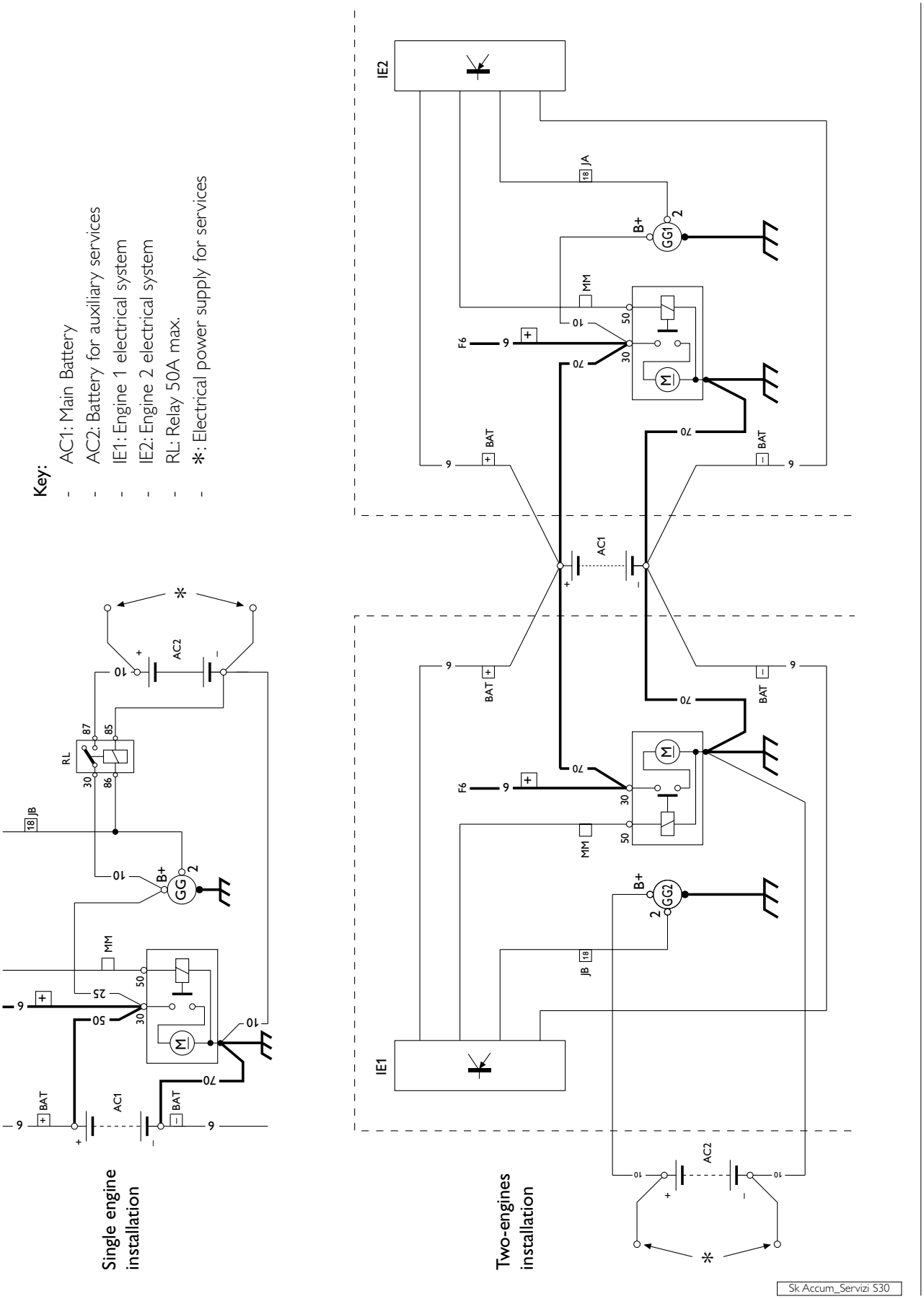


Wiring of the double personalised instrument board (main and secondary board)



Sk Quadri VDO 1°+2° S30

Supplementary services battery recharge



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