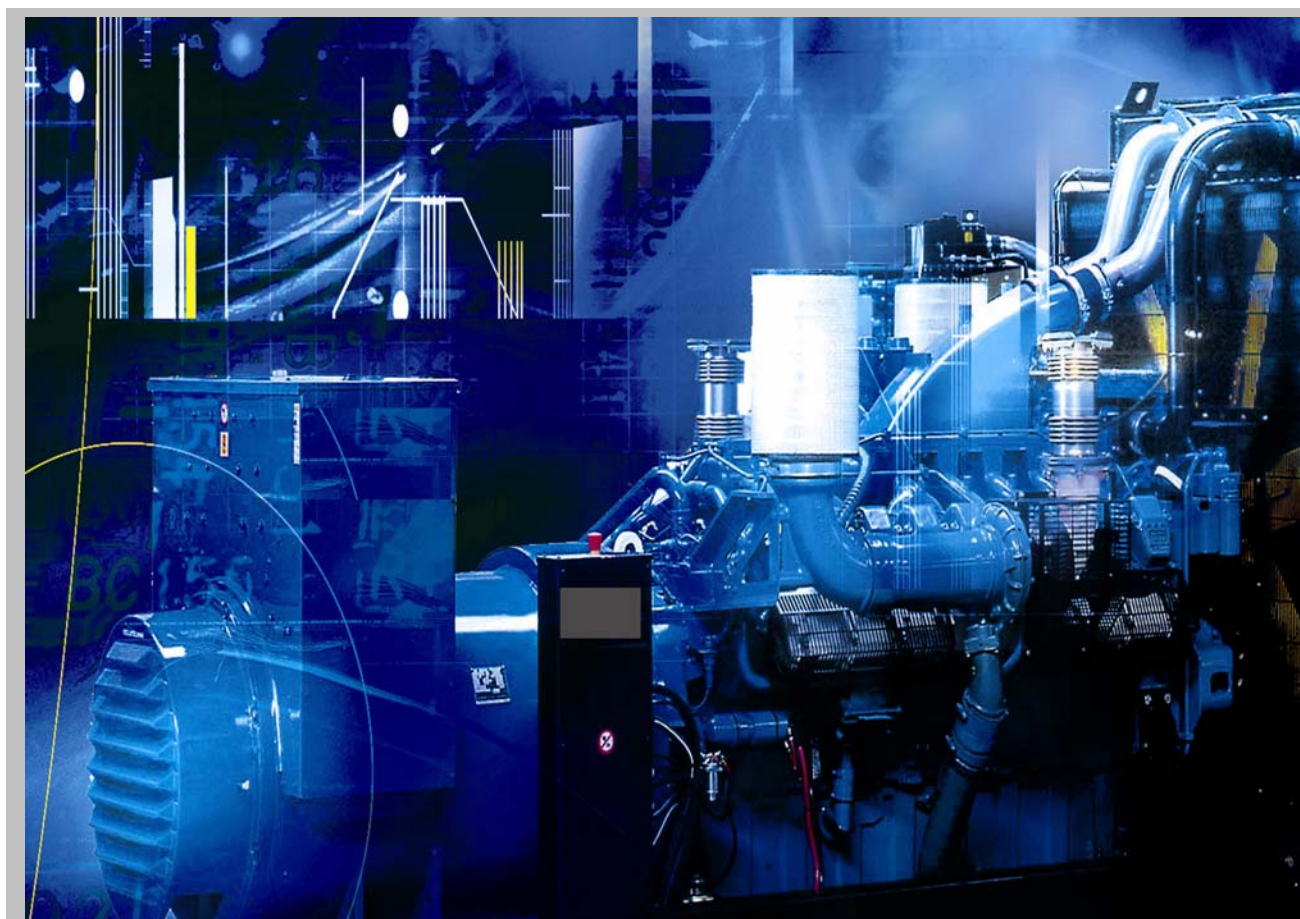


Users guide and maintenance manual for the generating sets

Model(s) : G220

Control device: M150



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Réf. constructeur : 33501188301

Réf. GPAO : 33501188301NE

Revised (10-12)



Users guide and maintenance manual

All generating sets
General considerations
Safety instructions

Réf. constructeur : MUE-IR A

Réf. GPAO : 33522051901

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Attached documents

User manual for the control unit

User and maintenance manual for the engine

User and maintenance manual and spare parts catalogue for the alternator

Wiring diagrams (supplied with the electrical generating set)

Genset parts catalog.

1. PREAMBLE

1.1. Introduction

1.1.1 General recommendations

Thank you for choosing an electrical generating set from our company.

This manual has been designed to help you operate and maintain your electrical generating set correctly.

Read the safety instructions carefully in order to prevent any accident, incident or damage. These instructions must always be followed.

In order to obtain optimum efficiency and the longest possible life for the electrical generating sets, maintenance operations must be carried out according to the periods indicated in the attached preventative maintenance tables.

If the electrical generating set is used under dusty or unfavourable conditions, some of these periods will be shorter.

Ensure that all adjustments and repairs are carried out by personnel who have received the appropriate training. The dealers are suitably qualified and can answer all of your questions. They can also supply you with spare parts and other services.

The left and right sides can be seen from the back of the electrical generating set (the radiator is at the front).

Our electrical generating sets have been designed so that damaged or worn parts can be replaced by new or reconditioned parts thereby reducing the out of action period to a minimum.

For all parts replacement, contact your nearest dealer representing our company who will have the necessary equipment and properly trained and informed staff to carry out maintenance, parts replacement and even total reconditioning of generating sets.

Contact your local dealer for the available repair manuals and to make the necessary arrangements for training personnel in implementation and maintenance.

IMPORTANT

Some user manuals and maintenance manuals for the engines fitted to the electrical generator assemblies include information on the control units and detail the engine starting and stopping procedures.

As the electric generator assemblies are fitted with assembly-specific test and control panels, only the information in the documentation regarding the panels fitted to the assemblies should be taken into consideration.

1.1.2. Structure of the reference material

The reference material delivered with the generating sets enables you to get to know the equipment, operate it and maintain it, both on a daily basis and periodically.

The reference material for the engines and alternators fitted to the sets consists of engine user and maintenance manuals (from the manufacturer) and alternator user and maintenance manuals (from the manufacturer).

The reference material contains:

- the user and maintenance manual, containing among other things:
 - o general recommendations and safety regulations to be adhered to
 - o general recommendations for installing generating sets
 - o tables of capacities (lubricants and coolants) and fuel tanks of different engines that may be fitted to the sets according to their configurations
 - o general reference material for maintaining starter batteries
- user and maintenance manual for the engine fitted to the set
- maintenance manual for the alternator fitted to the set
- user manual for the control panel
- wiring diagrams (these diagrams are delivered with the generating set)

1.2. Pictograms and their meanings



Warning danger



Warning, risk of electric shock



Warning, toxic materials



Warning, pressurised liquids



Warning, high temperature, risk of burns



Publications delivered with the generating set must be referred to



Protective clothing must be worn



Your eyes and ears must be protected



Periodic maintenance must be carried out



Battery level must be checked



Warning, rotating or moving parts (risk of getting caught in the machinery)



Warning, corrosive product



Warning, risk of explosion



Entry prohibited to non-authorized persons



Power



Earth



Lifting point required



Stacking point required



Naked flames and unprotected lights prohibited.
No smoking



Exinction by water prohibited



When on a trailer, earth the set before starting it



Emergency cut-out

Application of EU Machine Directive 98/37 of 22 June 1998 in relation to generating sets.

- access restricted to authorised personnel only according to the legislation in force
- live installation: possible automatic start-up.

1.3. Safety instructions and regulations

THESE SAFETY PRECAUTIONS ARE IMPORTANT

If you do not understand or have any questions about any point in this manual, contact your dealer who will explain it to you or give you a demonstration. A list of risks and precautionary measures to take follows. You should also refer to any local and national regulations that apply in accordance with your own jurisdiction.

1.3.1 General advice

- Read and understand the manuals provided with the generating set in full.
 - Do not wear loose clothing and do not go near the machines when operating. Note that the fans are not clearly visible when the engine is running.
 - Warn all people present to keep well back during operation.
-
- The generating set should always be controlled by an experienced person.
 - Always test the generating set from the control panel.
 - Follow the maintenance table and its directions.
 - Never let anyone else use the generating set without having first given them the necessary instructions.
 - Do not run the engine without having refitted the protective covers.
 - Engine with turbocharger: never start the engine without fitting the air filter. The rotating compressor wheel in the turbocharger can cause severe physical injury. Foreign objects in the intake duct can cause mechanical damage.
 - Engine with air preheating (starter components): never use starter aerosol or similar product as starter assistance.
When it comes into contact with the starter component, an explosion may occur in the inlet manifold and lead to physical injury.
 - Never let a child touch the generating set, even when not in use. Avoid using the generating set in the presence of animals (can distress the animal).
 - Never start the engine without an air filter or exhaust.
 - Always follow current local regulations regarding generating sets and use of fuel (petrol and gas) before using your generating set.
 - Never use sea water or any other electrolytic or corrosive product in the coolant circuit.



- Disconnect the battery and pneumatic starter (if there is one) before carrying out any repair, to prevent the engine from starting accidentally. Fit a panel over the controls to prevent any attempt at starting.
- Do not modify the engine.
- Only use the correct techniques for turning the crankshaft to rotate the crankshaft manually. Do not try to rotate the crankshaft by pulling or exerting force on the lever on the fan. This method can cause serious physical or material harm or damage the fan blade (s), leading to premature breakdown of the fan.
- Always use tools in good condition. Check that you have understood how to use them before starting a procedure.
- Only fit original spare parts.
- Use tools that correspond to the work being carried out.
- Clean all traces of oil or coolant with a clean cloth.
- Never use petrol or other flammable substances to clean parts. Use only approved cleaning solvents.
- Do not use a high-pressure cleaner for cleaning the engine and fittings. The radiator, hoses, electrical components etc. could be damaged.
- Avoid accidental contact with parts that reach high temperatures (exhaust manifold, exhaust)
- Engage the parking brake when the generating set on its trailer is installed on the operating site.
- When setting on a slope; check that no-one is behind the trailer.
- Protective eyewear must be worn when handling during maintenance operations. Operators should remove watches, chains, etc.

1.3.2 Risks related to feed gas (concerns gas sets)

WARNING – DANGER

The gas is explosive. It is forbidden to smoke, go near or create sparks when the tank is being filled and near to the generating set.

- Request the user technical notes and LPG or NG safety data sheets from your gas supplier.
-
- Gas installations must be installed, maintained and repaired by recognised specialists.
- Do not attempt to open, unseal or intervene in gas supply pressure relief valves and on the gas line in general.
-
- Gas supply procedures must be carried out in fresh air (outside) in accordance with local regulations, in an area well away from fire, people or animals.

1.3.3 Risks related to exhaust gases and fuels

WARNING - DANGER

generating sets should not be operated in unventilated areas.

- Always follow the local regulations in force regarding generating sets and use of fuel (petrol, diesel and gas) before using your generating set.
- Fuel filling should be carried out when the engine is stopped (except for sets with an automatic filling system)
- Engine exhaust gases are toxic: Do not operate the generating set in non ventilated areas. When installed in a ventilated area, the additional requirements for protection against fire and explosions must be observed.
- If a burnt gas exhaust leaks, the generating set may become more noisy. In order to be sure of its efficiency, you should periodically examine the burnt gas exhaust.
- Pipes must be replaced as soon as their condition requires it.

1.3.4 Risks related to toxic products

WARNING – DANGER

The corrosion inhibitor contains alkali. This substance should not come into contact with the eyes. Avoid any prolonged or repeated contact with skin. It should not be swallowed. In the event of skin contact, wash thoroughly with water and soap. In the event of contact with eyes, rinse immediately with plenty of water for at least 15 minutes. CALL A DOCTOR IMMEDIATELY. KEEP THE PRODUCT OUT OF THE REACH OF CHILDREN.

The anti-rust product is toxic and dangerous if absorbed. Avoid any contact with skin or eyes. Read the instructions on the packaging.

Glycol is a toxic product and dangerous if absorbed. Avoid any contact with skin or eyes. Read the instructions on the packaging.

- Never expose the equipment to liquid splashes or rainfall, and do not place it on wet ground.
- Always use the recommended fuels. Using low quality fuels risks damaging the engine and altering performance
- The battery electrolyte is harmful to skin and especially eyes. If splashes get into eyes, rinse immediately with running water and/or a 10% diluted boric acid solution.
- Wear protective eyewear and strong base resistant gloves for handling the electrolyte .

1.3.5 Risk of fire, burns and explosion

WARNING – DANGER

The engine should not be operated in areas containing explosive products. There is a risk of sparks forming where all electrical and mechanical components are not shielded.

- Beware of creating sparks or flames and do not smoke near batteries as the electrolyte gases are highly flammable (especially when the battery is being filled). Their acid is also harmful to the skin and particularly the eyes.
- Never clean, lubricate or adjust an engine when it is in operation (unless you are qualified to do so, in which case extreme care must be taken to avoid accidents)
- Never make adjustments that you are not familiar with.
- Never cover the generating set with any material while it is working or just after it stops (wait until the engine has cooled)
- Do not touch hot components such as the exhaust pipe and do not put combustible material on them.
- Keep all flammable or explosive products (petrol, oil, cloth, etc.) well away when the set is running.

- Good ventilation is required for your generating set to work properly. Without ventilation, the engine will quickly reach an excessive temperature that could lead to accidents or damage to the equipment and surrounding items.
- Do not take off the radiator cap when the engine is hot and the coolant is pressurised due to risk of burns.
- Depressurise the air, oil and coolant circuits, before removing or disconnecting any unions, ducts or connected components. Be aware of any possible pressure that might be present when disconnecting a device from a pressurised system. Do not look for pressure leaks manually. High pressure oil can cause physical accidents.
- Some preservative oils are flammable. Also, some are dangerous to inhale. Check that ventilation is good. Use a protective mask.
- Hot oil causes burns. Avoid contact with hot oil. Check that the system is no longer pressurised before carrying out any procedures. Never start or run the engine when the oil filling cap is off as oil may be ejected.
- Never start or run the engine when the oil filling cap is off as oil may be ejected.
- Never cover the generating set with a fine layer of oil for anti-rust protection.
- Never fill up the oil or coolant when the generating set is running or when the engine is hot.

1.3.6 Risks related to electrical networks

- The electrical equipment supplied with the generating set complies with standard NF C15.100 or the standards of the relevant countries
 - Read the manufacturer's identification plate carefully. The values for voltage, power, current and frequency are shown. Check that these values match the supply use.
 - Never accidentally touch naked wires or disconnected connections.
 - Never handle a generating set with wet hands or feet.
 - Maintain electrical wires and connections in good condition. Using equipment in poor condition can lead to electrocution and damage to equipment.
-
- Any procedure on the equipment must be carried out voltage free.
 - Electrical connections must be made in accordance with current standards and regulations in the country.
 - Do not use faulty, poorly insulated or provisionally connected wires.
 - Do not invert the positive and negative terminals of batteries when connecting them. Such an inversion can lead to severe damage to the electrical equipment. Follow the wiring diagram supplied by the manufacturer.
 - The generating set should not be connected to any other power sources, such as the public distribution network. In specific cases where there is a reserve connection to existing electrical networks, it must only be carried out by a qualified electrician, who should take the operating differences of the equipment into account, according to whether the public distribution network or generating set is being used.
 - Protection against electric shocks is ensured by an assembly of specific equipment. If this needs to be replaced, it should be by components with identical nominal values and specifications.
 - Due to strict mechanical specifications you should only use flexible resistant rubber sleeved wires, in compliance with CEI 245-4 or equivalent wires.

1.3.7 Dangers presented by electric currents (first aid)

First aid

In the event of an electric shock, cut off the voltage immediately and activate the set's emergency stop. If the voltage has not yet been cut off, move the victim out of contact with the live conductor as quickly as possible. Avoid direct contact both with the live conductor and the victim's body. Use a dry plank of wood, dry clothes or other non-conductive materials to move the victim away. The live wire may be cut with an axe. Take extreme care to avoid the electric arc that results from this.

Begin emergency procedures

Resuscitation

If breathing has stopped, begin artificial respiration at once in the same place the accident took place unless the victim or operator's life could be endangered by this.

In the event of cardiac arrest, carry out cardiac massage.

1.3.8 Risks related to moving the set

- Use lifting units to lift the generating set. Always make sure that the lifting equipment is in good condition and has a sufficient lifting capacity.
- In order to work in complete safety and prevent the components fitted to the top of the engine from being damaged, the engine should be lifted with an adjustable boom. All chains and cables should be parallel to one another and as perpendicular as possible to the top of the set.
- If other equipment fitted to the generating set alters its centre of gravity, special lifting devices may be required to maintain the correct balance for working in total safety.
- Never carry out work on a generating set that is suspended on a lifting device only.

1.3.9 Recommendation for the operator and environment

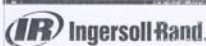
- Operating personnel should be aware of the safety and operating instructions. These will be regularly updated.
- Operating should be monitored, directly or indirectly, by someone designated by the operator who is familiar with the installation and dangers and problems regarding products stored and used in the installation.
-
- Manufacturers' notes should be available to technical staff, on site if possible.
- Written operating instructions must be available for operations that involve dangerous handling procedures and driving installations. In particular, these instructions prescribe:
 - o Operating modes
 - o Frequency of testing for safety devices and devices for handling pollution and other harmful substances generated by the installation
 - o Methods for maintenance, checking and use of adjustment equipment and safety devices.
- The presence of dangerous or combustible materials on premises where combustion apparatus is sheltered is limited to what is required for the operation.
- The installations must be operated under the constant supervision of a qualified person. This person should periodically check that the safety devices are working properly and ensure the correct fuel supply to the combustion apparatus.
- Apart from combustion apparatus, flames in any form are prohibited. This should be displayed in bold on a sign.
- Residual water, mud and waste spray is prohibited.
- The fuels to be used should correspond to the ones in the declaration file and the specifications prescribed by the combustion apparatus manufacturer.
- The fuel is considered as being in the physical state that is introduced into the combustion chamber.
- Always protect your hands when detecting leaks. Pressurised fluids can enter body tissues and cause severe harm. Risk of blood poisoning.
- Drain and discard engine oil in a designated container (the fuel distributors can collect your used oil).



1.4. Identifying sets

generating sets and their components are identified by means of identification plates.
The precise rules for identifying each major component (engine, alternator etc.) are set out in each manufacturer's documents contained in this manual.

Examples of identification plates

generating set

PLAQUE CONSTRUCTEUR / MANUFACTURER PLATE					
GROUPE ELECTROGENE / GENERATING SET					
		Type		G200	
		Execution		IV	
		Version			
		Masse (Kg)		2980	
		Weight			
V	Hz	rpm	Cos Phi	Phase	
400/230	50	1500	0.8	3	
PRP		ESP		Ambiance(°C)	
Kva	180	198	Ambiant		Alt(m)
Kw	144	158.4	25		1000
A	260	286	PRP: Puissance Principale / Prime Power		
		ESP: Service Secours / Standby Duty			
Année	2002	Numéro de Série		020002009371	
Year		Serial Number			
INGERSOLL-RAND Co. Ltd. - Hindley Green Wigan UK					



CEE 84-536 PUISSANCE ACOUSTIQUE / SOUND POWER				
L _{WA}		98.5		
Numéro Homologation		M216.6068HF160.		

PRESSION ACOUSTIQUE / SOUND PRESSURE				
dB(A)		1 m	7 m	15 m
	50 HZ	80.5	71	67
	60 HZ	87	77	73

020002009371

INGERSOLL-RAND

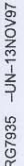



020002009371

INGERSOLL-RAND

S/N	020002009371
TYPE	G200
Année	2002
Year	

Engines

JOHN DEERE	
Engine Serial Number	
CD4045T123456	
CD4045TF150	Abs. Coeff. X.XX
DEERE & COMPANY MOLINE, ILLINOIS MADE IN FRANCE	




VOLVO PENTA	
ENGINE MODEL	XXXXXXXX
SPEC. NO.	XXXXXX
SERIAL NO.	XXXXXXXXXX
RATED NET POWER without fan kW/hp	XXX/XXX
with fan kW/hp	XXX/XXX
SPEED AT RATED POWER rpm	XXXX
PRELIFT mm/INJ. TIMING	X,X+X,X/XX±X,X°
MADE IN SWEDEN 3826077	

Alternator


ALTERNATEURS PARTNER ALTERNATORS

LSA	44.2S7 C 6/4	Date	01/14
N°	117204 / 9		60 Hz
Min-1/R.P.M.	1800	Protection	IP23
Cos Ø / P.F.	0,8	Cl.ther./Th.class	H
Régulateur/A.V.R.	R438 LS/C AREP		
Altit. < 1000m	Masse/Weight	440 Kg	
Rlt AV/D.E bearing			
Rlt AR/N.D.E bearing	6309 2RS		
Graisse/Grease	Euro UNIREX N3		
Valeurs excit/Excit.values	480 V / 40°C		
on charge / full load	17,78 V / 3,84 A		
à vide / at no load	0,95 A		

PUISSANCE / RATING						
Tension Voltage	480	440	415	240	208	240 V
Phase	3	3	3	3	3	1
Conn.						ZZ
Cont.	150	135	130	150	130	78 kVA
Base	120	108	104	120	104	62.4 KW
40°C	180	177	180	361	361	325 A
Secours	155	150	144	165	144	87 kVA
Std by	132	120	115	132	115	69.6 KW
27°C	198	197	200	397	400	363 A



LR 57008



Conforme à C.E.I 34-1(1994). According to I.E.C 34-1(1994).

Made by Leroy Somer - 1 024 93046

2. INSTALLATION

2.1. Unloading

2.1.1 Safety during unloading

In order to unload generating sets from their transport mountings, under optimum conditions of safety and efficiency, you should check that the following points are being followed correctly.

- Suitable lifting vehicles or equipment for the work.
- Slings positioned in the rings provided for this procedure or lifting arms resting fully underneath the frame cross beams.
- Suitable ground to accommodate the load of the set and lifting vehicle, without strain (if not, put down sufficiently strong and stable boards).

Remove the set as close as possible to its place of use or transport, in a clear space with free access.

2.1.2 Example of material

- crane, slings, lifting beam, safety hook, shackles.
- fork lift truck.

2.1.3 Instructions for unloading

2.1.3.1 Slings

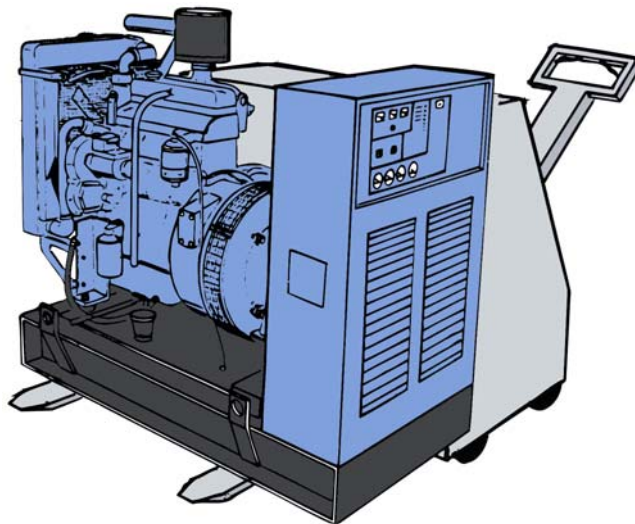
- attach the lifting vehicle slings to the rings on the generating set designed for this procedure.
- hang the slings carefully.
- check that the slings are correctly attached and the equipment is solid.
- lift the generating set carefully.
- direct and stabilise the set towards the chosen position.
- carefully set down the equipment while continuing to position it.
- release the slings, then detach and remove the lifting rings.

2.1.3.2 Fork lift truck

- position the arms of the fork lift under the frame, making sure that only the cross beams are resting on the arms.
- lift and handle the equipment carefully.
- set down the generating set in its unloading position.



It is recommended to use a fork lift truck with arms that are longer than the width of the frame



3. INSTALLATION OF MOBILE SITE SETS

3.1 Specific arrangements

An area will be reserved to install the generating set. Its should be flat and strong enough so that the generator does not sink into it. It could be made of concrete or even large planks fitted together.

It should be noted that a generating set that does not rest correctly on its base (frame or trailer) will be subject to vibrations that could cause damage to all the equipment.

The location of the set on site should be chosen for ease of fuel supply and distribution of current to the users.

Access to the set's doors should be available at all times for safety and maintenance reasons. Ventilation of the generating set should not be affected if there are different objects close by. It will cause abnormal heating and reduced power.

Burnt gas evacuation will take place in such a way that there is no reaspiration into the air filter or cooling system.

The generating set's neutral speed must be used to protect people.

Earthing is carried out using a metal post buried deeply in the ground.

These sets are to be covered or protected from bad weather by a suitable construction (see previous sections).

Examples of problems that may be encountered :



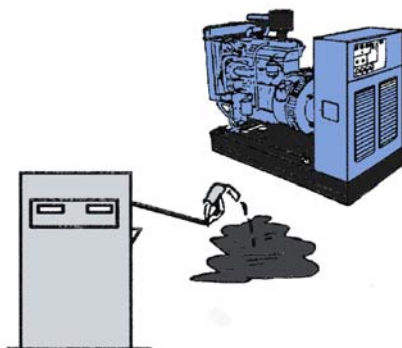
Incorrect exhaust and ventilation



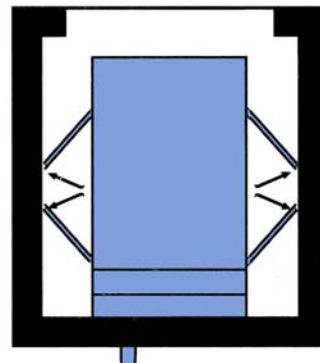
Ground too uneven or soft.
Set incorrectly positioned



Reduced access



Fuel filling impossible



Opening cover doors impossible

4. ROAD TRAILER

4.1 Trailer linkage

Before attaching the trailer, check the trailer hook on the tow vehicle; it should fit the trailer ring perfectly.

WARNING – DANGER

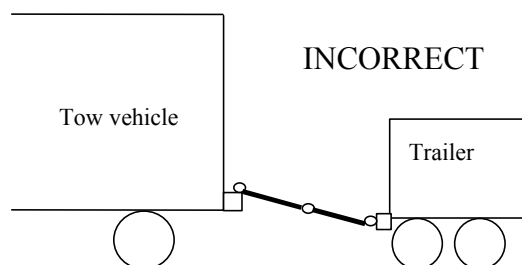
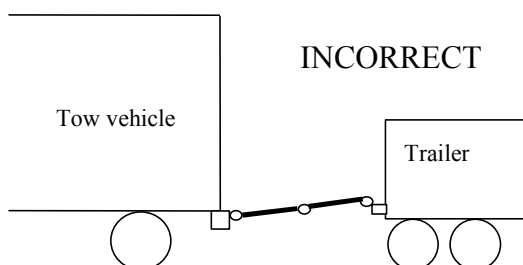
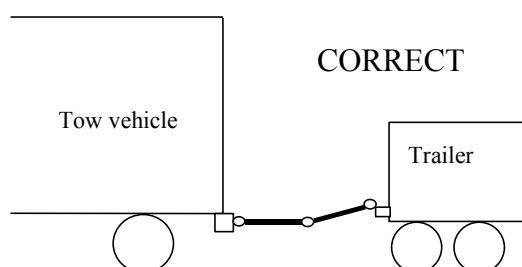
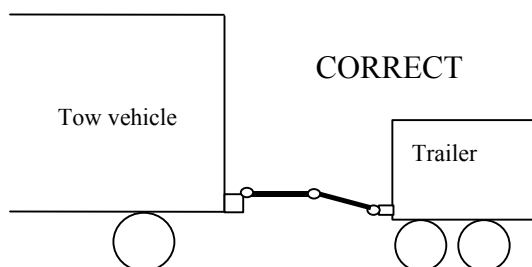
Trying to tow a trailer with a non-matching device (bar, wires, cords, etc.) could lead to serious accidents.

Also check:

- no incipient fractures or excessive wear on the hitching system.
- locking system is operating properly

To hitch the trailer, proceed as follows:

- lock the wheels to stop the trailer from moving
- lift up the rear trailer supports and lock them
- release the parking brake
- release the locking levers for the draw bar arms and adjust the ring to the same height as the vehicle hook
- hitch the trailer, remove the locks on each side of the wheels then lift up the front wheel fully using its handle
- connect the electrical circuit of the trailer to that of the tow vehicle
- hook the handbrake safety wire onto the hook on the tow vehicle.



4.2 Check before towing

Before towing carry out the following checks:

- wheel torquing
- lock trailer hook
- tyre pressure
- light signals working
- cover doors closed
- parking brake off
- front wheels and rear supports lifted.
- tightening and fixing the draw bar arms locking levers
- brake test for "road" type trailers
- fitting brake safety cable.

4.3 Driving

- "On-site" type trailer

These trailers are not fitted with a main brake and so cannot brake when operating; the tyres are designed for a speed of 17 mph (27 Km/h). Therefore, it is absolutely forbidden to exceed this speed .

- "Road" type trailer

The driving speed should be adapted to road conditions and the trailer handling.

Driving at sustained speed causes tyres to heat up; therefore it is important to stop from time to time to check them. Excessive heating can lead to a blow out and hence a serious accident. When reversing, do not forget to lock the overrun brake.

NOTE

Particular attention must be paid to wheel torquing on new vehicles. Indeed, during the first few miles, heat build-ups on the wheel hubs and brake drums lead to reduced wheel torquing. It is therefore essential to check the torquing every 6 miles (10 kilometres) until no further loosening is noted.

The torque test should nevertheless be carried out before towing.

4.4 Unhitching the trailer

This operation should be carried out on horizontal, flat, stable ground.

- lock the wheels
- lower the front wheel
- disconnect the road signals wire
- refit the hitch using the wheel to release the hook ring from the tow vehicle,
- release the tow vehicle
- engage the handbrake.

4.5 Implementation for installation

Procedures to be carried out:

- check that the ground is strong enough for the assembly not to sink into it
- using the front wheel, position the set as horizontally as possible
- engage the handbrake.
- lower the rear trailer supports and lock them

5. BATTERY MAINTENANCE

WARNING – DANGER

- install the battery so that it has the correct ventilation
- never place the battery close to a flame or fire
- use only insulated tools
- never use sulphuric acid or acid water to top up the electrolyte level.

PROCEDURE FOR TESTING STARTER BATTERIES

TEST TYPE	PROCEDURE	RESULT	ACTION
1 VISUAL INSPECTION STEP 1	TRAY AND TERMINALS	CHECK THAT THE TRAY IS NOT BROKEN, THAT THERE IS NO ELECTROLYTE LEAK AND CHECK THE CONDITION OF THE TERMINALS (DAMAGED, BLACK)	DAMAGE NOTED → REPLACE THE BATTERY NO DAMAGE → CHECK THE ELECTROLYTE LEVEL
	ELECTROLYTE LEVEL	BELOW THE PRESCRIBED LEVEL	ADD WATER UP TO THE PRESCRIBED LEVEL, CHARGE FOR 4-5 HOURS AT 1/10 OF THE NOMINAL CAPACITY THEN CHECK THE ELECTROLYTE DENSITY (step 2)
		PRESCRIBED LEVEL OK	CHECK THE ELECTROLYTE DENSITY (step 2)
2 ELECTROLYTE DENSITY TEST STEP 2		< 1.22 kg/l OR VARIATION ABOVE 50 g/l BETWEEN CELLS	RECHARGE THE BATTERY FULLY
		> 1.22 kg/l	CARRY OUT QUICK ELECTRICAL PERFORMANCE TESTS (step 3)
3 TEST OF QUICK ELECTRICAL PERFORMANCES STEP 3		CHECK THE BATTERY USING A MIDTRONICS, WEGA OR SIMILAR TYPE OF TESTER	THE TESTER GIVES A POSITIVE RESULT → FIT TO OPERATE THE TESTER GIVES A NEGATIVE RESULT → REPLACE THE BATTERY

6. FUEL AND CONSUMABLES

All specifications (product features) are given in the engine and alternator maintenance manuals attached to this manual.

6.1 Circuit capacities – Mitsubishi engines

Engines CIRCUIT AND TANK CAPACITY	S4L2-SD (series SL)	S4Q2 (series SQ)	S4S (series SS)	
	MODEL	G 16	G 22	G 33
	LUBRICATION (in litres)	5.4	5.5	10
	COOLING (in litres)	4.9	8.1	8.9
	FUEL (in litres)	100	100	100

6.2 Circuit capacities – john Deere engines

Engines CIRCUIT AND TANK CAPACITY	3029TF120	4045TF120	4045HF120	6068TF220	6068HF120 (153kW@1500rpm)	6068HF160 (183kW@1500rpm)
MODEL	G 44	G 66 G 77	G 110	G 130	G 160	G 200
LUBRICATION (in litres)	6	13.5	13.5	21.5	21.5	31.5
COOLING (in litres)	16.1	23.6	20.2	27.3	25.8	25.8
FUEL (in litres)	100	175	200	410	410	410

6.3 Circuit capacities – Volvo engines

ENGINES					
CIRCUIT AND TANK CAPACITY	TWD 740	TAD 740	TAD 1032	TAD 1242	TAD 1631
MODEL	G 220	G 270	G 330	G 440	G 550
LUBRICATION (in litres)	29	29	36	35	64
COOLING (in litres)	41.9	36.9	37.3	44	64
FUEL (in litres)	350	700	700	800	800

Instructions for use

M 50
M150
A50
X200
INS / ATS

Réf. constructeur :

Réf. GPAO : 33502013301

SAFETY SYMBOLS



Caution : danger



Caution, refer to the publications supplied with the Genset



Caution : risk of electric shock



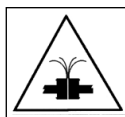
Protective clothing required.



Caution : toxic substances



Eye and hearings protection necessary



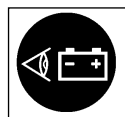
Caution : pressuried fluids



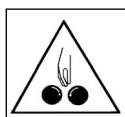
Periodic maintenance required



Caution : high temperature (risk of burning)



Check battery charge



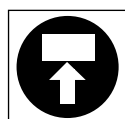
Caution : rotating or moving parts (risk of entanglement)



Recommended Lifting point



Caution : risk of corrosion



Fork lift stacking point



Caution : risk of explosion



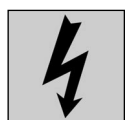
Naked flame and non protected lightning forbidden, no smoking



Authorised personnel only



Do not use water based fire extinguishers



Power



Trailer : link up the earth before starting the generator



Earth

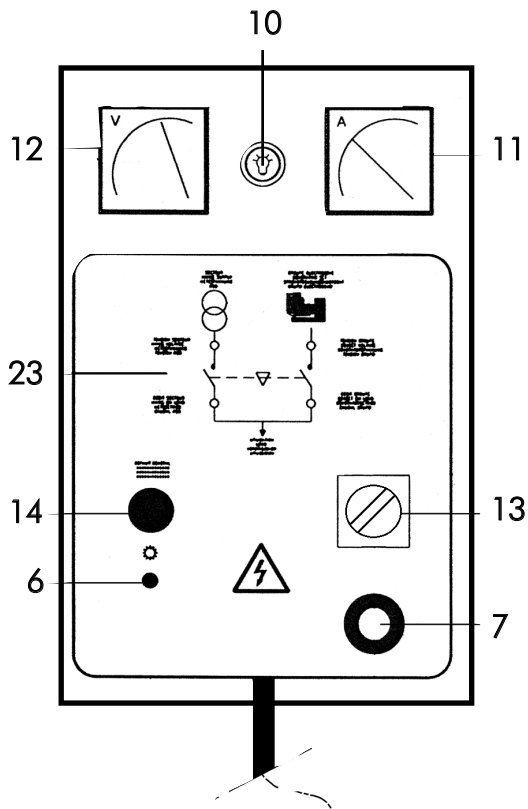


Emergency stop

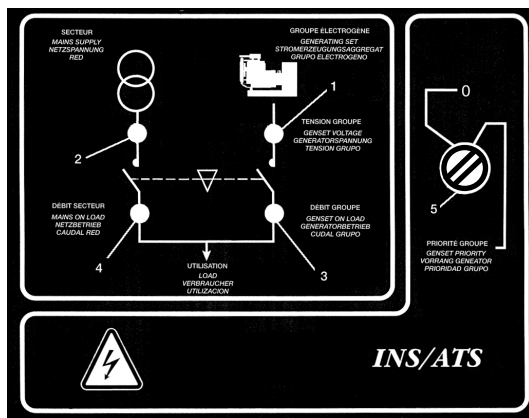
MACHINERY DIRECTIVE 98/37/EC INSTRUCTION FOR GENERATING SETS

- Access prohibited to unauthorized personnel
- Live installation, potential automatic starting.

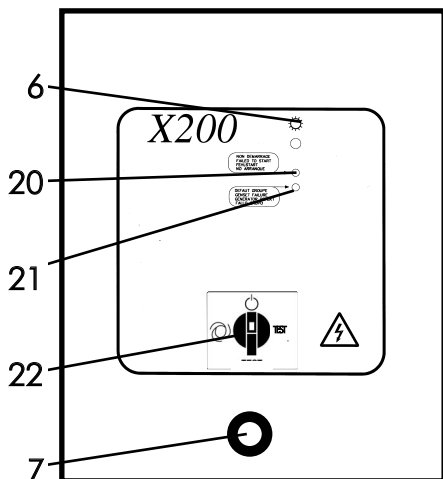
A50



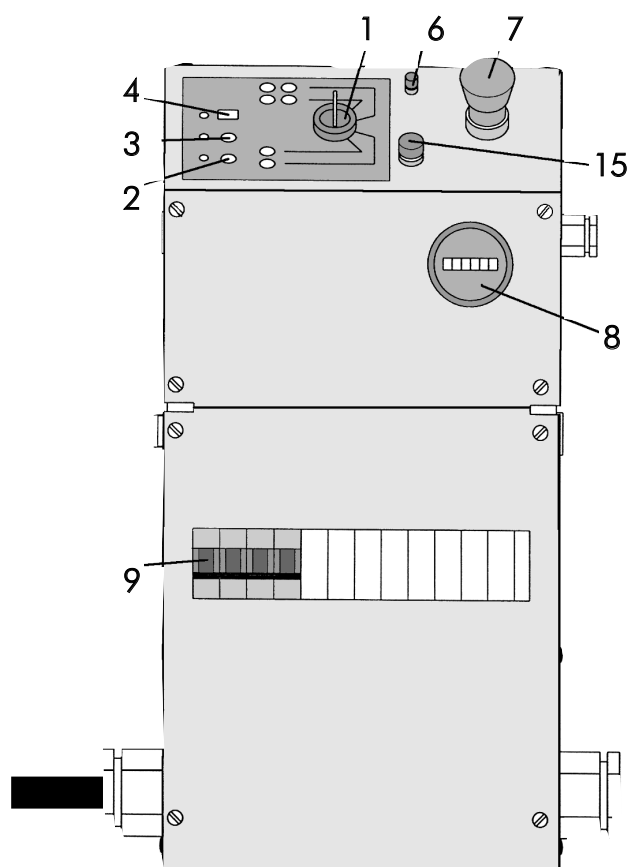
INS/ATS



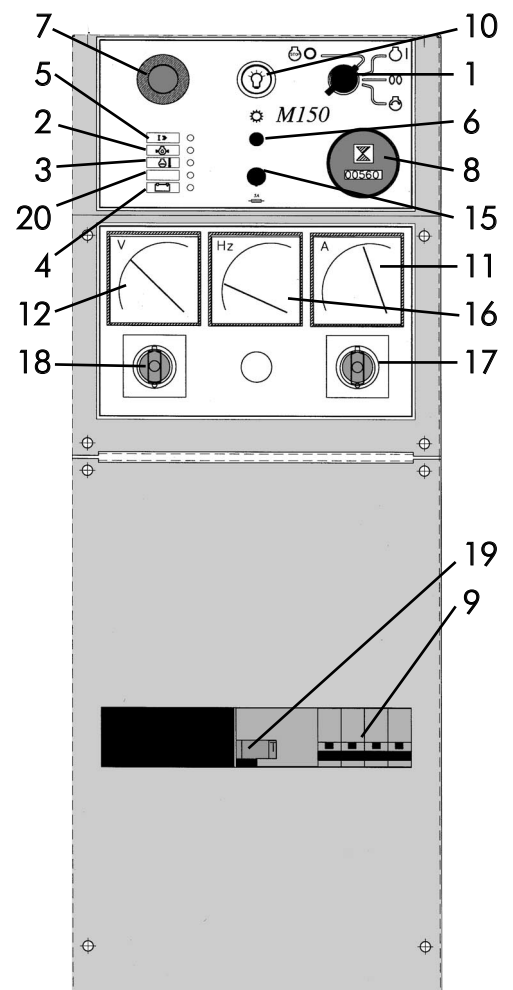
X200



M50






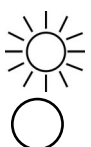


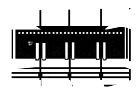

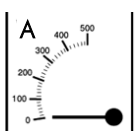


M150



A – DESCRIPTION

The manual control panels and the automatic control boxes are equipped with various switchgear and standard indicators. The following figures define the functions of the different switchgear.

- 1  M50 - STARTING AND STOPPING KEY:
M150
- 2  - OIL PRESSURE WARNING LIGHT (M50-M150):
- 3  - COOLING SYSTEM WARNING LIGHT (M50-M150):
- 4  - VOLTAGE AND CHARGING ALTERNATOR EXCITATION WARNING LIGHT (M50-M150):
- 5  - «OVERCHARGE» WARNING LIGHT (M150):
- 6  - WARNING LIGHTS TEST (M150-A50-X200):
- 7  - EMERGENCY STOP PUSH BUTTON:
- 8  - HOURMETER (M50-M150):
- 9  - CIRCUIT BREAKER (M50 - M150):
- 10  - RACK LIGHTING (A50-M150):
- 11  - AMMETER (M50-M150):

The key has 4 positions :

⊗ : Position of the key when the generator set is not running. It also allows it to be stopped and the clearing of faults.

⊖ : In this position, the electrical circuit of the generator set is energised (the fuel solenoid valve is energised). The battery charge warning light is on. The battery indicators and voltmeter are energised and indicate the state of the different organs under control.

⊕ : Certain engines are equipped with cold weather starting aids. The key held on this position for 5 to 20 seconds is necessary before starting.

⊙ : In this position, the starter is activated ; it turns the motor at a speed allowing starting.

Normally off during running of the generator set, this warning light comes on in the case of an abnormal drop in oil pressure. It indicates an operating incident like lack of oil, a fault with the lubricating system, etc. This fault stops the generating set instantly.

⚠ (The warning light can come on furtively during starting of the generator set.)

Normally off during running of the generator set, this warning light comes on in case of an abnormal rise in engine temperature. It indicates an operating incident like disturbance of airflow, etc. This fault stops the generator set instantly.

Normally off, this warning light comes on in case of a charging incident with the battery(ies) during running of the generator set. For generator sets equipped with a charging alternator, it highlights a fault in the system. This fault does not stop the generator set. During starting of the generator set, this warning light goes off as soon as the alternator has reached an excitation speed of 400 rpm..

Normally off, this warning light comes on when the circuit breaker has disconnected on an overcharge or a short circuit, so freeing the generator from its charge. When this fault arises, it is necessary to limit the charge on disconnecting some appliances or by eliminating the short circuit then re-closing the circuit breaker.

⚠ Trip time user adjustable.

By activating the push button, the warning lights which are normally off light up and signal that they are functioning (except for the battery charge light). The warning light test is always active on the A50 and is active only on position : « ⊕ » of the X200 operating selection switch. « ⊖ » of the M50 and M150 starting and stopping switch.

To be pressed in the event of an accident or incident, it instantly stops the running of the generator set and should be unlocked when put back into service.

⚠ : Type push/pull or push/turn

It totals the number of generator set running hours as soon as the starting key is in the « ⊖ » position.

It interrupts output to the installations in the case of a short circuit or an overcharge or manual activation. In the «ON» position, the power circuit is closed and the generator can supply the installations.

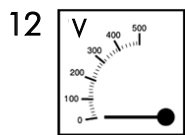
This lights up (if no fault present) :

-the front of box A50 when the operating selection switch is in the auto position and if the order to start is present.

-The front of console M150, when the key is on « ⊖ ».

It indicates the intensity in amps on a phase.

It indicates the power in Volts supplied by the generator set.



- VOLTMETER (A50-M150):

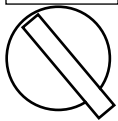


- OPERATING SELECTION SWITCH (A50):

It allows selection of the operating mode :

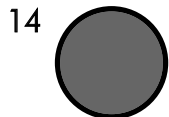
-STOP : manual operation from the console M50

-AUTO : automatic operation on external order or lack of mains supply.



- GENERAL FAULT WARNING LIGHT (A50):

Normally off, this light comes on in case of a fault immobilising the generator set.



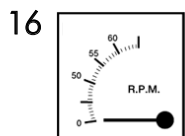
- FUSE (M150):

It protects the remote control circuit against eventual short circuits.



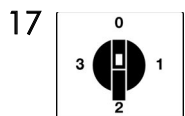
- FREQUENCY METER (M150):

It indicates the frequency in Hertz of the electrical current supplied by the generator set.



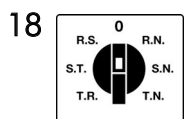
- AMMETER SWITCH (M150):

Its different positions allow reading of the amperage of the current produced by each phase.



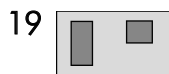
- VOLTMETER SWITCH (M150):

Its different positions allow reading of the voltage on the voltmeter between each phase or between phase and neutral.



- DIFFERENTIAL:

It ensures the safety of people (adjustment 30 mA instantaneous). The neutral rating of the installation should be TT Rating (an adjustment becomes necessary if an adjustable differential relay is used on option).



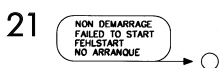
- OPTIONAL WARNING LIGHTS (M150):

These warning lights, normally off, are available for different optional functions.



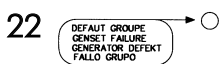
- FAILED TO START WARNING LIGHT (X200):

Normally off, this light comes on, in the case of an operational fault of the generator set.



- GENERATOR FAULT WARNING LIGHT (X200):

Normally off, this warning light comes on in case of the presence of an operating fault with the generator.



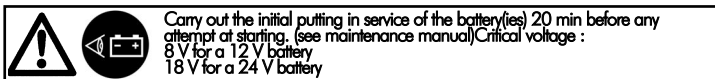
- OPERATING SELECTION SWITCH (X200):

The switch has 3 positions :

⏏ : In this position, the generator set will not start in the event of a mains power cut. The preheating resistance is still energised.

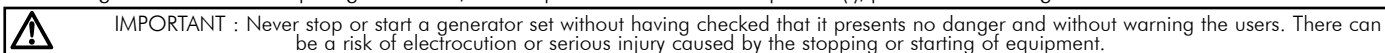
TEST : This operating mode is used for maintenance of the generator set (see manual starting switch).

⏻ : In this operating mode, the generator set is ready to start in the event of a mains power cut and/or an external order. Starting is regulated by a time delay to avoid starting on micro mains power cuts.



B – USE

After having carried out the initial putting into service, and the preventive maintenance operation(s), proceed with starting as follows :



I – M50 AND M150


A) STARTING

- Check that there is no danger of output to installations. I.E. : bare cables in contact, personnel carrying out work on electrical equipment connected to the generator, etc.
- Check that battery voltage is good and that the fuel level is sufficient.
- M50 : Open the circuit breaker in order not to have output to installations.
- M150 : Relieve the equipment without opening the circuit breaker (manual opening of the circuit breaker provokes a fault).
- Turn the switch key clockwise to position « ⏏ ».
- Check that the presence of voltage warning light and excitation of the charging alternator is on.
- Keep turning the key to position « ⏻ » (engine equipped with a starting aid). Remain in this position for 5 to 20 seconds depending on ambient temperature. The lower the temperature, the longer the preheating time (some engines are not equipped with preheating).
- Turn the key to position « ⏻ » and release it as soon as the engine starts ; it automatically returns to the « ⏏ » position.


- Let the generator set run empty for several minutes depending on the ambient temperature.
- M50 : Close the circuit breaker.
- From this moment the generator set is outputting to the installations.

B) NORMAL OPERATION

- During operation of the generator set, carry out a regular inspection to ensure there are no anomalies.
- Do not overload the generator set, its power is indicated on the manufacturer's plate. Any overloading could provoke an incident in the short term.

 Operating empty or on low charge is not advised. In case of doubt, consult our after sales service or our agents.

C) NORMAL STOPPING



- M50 : Open the circuit breaker and let it run empty for 3 minutes.
- M150 : Relieve the installation (manual opening of the circuit breaker provokes immediate stopping of the engine, with indication from the overcharging warning light) and let it run empty for 3 minutes.*
- Stop the generator set by turning the key to the «» position.

D) EMERGENCY STOPPING

- Press the emergency stop push button in the event of an accident or incident. The engine will stop instantly.


 Do not forget to unlock the emergency stop push button when putting back in service.


E) CLEARING FAULTS

- Note the signalled fault and turn the starter switch to «».
- Make repairs and start up in «» mode to check for correct operation.

II – A50 (connected to M50)

A) AUTOMATIC START «AUTO»

- Check that battery charge state is good and that the level of fuel is sufficient.
- Place the starting and stopping switch of the M50 in the «» position.
- Close the M50 circuit breaker.

-  If the circuit breaker closes during operation of the generator set, a general fault will be signalled after 30 seconds (stopping of generator).
- Place the operating selection switch in the «**AUTO**» (A50) position.
- In this position, the generator set is ready to start on shutting down of mains (single phase detection) or on external order. (clock, automaton, etc...).
- Check that the panel light warning light is on with the A50.

B) NORMAL STOPPING «STOP»

This position allows stopping of the generator set and the operation of the INS/ATS system and returning to mains supply.
N.B. : the switch on the mains side will only close if mains power is present again.

C) EMERGENCY STOPPING

- Press the emergency stop push button in the event of an accident or incident. The engine will stop instantly.


 Do not forget to unlock the emergency stop push button when putting back in service.



D) RESTARTING AFTER STOPPING FOR A FAULT

- Note the fault and turn the operating selection switch to «**STOP**».
- Make repairs and start with the starting key of the M50.
- Then replace the operating selection switch to «**AUTO**» (A50).

III – X200 (connected to the M150).

A) AUTOMATIC STARTING «»

- Check that battery charge state is good and that the level of fuel is sufficient.
- Place the starting and stopping switch of the M150 in the «» position.
- Close the M150 circuit breaker.

-  If the circuit breaker closes during operation of the generator set, a general fault will be signalled immediately.
- Place the operation selection switch in the «» position.
- In this position, the generator set is ready to start on shutting down of mains (mains detection) (three phase optional) or on external order. (clock, automaton, etc...).
- On starting check that the presence of mains voltage warning light is on with the M150.

B) OPERATION IN TEST MODE «TEST»

This mode of operation is used for simulating a lack of mains or an external order.

- Place the operating switch in the «**TEST**» position.
- The generator set will start automatically after the preheating plug has had time to operate. (If the preheating plug has been configured on the automatics board).

C) STOP «»



This position allows stopping of the generator set and the operation of the ins/ats system and to return to mains supply.
N.B. : the switch on the «mains» side will only close if mains supply is present again.

D) EMERGENCY STOPPING

- Press the emergency stop push button in the event of an accident or incident. The engine will stop instantly.

 Do not forget to unlock the emergency stop push button when putting back in service.

E) RESTARTING AFTER STOPPING FOR A FAULT

- Note the fault and turn the operating selection switch to «».
- Make repairs and start with the starting key of the M150.
- Then replace the operating selection switch to «».

V – REVERSER OF NORMAL/EMERGENCY SOURCES INS/ATS :

The reverser of normal / emergency sources allows the installation to be supplied by the generator set as soon as mains supply disappears. The synoptic allows the display of the presence of mains and generator voltage as well as mains generator output.

Coupled with the M2/3, it allows also, during a mains breakdown, to select a priority generator (see 5).

1 – Presence of generator voltage warning light (White) :

This warning light, when it is on, signals the operation and the presence of voltage from the generator set, which is ready to supply to the installations.

2 – Presence of mains voltage warning light (White) :

This warning light, when it is on, signals the presence of mains voltage.

3 – Generator output warning light (green) :

This warning light, when it is on, signals the closed position of the emergency contactor, therefore output is possible to the installations.

4 – Mains output warning light (green) :

This warning light, when it is on, signals the closed position of the normal contactor, therefore output is possible from the mains to the installation.

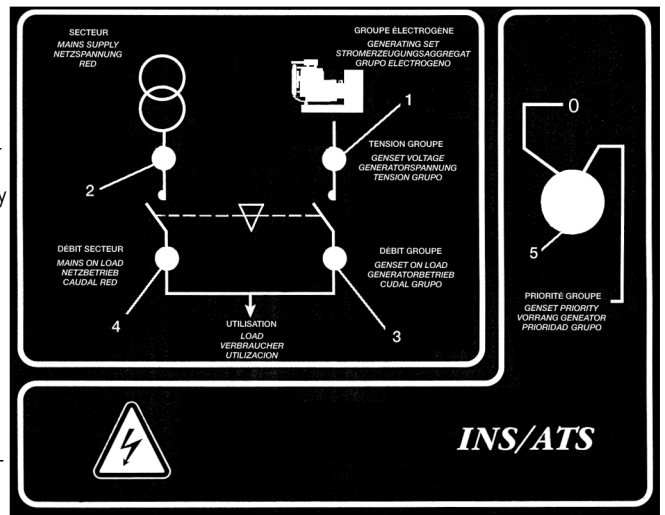
5 – Key switch :

This switch allows the selection of 2 modes :

- In the position «priority generator», to force the operation and the output of the generator set to the installations, and that, despite the return of the presence of mains voltage.

i.e. : This manoeuvre is used in the case of frequent and inopportune mains power cuts.

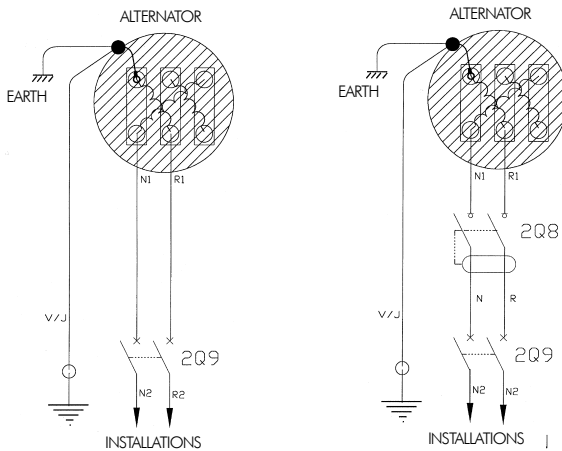
- In the «O» position the output is cut and the operation of the generating set is stopped as soon as mains voltage is restored.



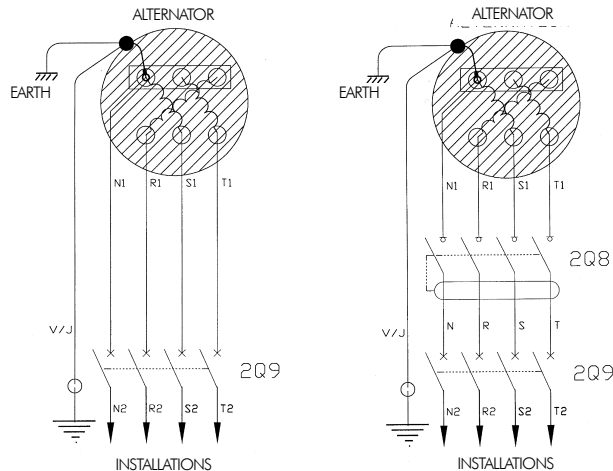
C) M50 WIRING DIAGRAM

I – POWER

SINGLE PHASE – TNS RATING SINGLE PHASE – TT RATING



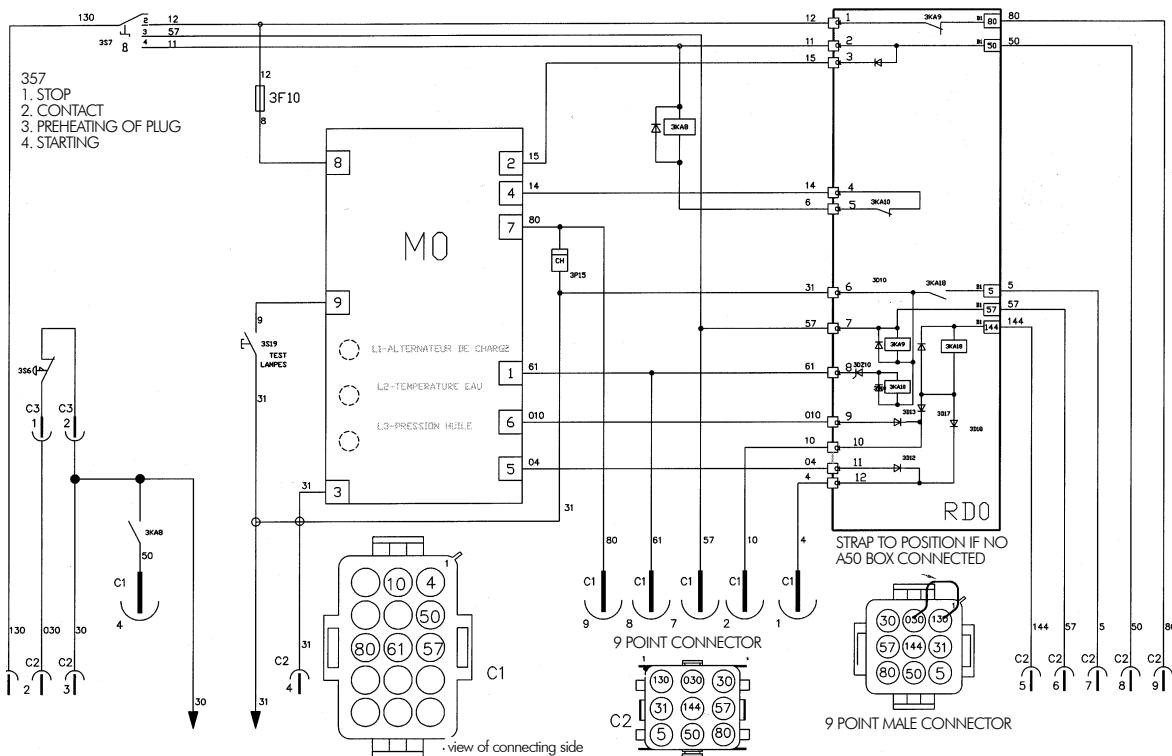
THREE PHASE – TNS RATING THREE PHASE – TT RATING



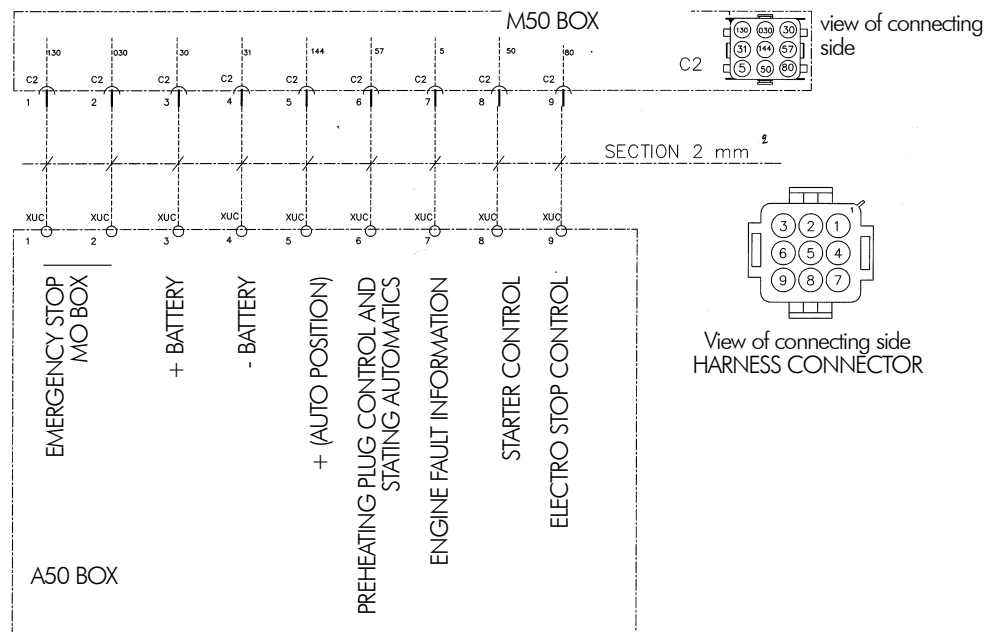
MARK	DESCRIPTION	REFERENCE
209	CIRCUIT BREAKER 2 X 20A	31613020703
	CIRCUIT BREAKER 2 X 25A	31613020704
	CIRCUIT BREAKER 2 X 32A	31613020705
	CIRCUIT BREAKER 2 X 40A	31613020706
	CIRCUIT BREAKER 2 X 50A	31613020707
	CIRCUIT BREAKER 2 X 63A	31613020708
	CIRCUIT BREAKER 2 X 80A	31613020709
	CIRCUIT BREAKER 2 X 100A	31613020710
208	INTER-DIF 2 x 25A - 30mA	31613043001
	INTER-DIF 2 x 25A - 300mA	31613061601
	INTER-DIF 2 x 40A - 30mA	31613043101
	INTER-DIF 2 x 40A - 300mA	31613021701
	INTER-DIF 2 x 63A - 30mA	31613043201
	INTER-DIF 2 x 63A - 300mA	31613061801
	INTER-DIF 2 x 100A - 30mA	31613043302
	INTER-DIF 2 x 100A - 300mA	31613061901

MARK	DESCRIPTION	REFERENCE
209	CIRCUIT BREAKER 4 X 10A	31613020711
	CIRCUIT BREAKER 4 X 16A	31613020712
	CIRCUIT BREAKER 4 X 20A	31613020713
	CIRCUIT BREAKER 4 X 25A	31613020714
	CIRCUIT BREAKER 4 X 32A	31613020715
	CIRCUIT BREAKER 4 X 40A	31613020716
	CIRCUIT BREAKER 4 X 50A	31613020717
	CIRCUIT BREAKER 4 X 63A	31613020718
	CIRCUIT BREAKER 4 X 80A	31613020719
	CIRCUIT BREAKER 4 X 100A	31613020720
208	CIRCUIT BREAKER 4 X 125A	31613020721
	INTER-DIF 4 x 25A - 30mA	31613043401
	INTER-DIF 4 x 25A - 300mA	31613062001
	INTER-DIF 4 x 40A - 30mA	31613043501
	INTER-DIF 4 x 40A - 300mA	31613062101
	INTER-DIF 4 x 63A - 30mA	31613043601
	INTER-DIF 4 x 63A - 300mA	31613062201
	INTER-DIF 4 x 100A - 30mA	
	INTER-DIF 4 x 100A - 300mA	31613043701
	INTER-DIF 4 x 125A - 30mA	
	INTER-DIF 4 x 125A - 300mA	31613050701

II - AUTOMATICS



III - TERMINAL BLOCK A50 CABINET



IV - NOMENCLATURE

MARK	DESCRIPTION	Qty	REFERENCE
RDO	RELAY BOARD 12VCC	1	3163044701
MO	SAFETY CARD 12VCC	1	3163003801
357	STARTING SWITCH	1	30702001301NE
3KA8	RELAYS 12VCC / 30A AUTOMOBILE TYPE	1	3163014401
	RELAY SOCKET	1	3163055901
3P15	HOURMETER 12VCC	1	3163042801
3S19	EMERGENCY STOP BUTTON	1	3163042701
3S19	LIGHTS TEST BUTTON	1	3163042901
3F10	CUT-OUT 5 X 20 - MOUNTED ON PANEL	1	3163004001
	FUSE CARTRIDGE 5X20 - 5A	1	3163004101
C1	MALE CONNECTOR - 15 WAY	1	3163060101
C2	FEMALE CONNECTOR - 9 WAY	1	3163057201
C2	MALE CONNECTOR - 9 WAY	1	3163057301
C3	FEMALE CONNECTOR - 2 WAY	1	163048501
C3	MALE CONNECTOR - 2 WAY	1	3163048601

V - WIRING


CIRCUIT	NEUTRAL	COLOUR
POWER	PHASE 1	LIGHT BLUE
	PHASE 2	BROWN
	PHASE 3	BLACK
ALTERNATING REMOTE CONTROL	NEUTRAL	LIGHT BLUE
	PHASE 1	BROWN
	PHASE 2	BLACK
	PHASE 3	BLACK
INSULATED ALTERNATING REMOTE CONTROL	BLACK	TO DOWNSTREAM
CIRCUITS NOT CUT-OFF BY BREAKING DEVICE	COLOUR IDENTICAL	CIRCUIT OF THE
		SWITCH +
		PREVENTION LABEL
DIRECT REMOTE CONTROL	MINUS	BLUE
	PLUS	RED
EXCITATION OF CHARGING ALTERNATOR	RED	RED
TRANSMITTER SIGNAL	BLUE	BLUE
INTENSIVE CIRCUIT	ORANGE	ORANGE

D) WIRING DIAGRAM M150-A50-X200-INS/ATS

SCHEMA ELECTRIQUE
ELECTRICAL DRAWING
ESQUEMA ELECTRICO
ESQUEMA ELECTRICO

M150

<=125A

B	EVOLUTION...02/10G-02/11F-11/02B-26/01C-26/02C-26/02G44C-26/04C-25/05C-26/06C-26/06G44C-26/08C-26/09C-26/09G44C	14/04/03	BG	14/04/03	BG
A	FIRST ISSUE	19-09-02	BERGOT Gilles	19-11-02	BERGOT Gilles
IND.	DESIGNATION DE LA MODIFICATION	DATE	VISA	DATE	VISA
		DESSINE		VERIFIE	
MATIERE :				FORMAT : 4	
REVETEMENT :				ECHELLE : 1	
TOLERANCE : JS13/Js13 sauf Indication Particulière				FOLIO :	
DESIGNATION : ELECTRICAL DRAWING PEDESTRAL M150 <= 125A INGERSOLL-RAND				MASSE (Vide/Plein) kg	
33513001701					
12 bis, rue de la Villeneuve 29272 BREST - Tel : 02.98.41.41.41 - Telex : 940757F - Telecopie : 02.98.41.63.07 CE PLAN EST LA PROPRIETE DE LA SOCIETE ; IL NE PEUT ETRE REPRODUIT , UTILISE OU COMMUNIQUE SANS SON AUTORISATION					

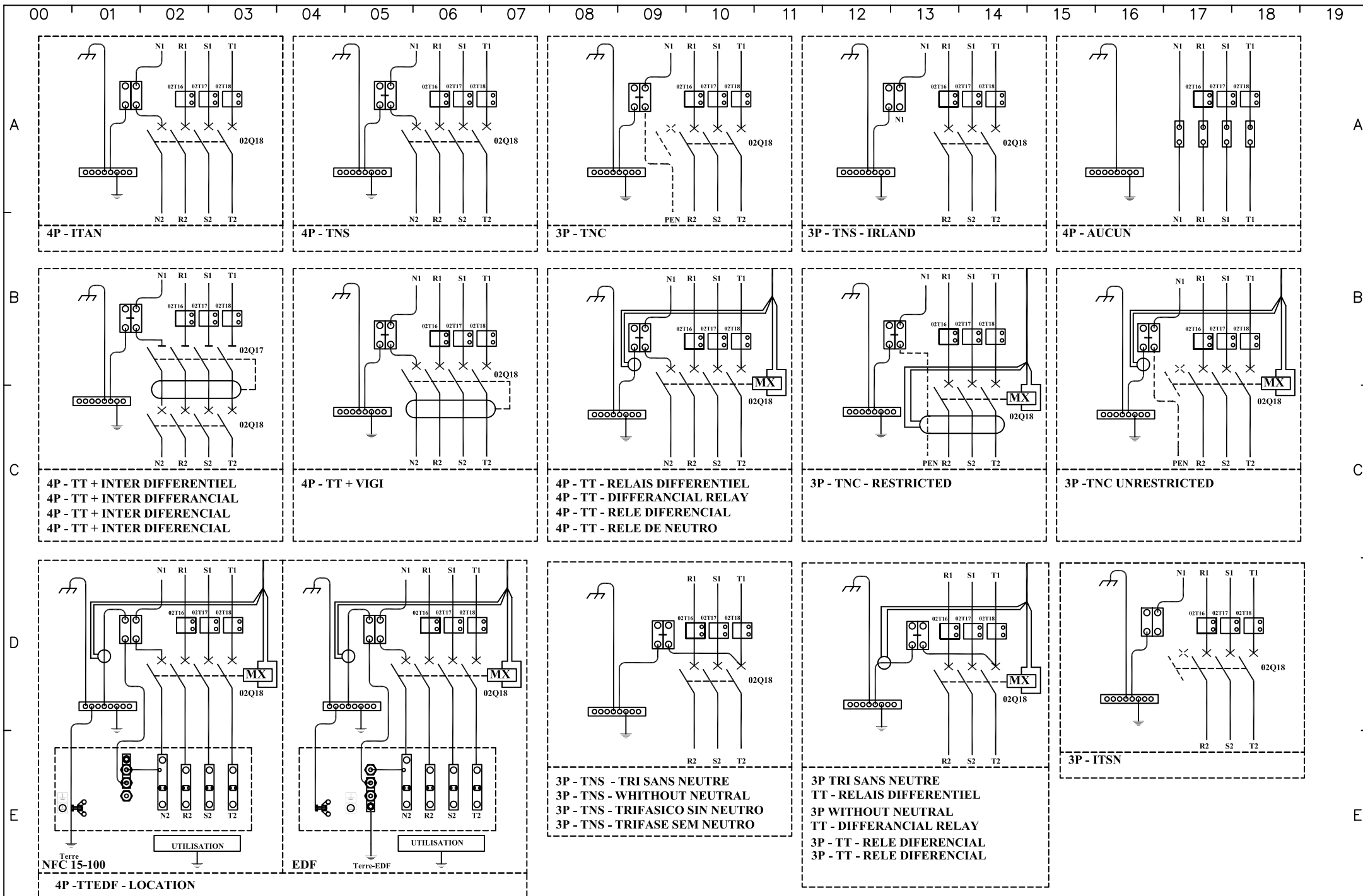
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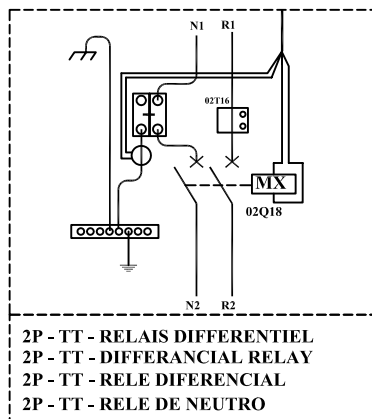
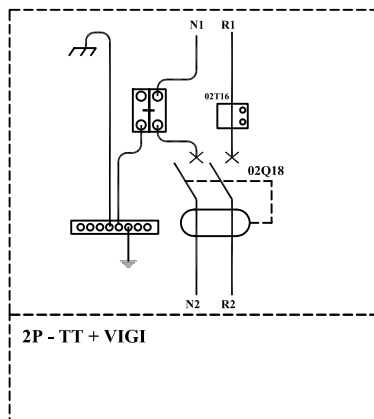
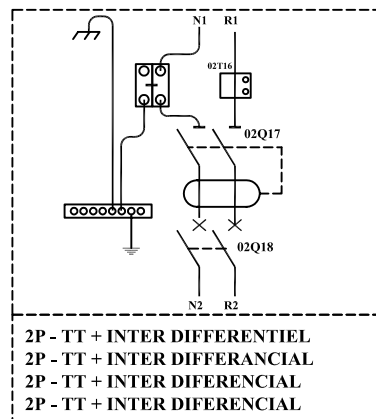
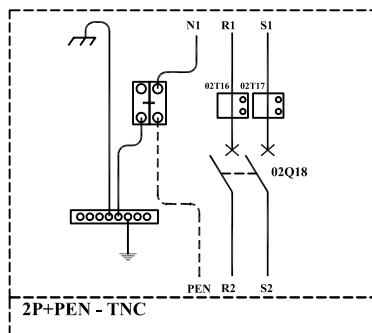
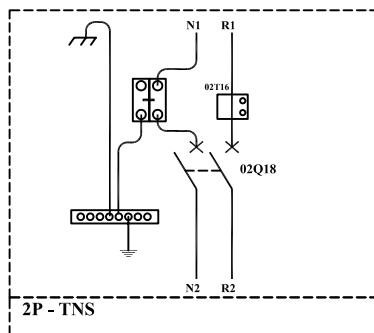
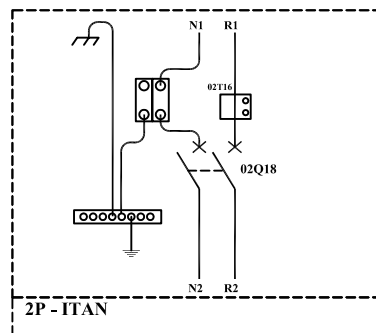
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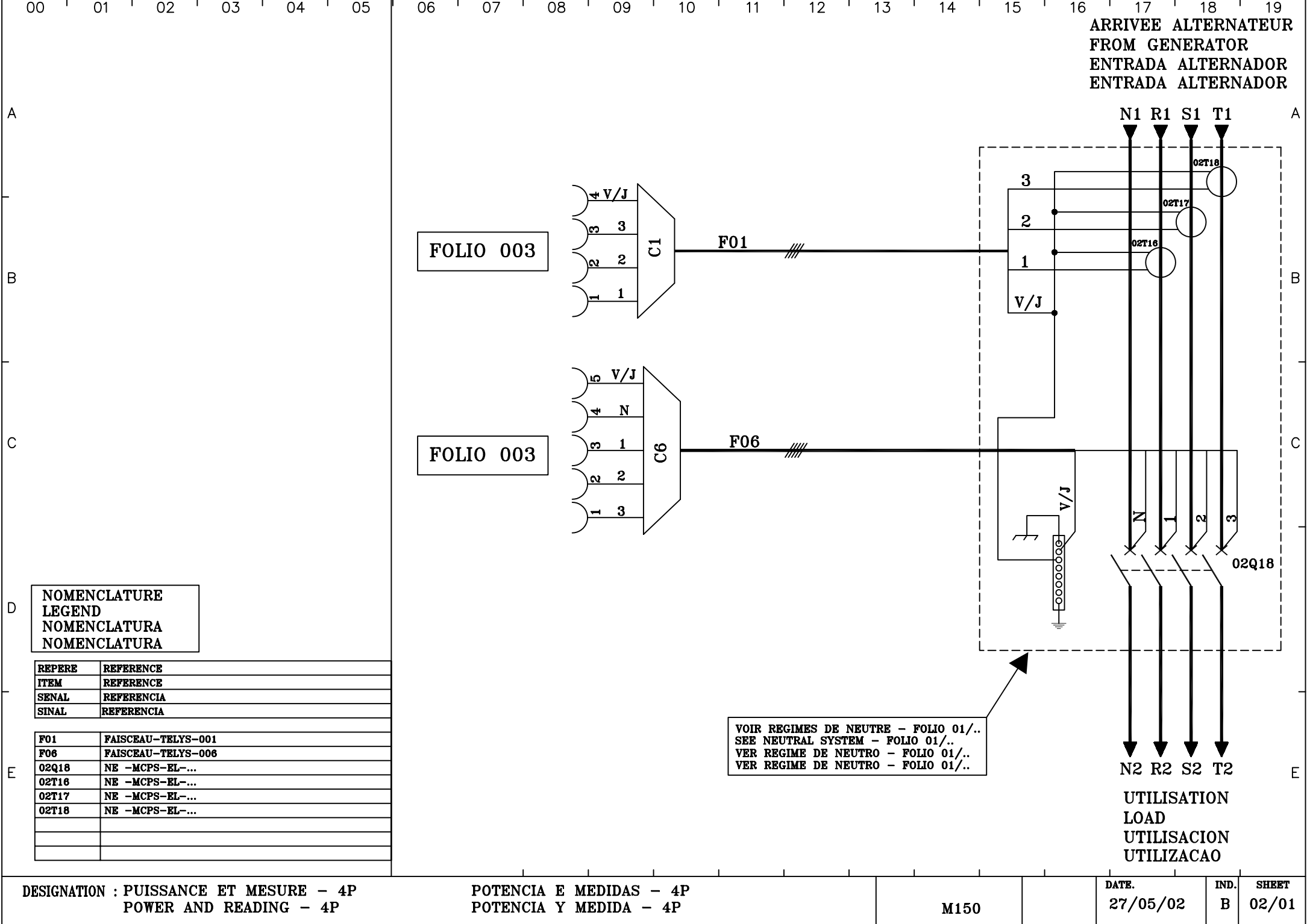
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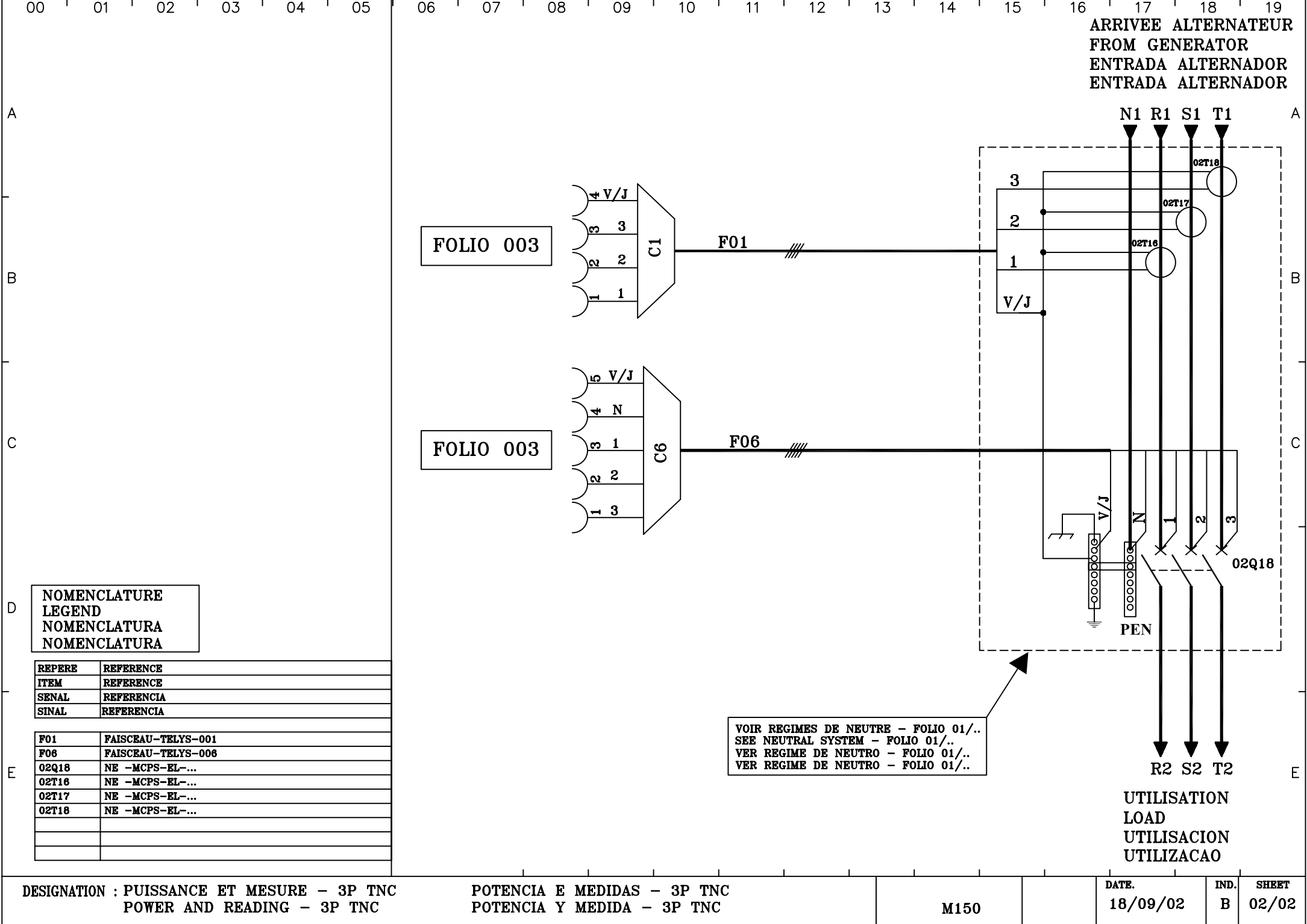
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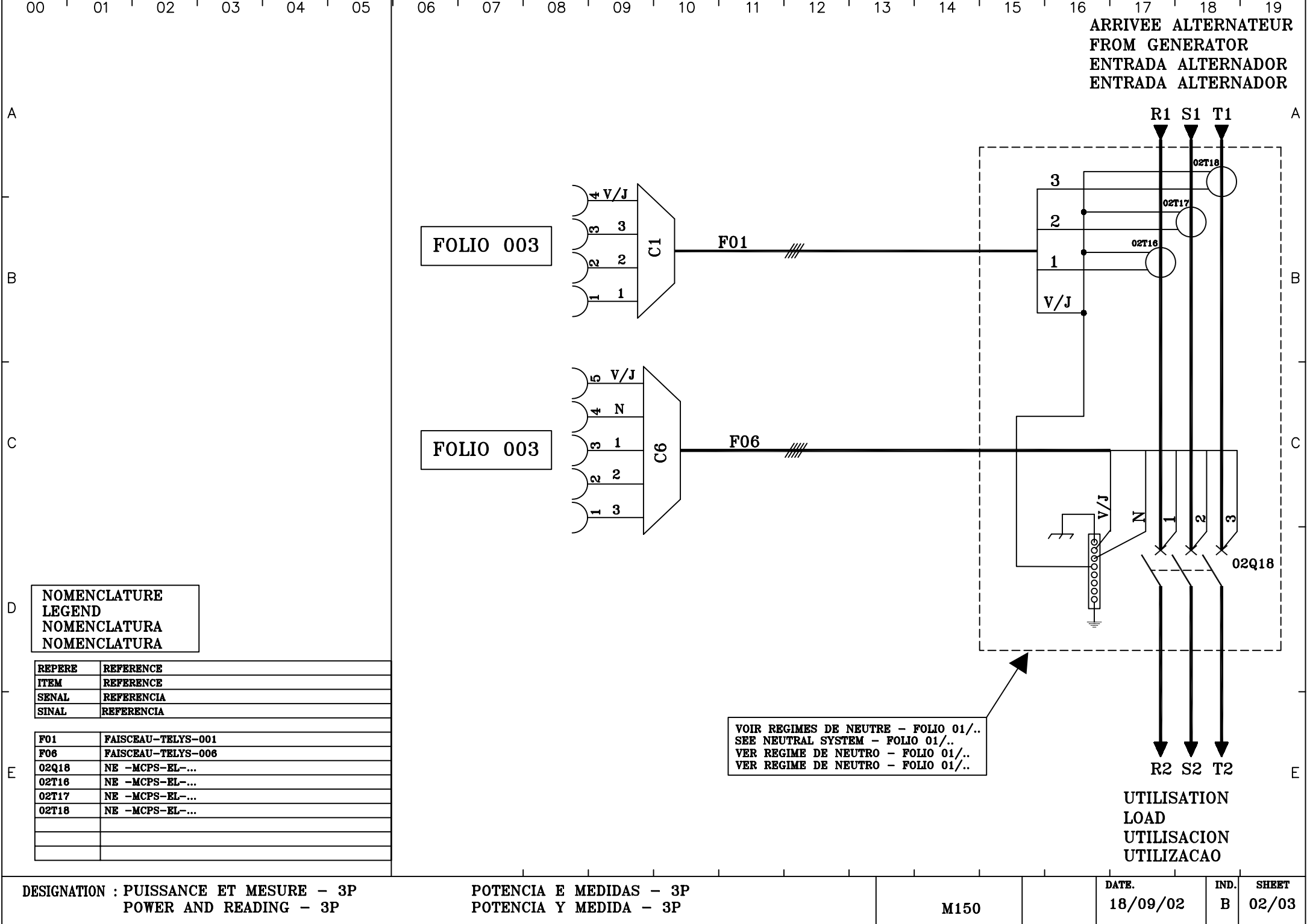
EE |

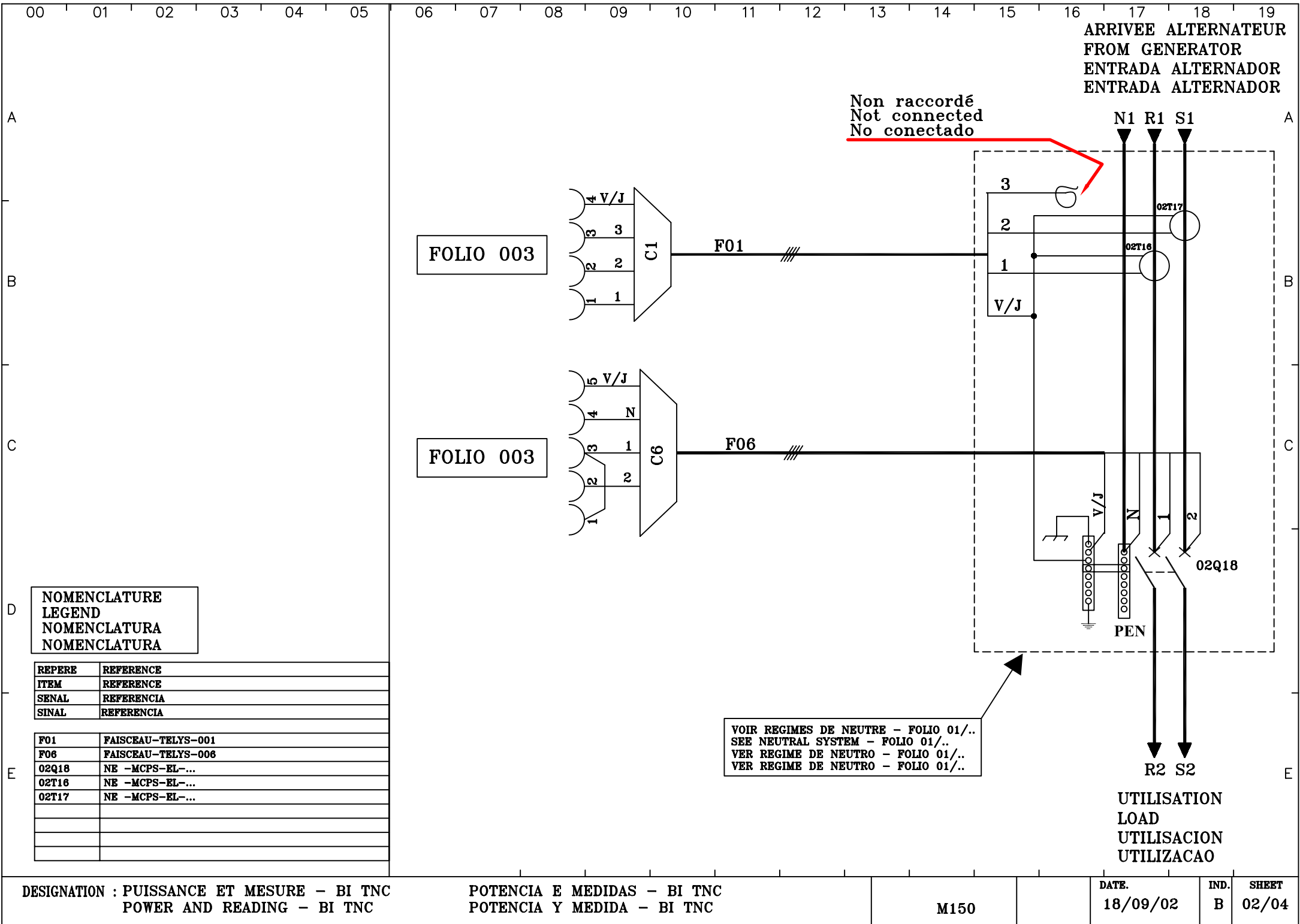


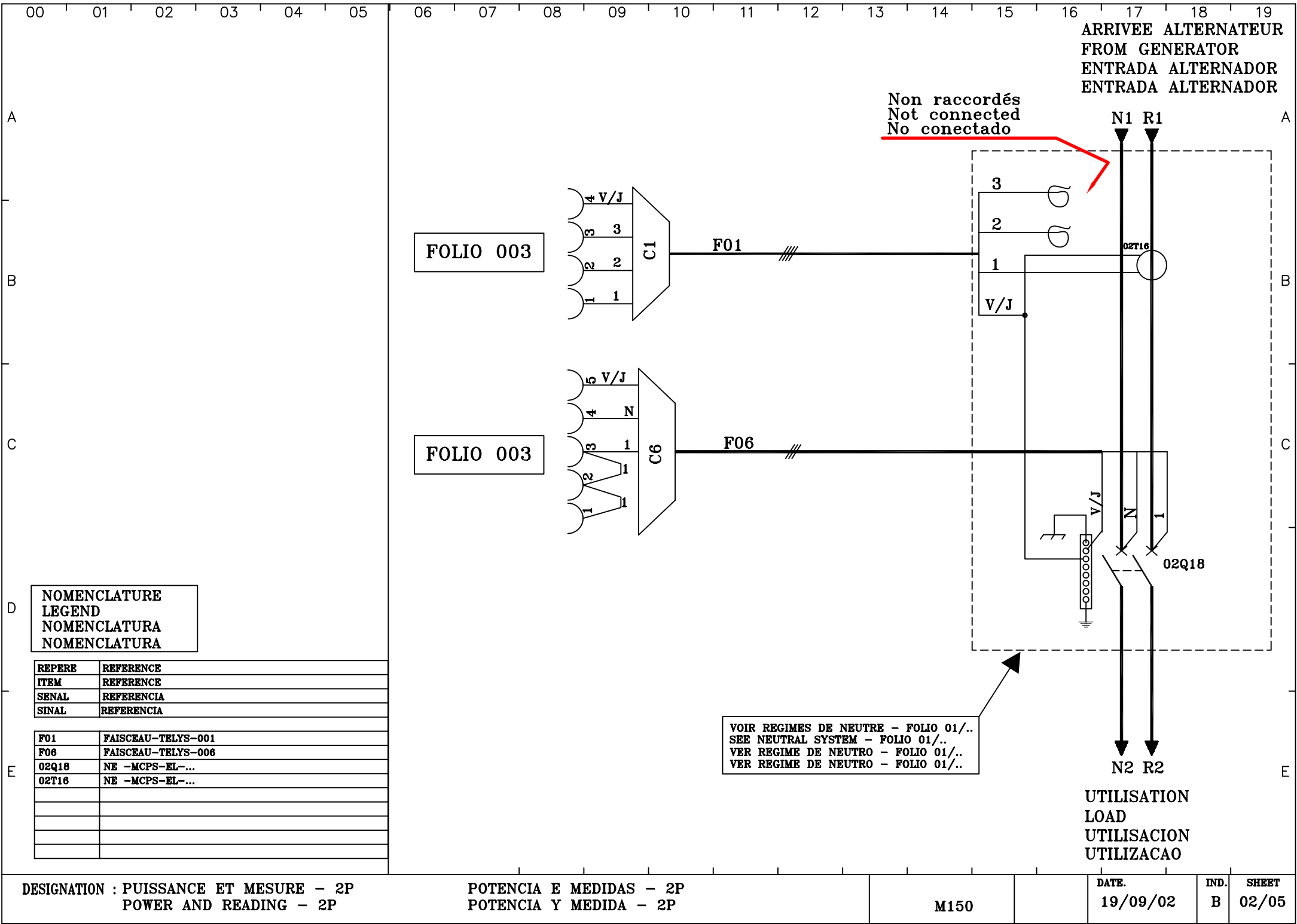












A

B

C

D

E

i A

B

C

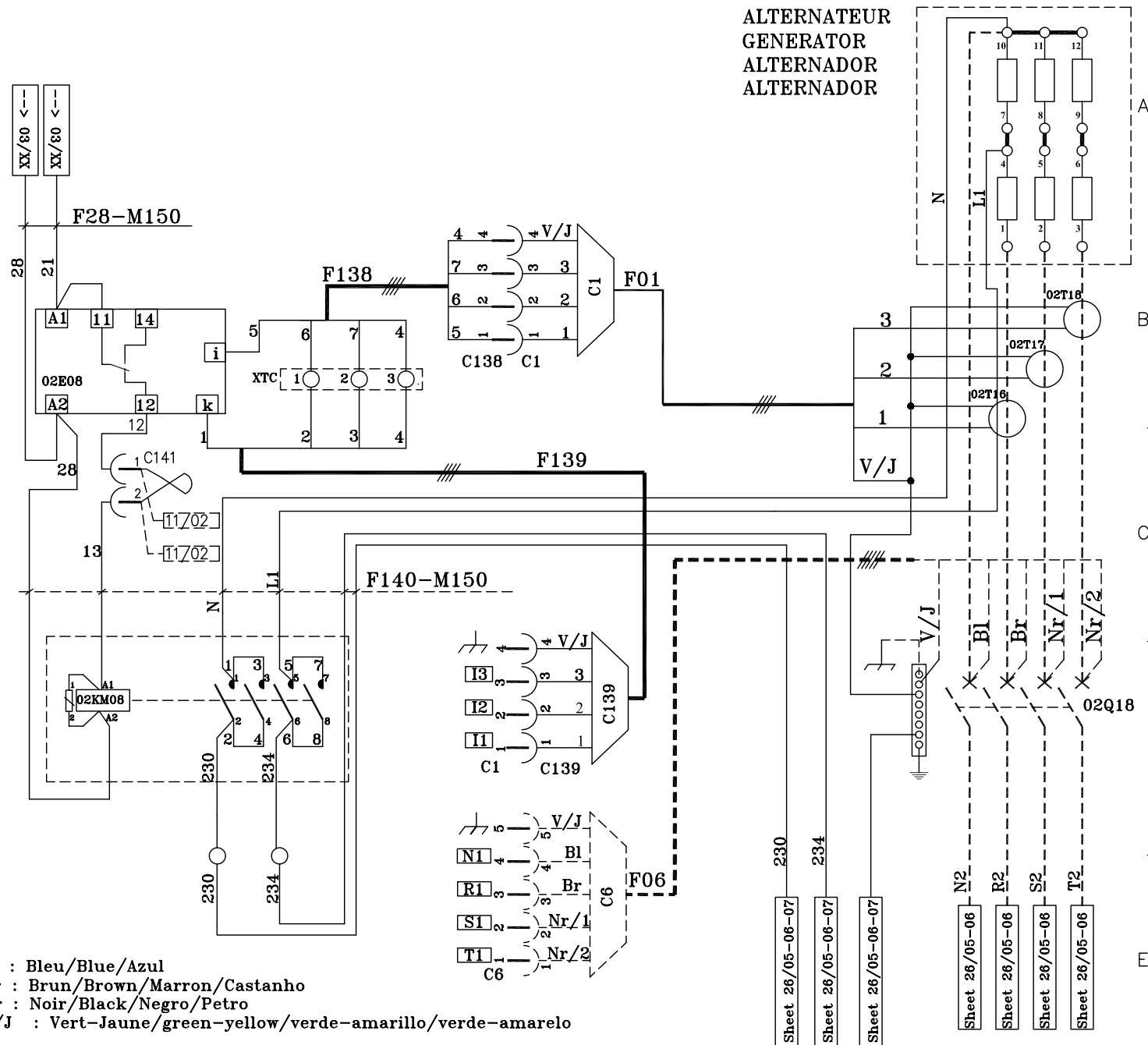
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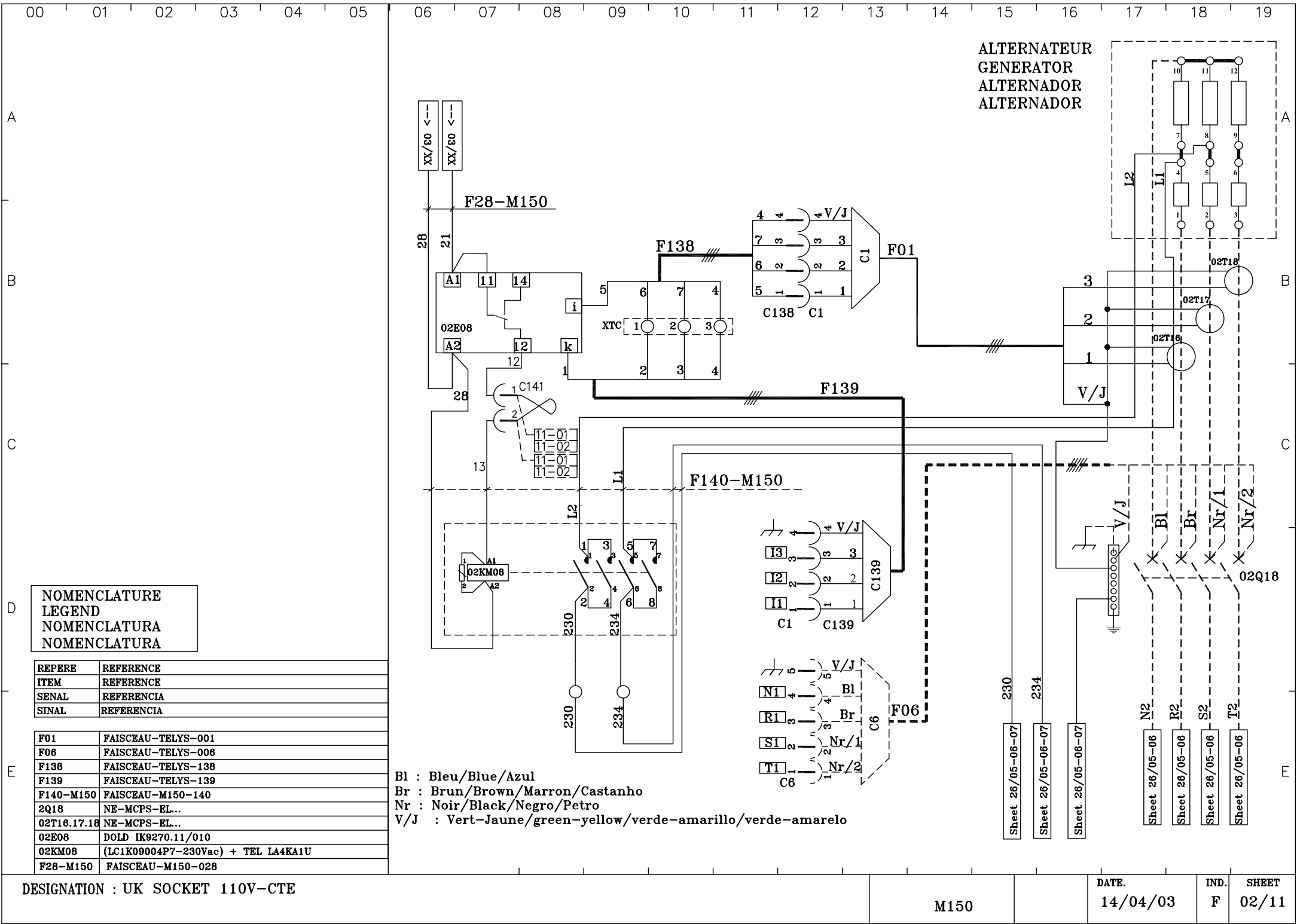
NOMENCLATURE
LEGEND
NOMENCLATURA
NOMENCLATURA

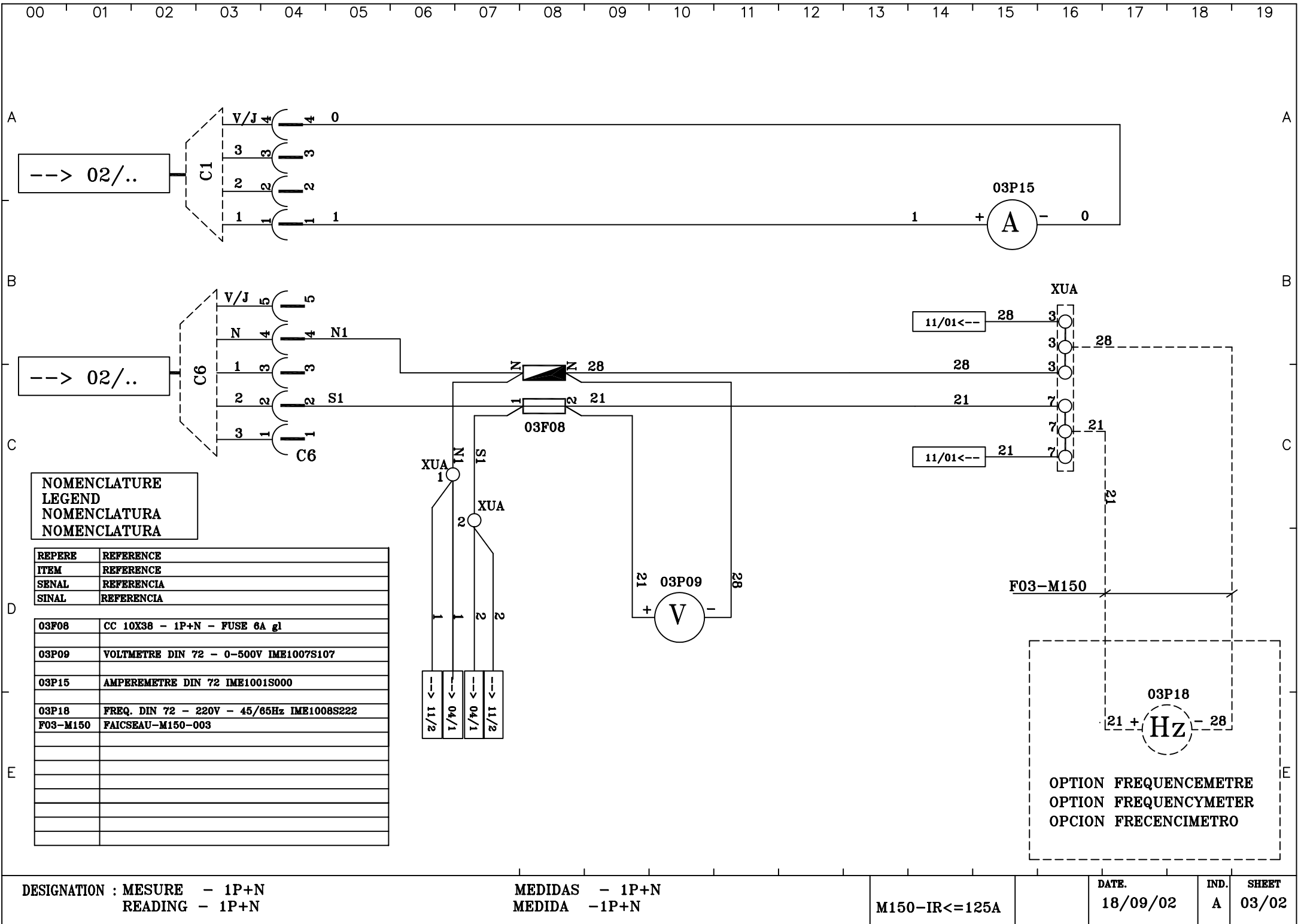
REPERE	REFERENCE
ITEM	REFERENCE
SENAL	REFERENCIA
SINAL	REFERENCIA

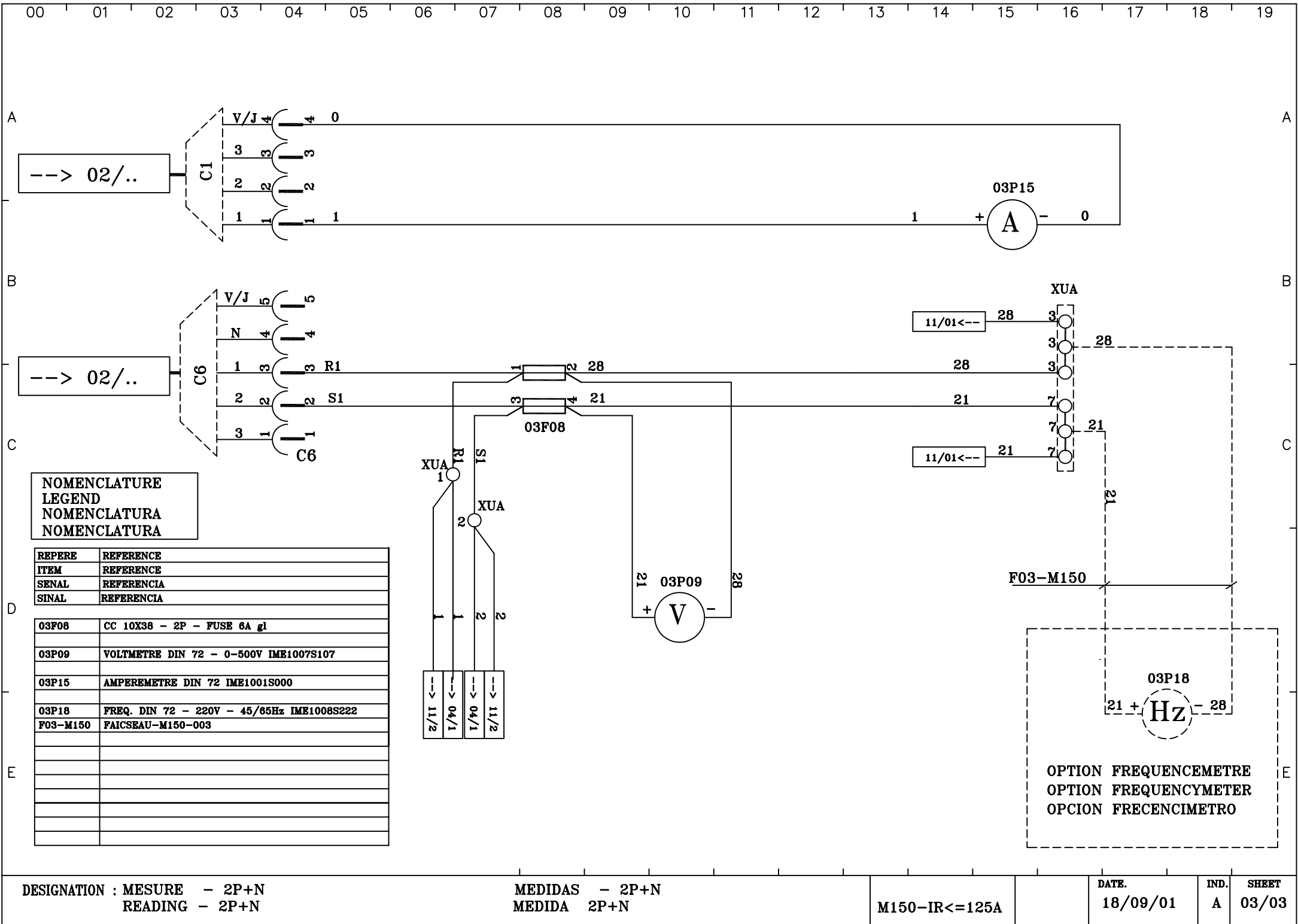
F01	FAISCEAU-TELYS-001
F06	FAISCEAU-TELYS-006
F138	FAISCEAU-TELYS-138
F139	FAISCEAU-TELYS-139
F140-M150	FAISCEAU-M150-140
2Q18	NE-MCPS-EL...
02T16.17.18	NE-MCPS-EL...
02E08	DOLD IK9270.11/010
02KM08	(LC1K09004P7-230Vac) + TEL LA4KA1U
F28-M150	FAISCEAU-M150-028

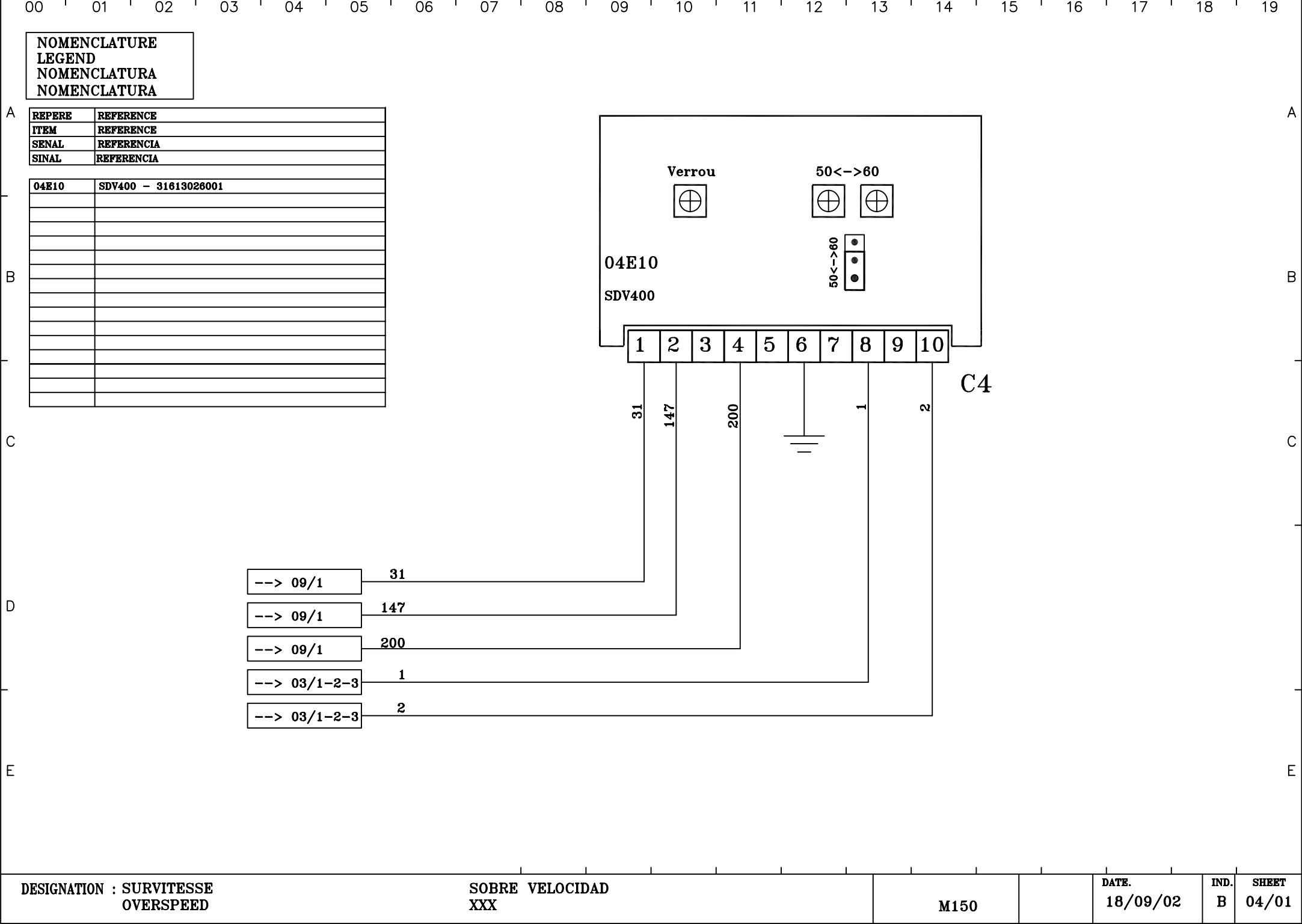
Bl : Bleu/Blue/Azul
Br : Brun/Brown/Marron/Castanho
Nr : Noir/Black/Negro/Petro
V/J : Vert-Jaune/green-yellow/verde-amarillo/verde-amarelo

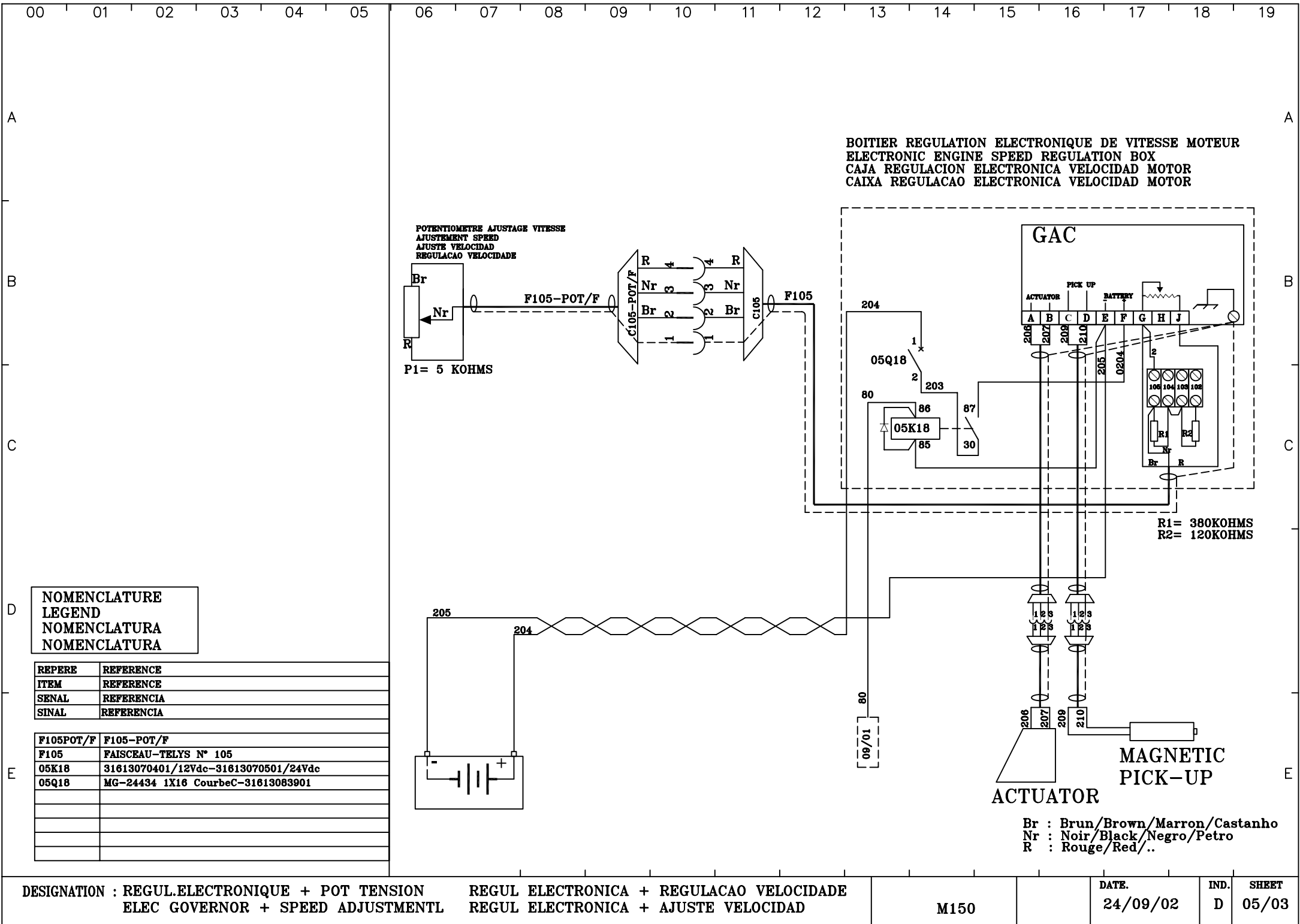


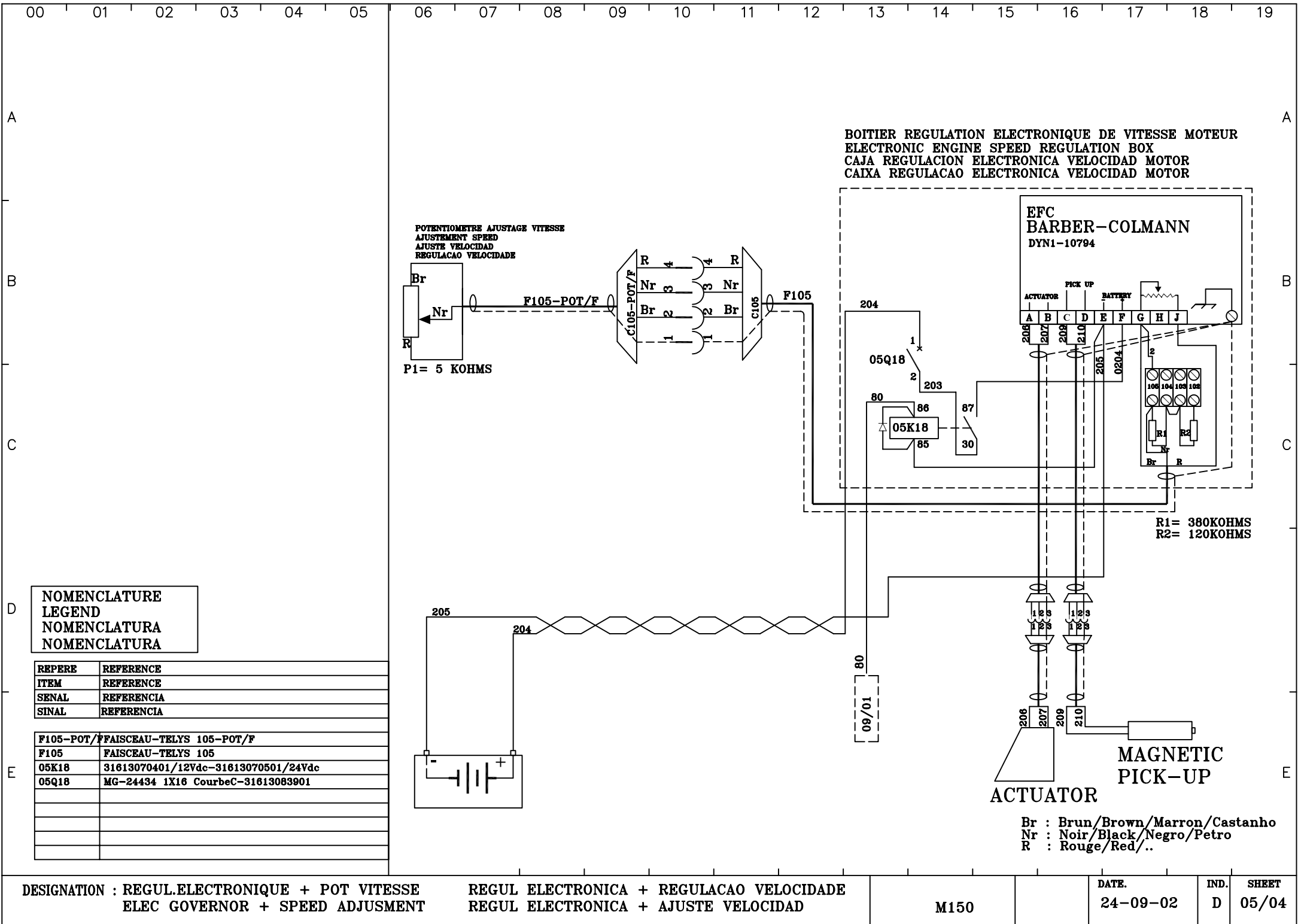


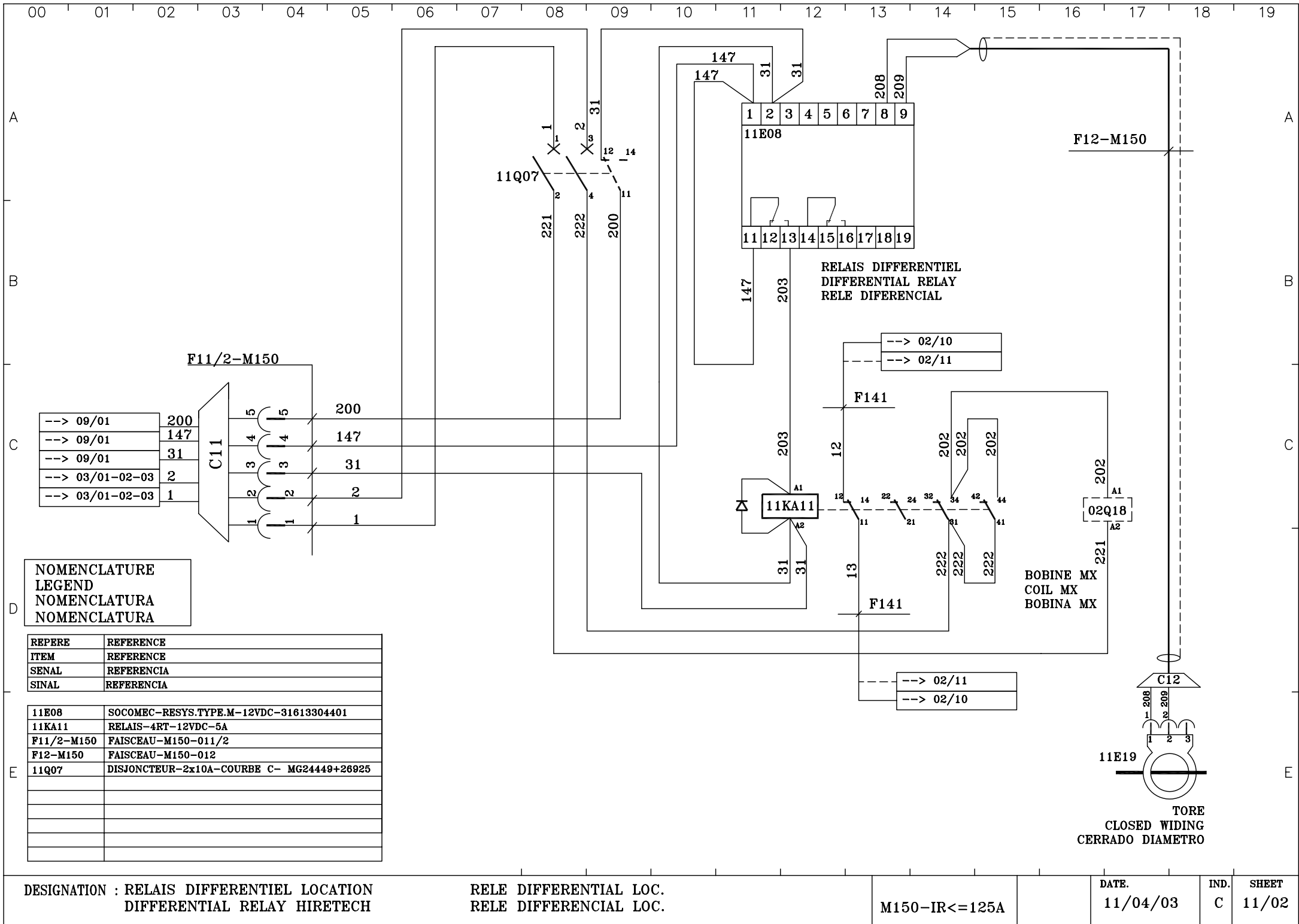


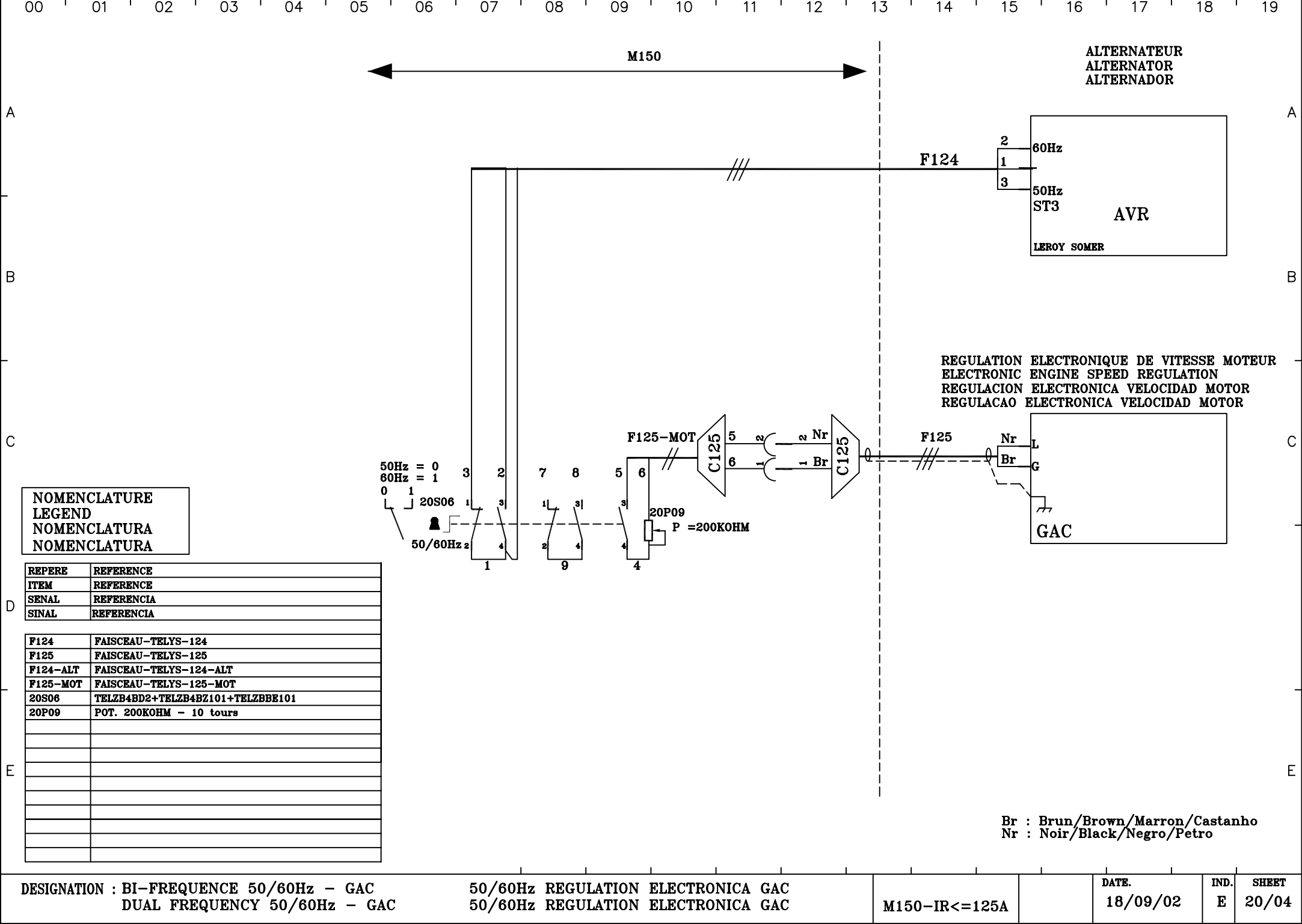


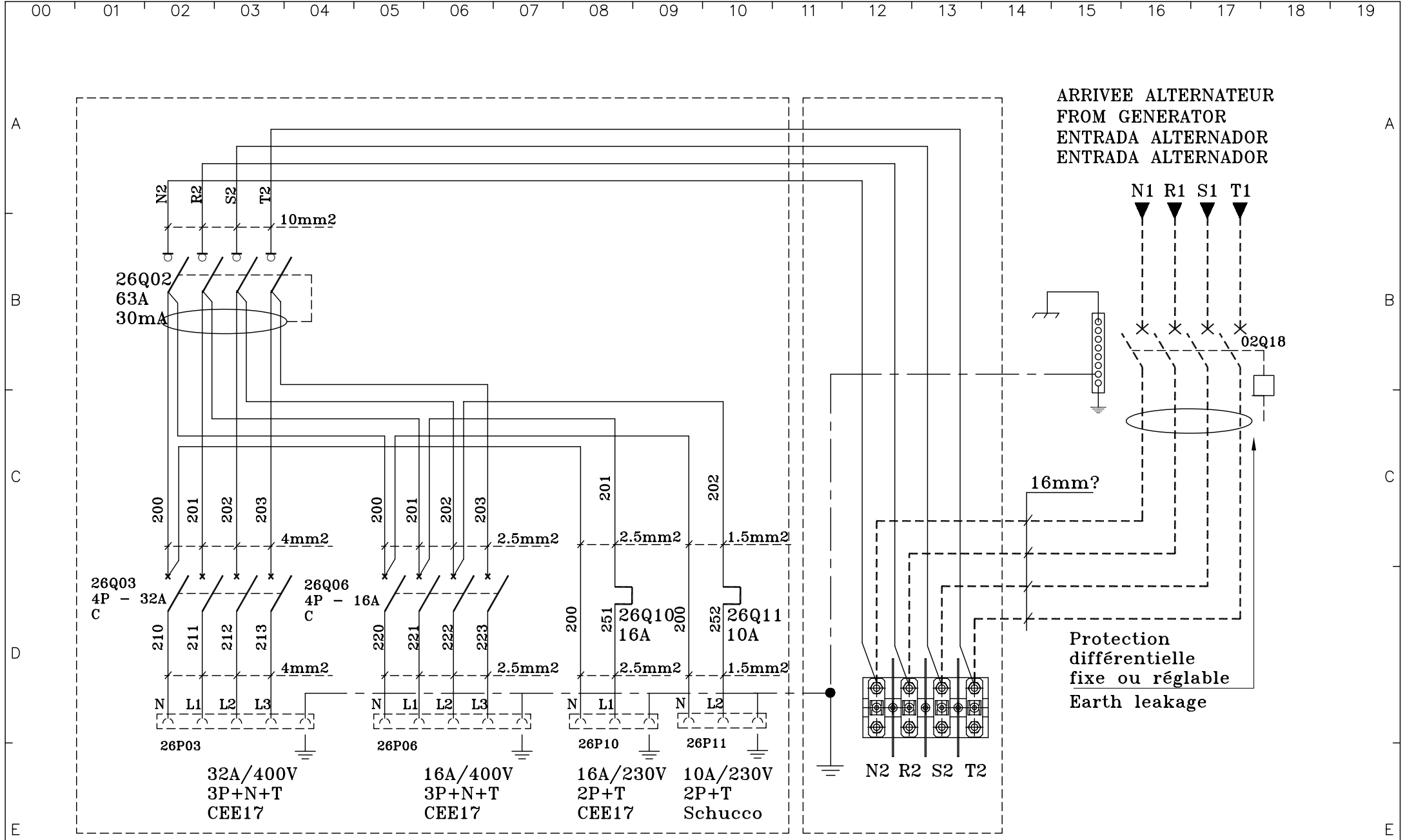












ARRIVEE ALTERNATEUR
FROM GENERATOR
ENTRADA ALTERNADOR
ENTRADA ALTERNADOR

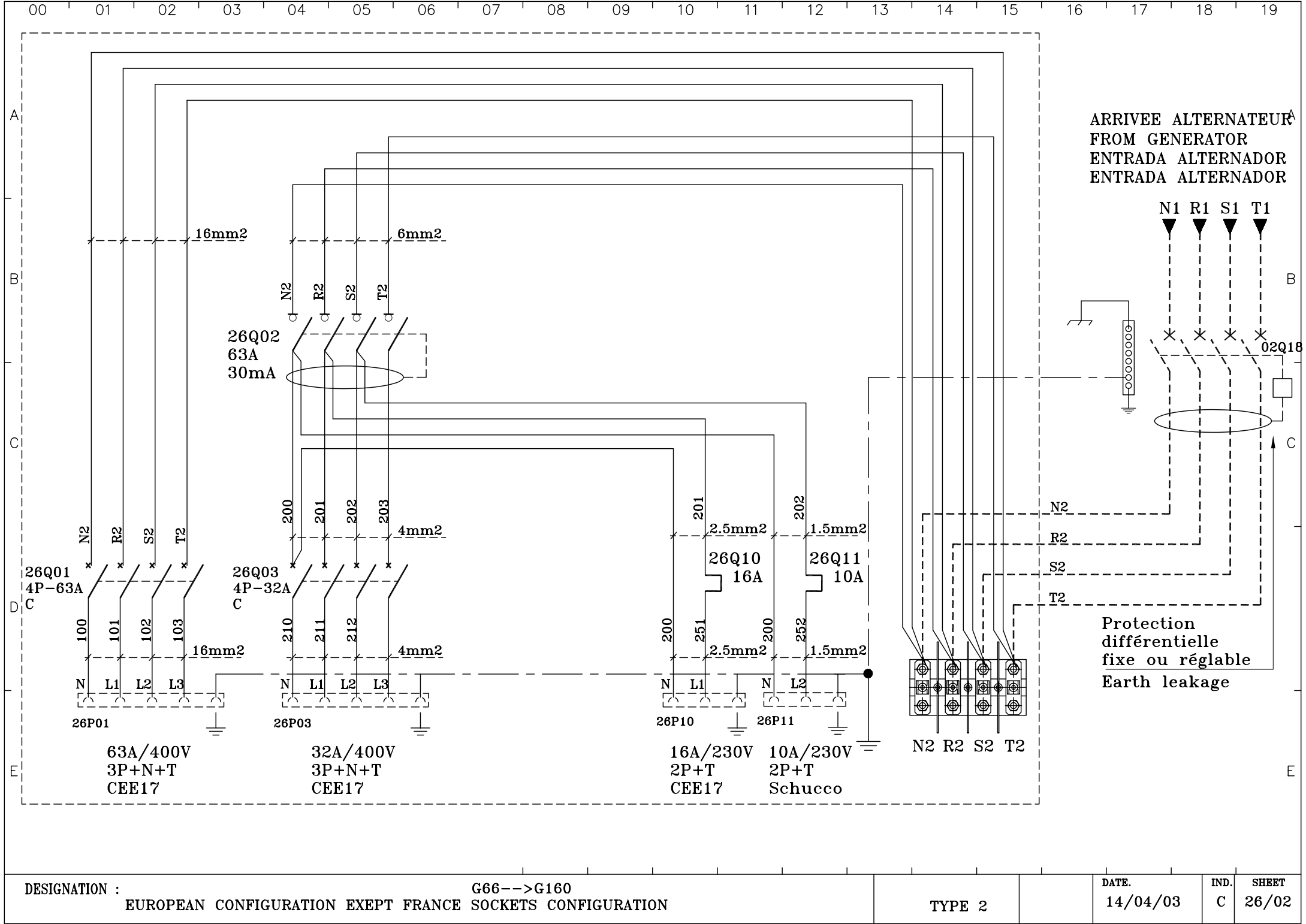
N1 R1 S1 T1

02Q18

16mm²

Protection
différentielle
fixe ou réglable
Earth leakage

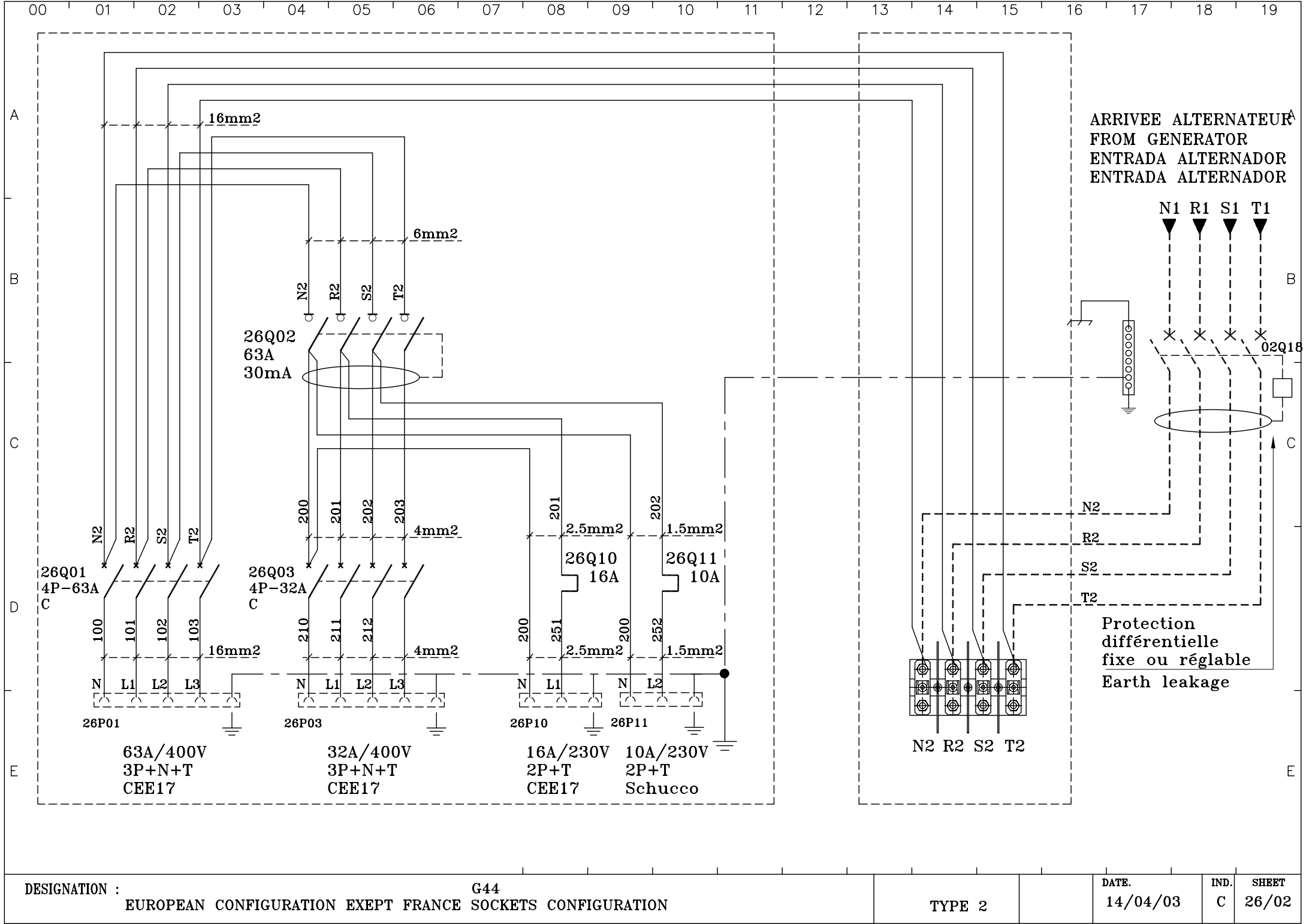
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DESIGNATION : G66-->G160
EUROPEAN CONFIGURATION EXEPT FRANCE SOCKETS CONFIGURATION

TYPE 2

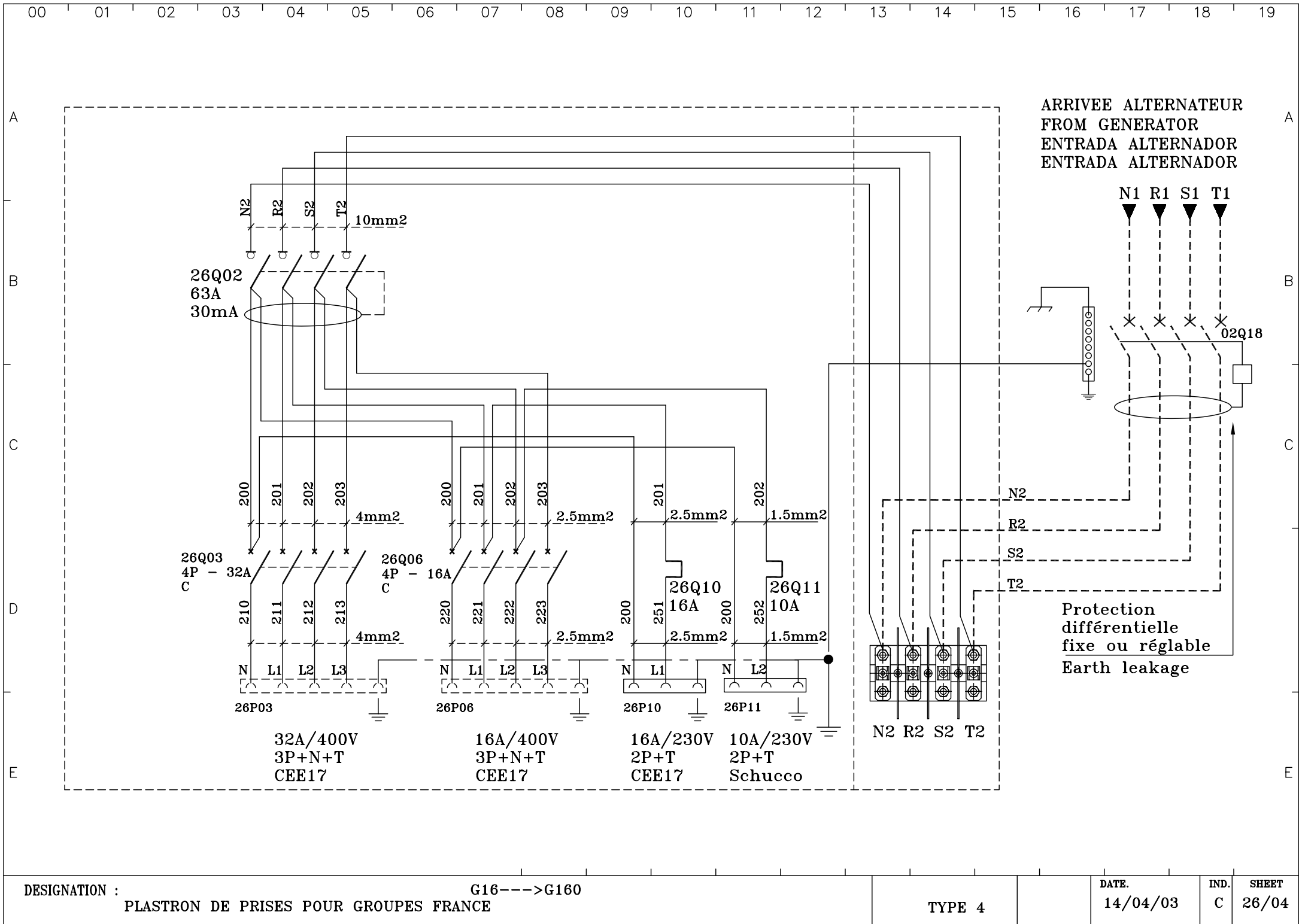
DATE. 14/04/03	IND. C	SHEET 26/02
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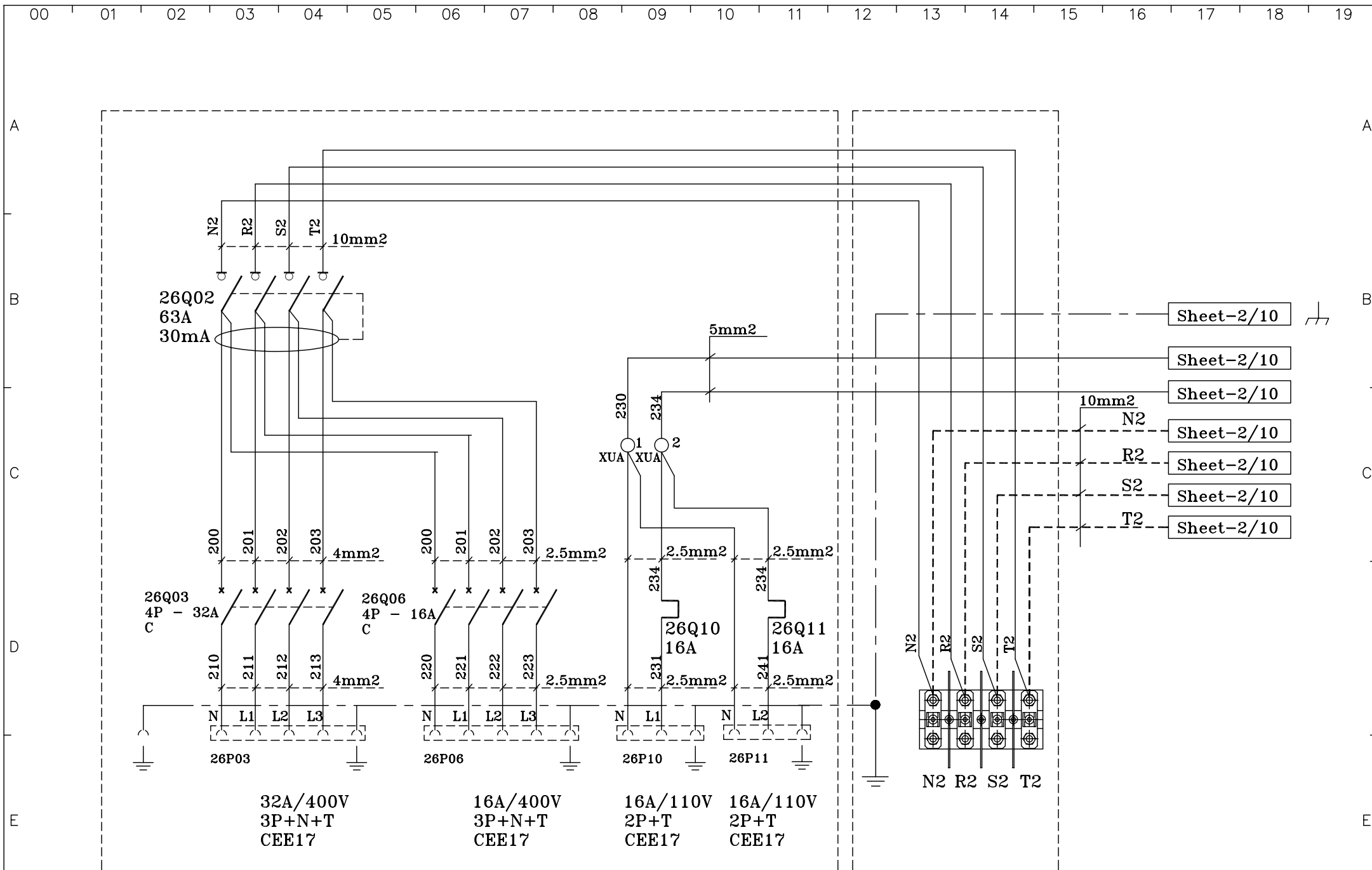


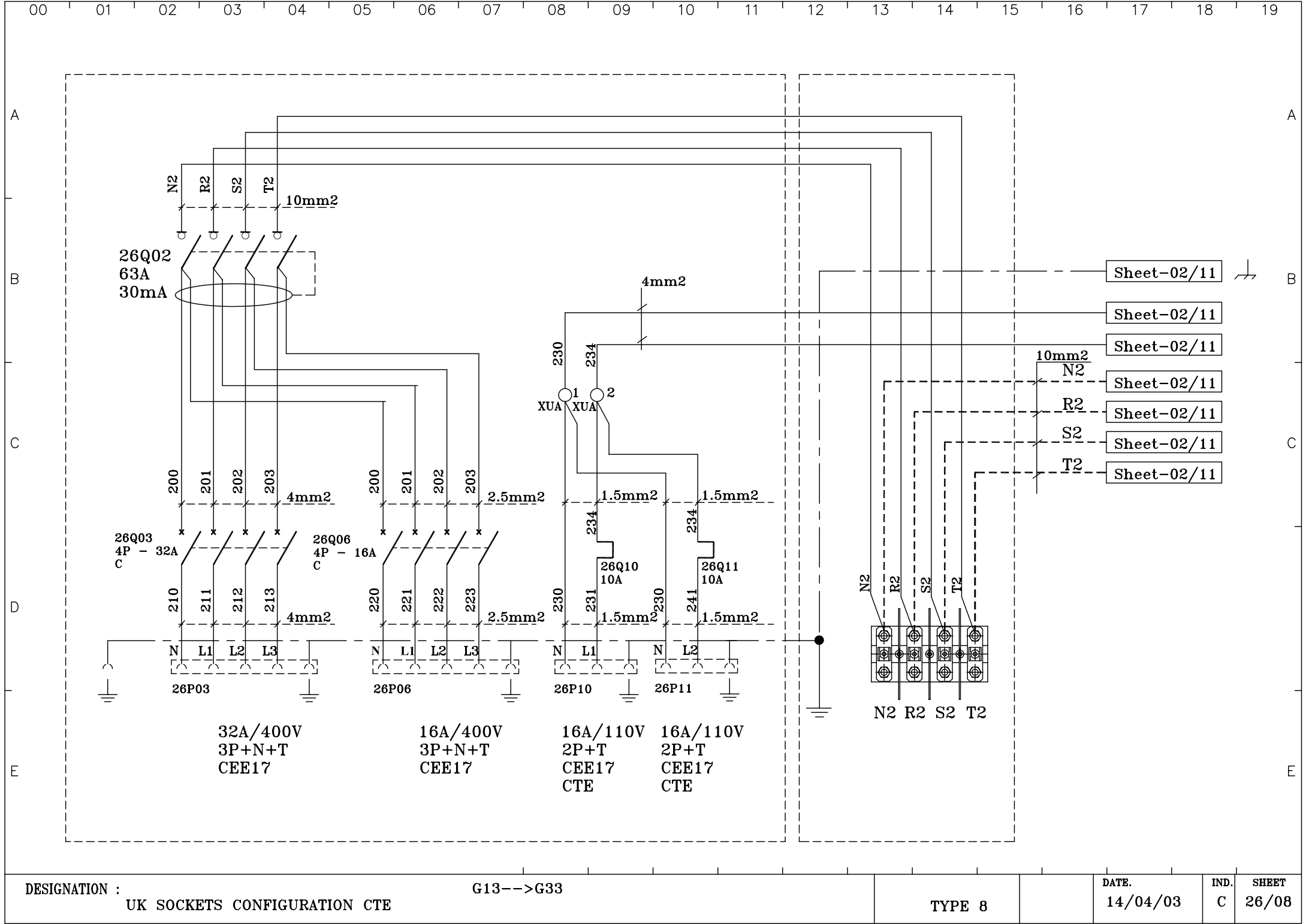
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EUROPEAN CONFIGURATION EXEPT FRANCE SOCKETS CONFIGURATION

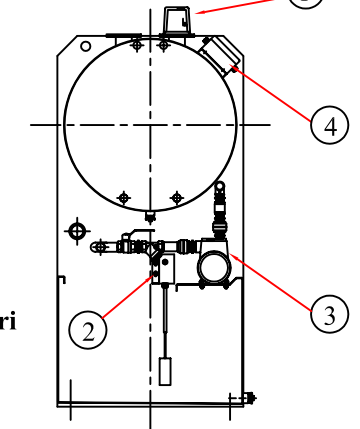
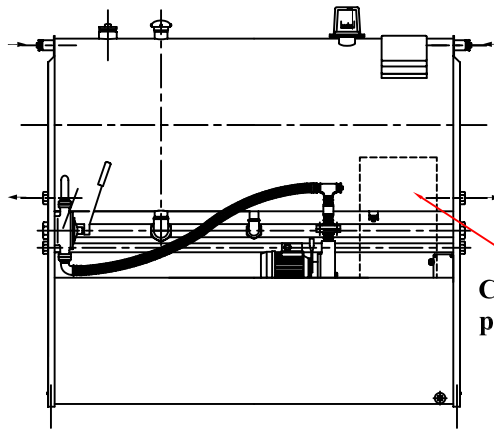
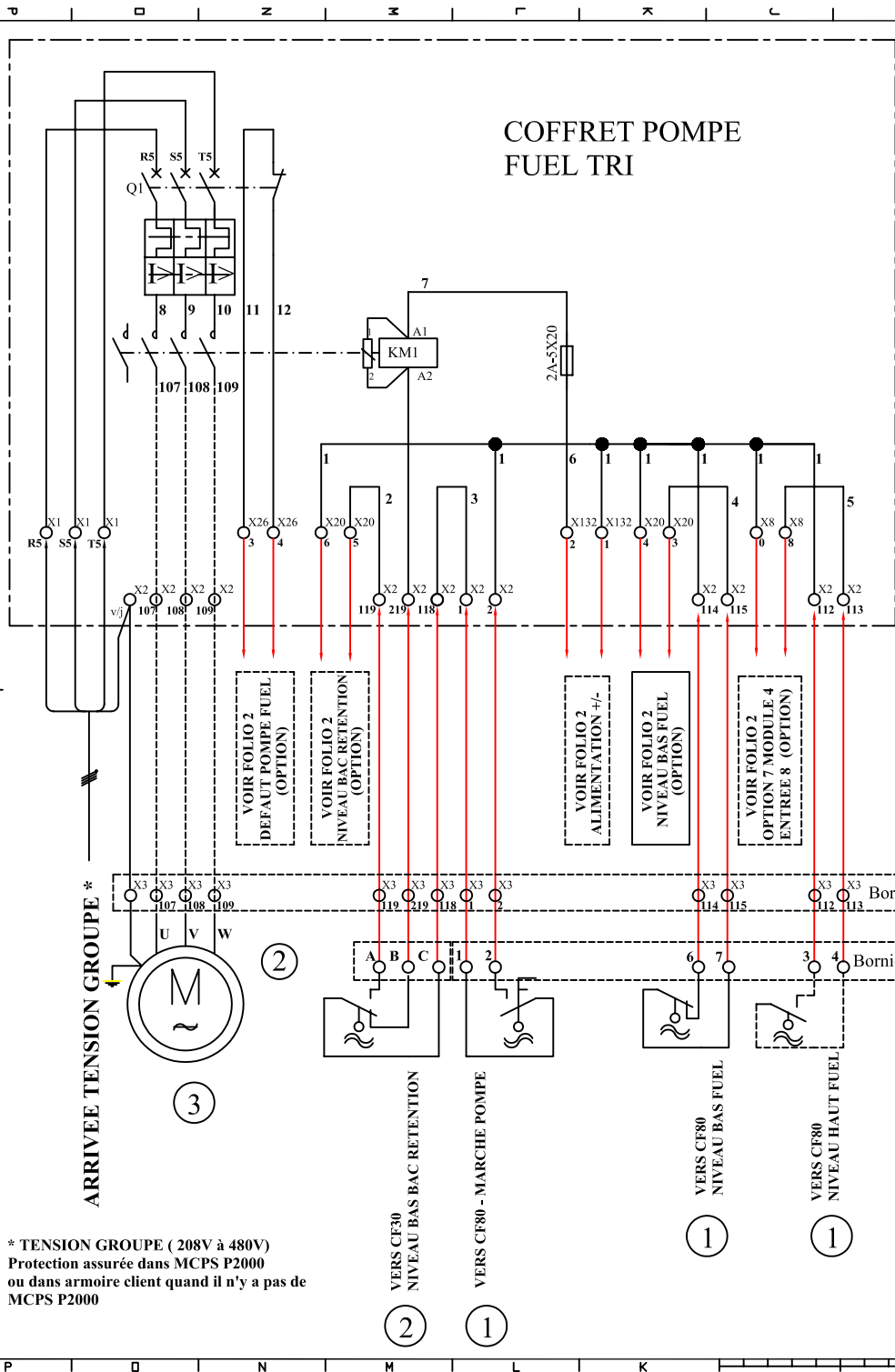
TYPE 2



DATE. 14/04/03	IND. C	SHEET 26/02
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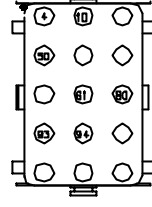




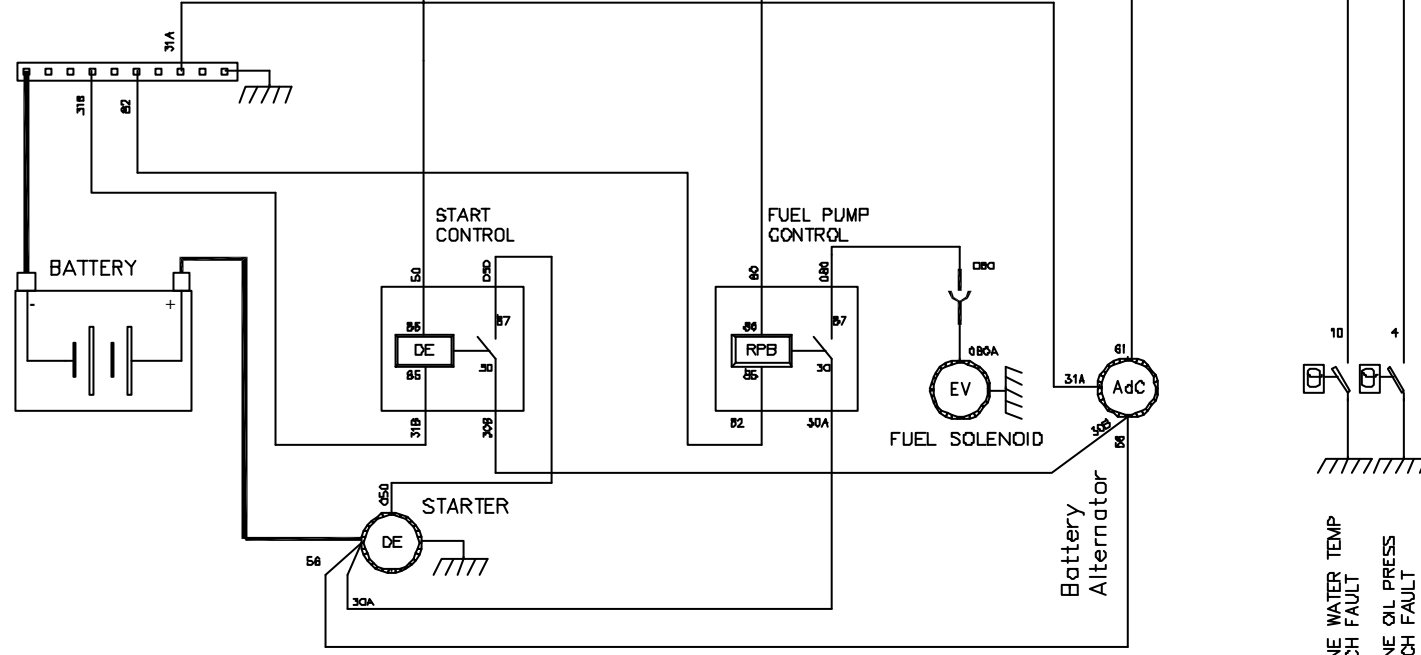
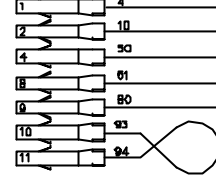
D	AJOUT DIODE ROUE LIBRE SUR KM1	28/03/02	CALVEZ G.		
C	AJOUT CONTACT SUR Q1-MODIFICATION NUMEROTATION BORNIER	05/03/02	CALVEZ G.		
B	MISE EN CONFORMITE NUMEROS	22/05/01	BERGOT Gilles		
A	CREATION DOCUMENT	30/11/98	BERGOT.G		
IND.	DESIGNATION DE LA MODIFICATION	DATE	VISA	DATE	VISA
			DESSINE		VERIFIE
MATIERE :				FORMAT :	
REVETEMENT :				ECHELLE :	
TOLERANCE :				FOLIO : 1/2	
DESIGNATION : NOTICE RACCORDEMENT – FOLIO1 COFFRET POMPE FUEL SIMPLE– 1 ou 4m3/h				MASSE (Vide/Plein) kg	
		3–35–03–0037–01–D			
12 bis, rue de la Villeneuve 29272 BREST – Tel : 02.98.41.41.41 – Telex : 940757F – Telecopie : 02.98.41.63.07 CE PLAN EST LA PROPRIETE DE LA SOCIETE ; IL NE PEUT ETRE REPRODUIT , UTILISE OU COMMUNIQUE SANS SON AUTORISATION					

* TENSION GROUPE (208V à 480V)
Protection assurée dans MCPS P2000
ou dans armoire client quand il n'y a pas de
MCPS P2000

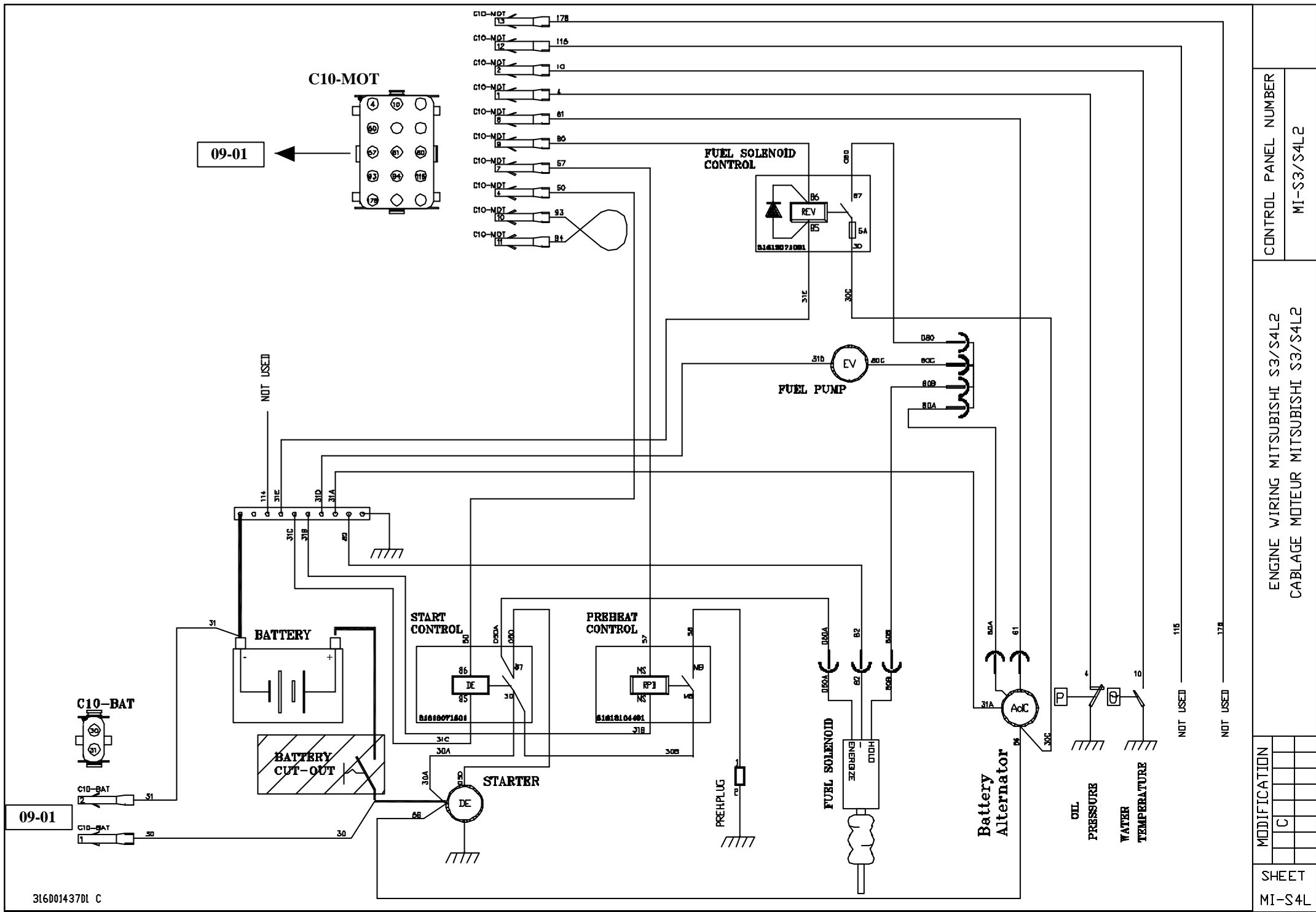
C10-MOT



C 10-MOT



MODIFICATION		CONTROL PANEL NUMBER	
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SHEET		ENGINE WIRING JOHN DEERE 3029 BASE	
JD 3029		CABLAG MOTEUR JOHN DEERE 3029 BASE	

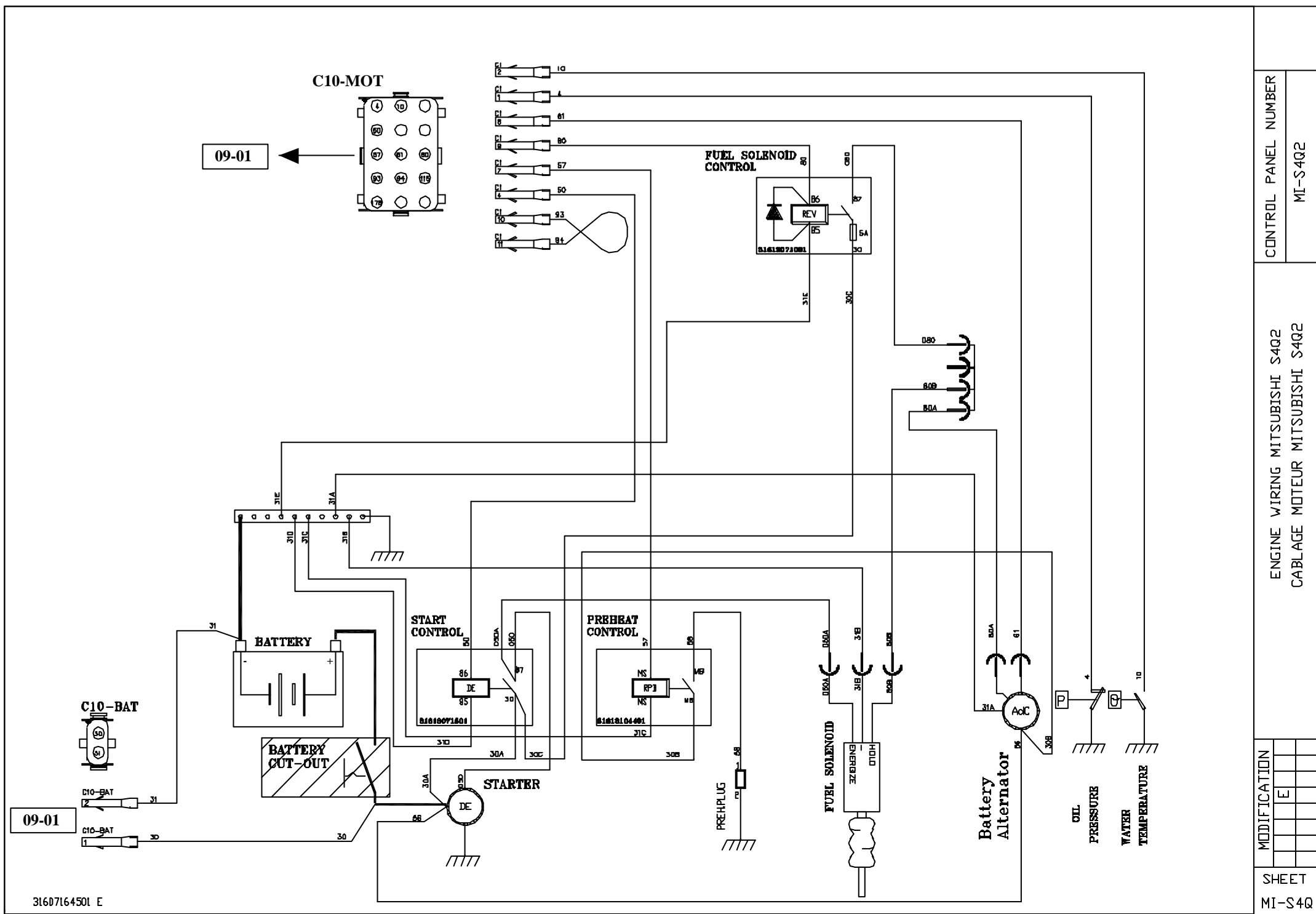


CONTROL PANEL NUMBER
MI-S3/S4L2

ENGINE WIRING MITSUBISHI S3/S4L2
CABLAG MOTEUR MITSUBISHI S3/S4L2

MODIFICATION
C

SHEET
MI-S4L



CONTROL PANEL NUMBER	
MI-S4Q2	
ENGINE WIRING MITSUBISHI S4Q2 CABLAGE MOTEUR MITSUBISHI S4Q2	
MODIFICATION	
E	
SHEET	
MI-S4Q	

Use and maintenance manual

Volvo Generating set and industrial engines

4 - 6 litre (non-EDC)
TAD 740 GE / 1032 GE /
1630 GE / 1631 GE -
TWD 740 GE / 1210 GE /
1232 GE / 1630 GE

Réf. constructeur : 7739614

Réf. GPAO : 33522045201

Preface

Volvo Penta industrial engines are used all over the world, in both mobile and stationary applications, in all conceivable service conditions. This is not a coincidence.

After 90 years of manufacturing engines, the name Volvo Penta has come to symbolise reliability, technical innovation, first class performance and long life. We believe that this also reflects what you require and expect from your new Volvo Penta industrial engine.

In order to fully meet your expectations, we ask you to read this Instruction Book carefully before starting the engine.

Best regards

AB VOLVO PENTA



Engine data

Engine designation Product number

Serial No.

Disengageable clutch, type/no.

Local Volvo Penta service workshop

Name Tel

Address

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CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.


Safety Information

Read this chapter carefully. It concerns your safety. This chapter describes how safety information is presented in the Instruction Manual and on the engine itself. It also gives a general account of basic safety precautions to be taken when maintaining the engine.

Check that you have the correct Instruction Manual before you read on. If this is not the case, please contact your Volvo Penta dealer.




If operations are performed incorrectly, this could result in personal injury, or damage to property or the engine. Read the Instruction Manual carefully before operating or servicing the engine. If anything is unclear, please contact your Volvo Penta dealer for assistance.


 This symbol is used in the book and on the engine to make you aware of safety information. Always read these safety precautions very carefully.

In the Instruction Manual warning texts have the following priority:

 **WARNING!** If these instructions are not followed, there is a danger of personal injury, extensive damage to the product or serious mechanical malfunction.

 **IMPORTANT!** Used to draw your attention to something that can cause damage, product malfunction or damage to property.

NOTE! Used to draw your attention to important information that will facilitate work or operations.

 This symbol is used in certain cases on our products and refers to important information in the Instruction Manual. Ensure that warning and information symbols on the engine and transmission are always visible and legible. Replace symbols that have been damaged or painted over.

Safety precautions for operation and maintenance

Daily checklist

Make a habit of checking the engine and engine compartment visually before operating (**before the engine is started**) and after operating (**after the engine has been stopped**). This will help you to quickly detect fuel, coolant or oil leaks and spot anything else unusual that has happened or is about to happen.

Refuelling

When refuelling, there is a danger of fire and explosion. Smoking is forbidden and the engine must be switched off.

Never overfill the tank. Close the fuel tank filler cap properly.

Only use the fuel recommended in the Instruction Manual. The wrong grade of fuel can cause operating problems or cause the engine to stop. On a diesel engine, poor quality fuel may cause the fuel injection pump to seize and the engine to overrev with a resultant risk of damage to the engine and personal injury.

Carbon monoxide poisoning

Start the engine only in a well-ventilated area. If operating the engine in an enclosed space, ensure that there is proper ventilation in order to remove exhaust gases and crankcase ventilation emissions from the working area.

Operation

The engine must not be run in areas where there are explosive materials or gases. Not all electrical and mechanical components are non-sparking.

Approaching a running engine is dangerous. Loose clothing, hair, fingers or a dropped tool may catch in the rotating parts of the engine and cause serious personal injury.

Engines are supplied without guards. After the engine is installed, all rotating and hot components must be protected where necessary for reasons of personal safety.

Starting lock

If the instrument panel does not have an ignition switch, the engine compartment must be lockable to prevent unauthorised persons from starting the engine. Alternatively, a lockable main switch can be used.

Maintenance and service

Knowledge

The Instruction Manual contains instructions on how to carry out general maintenance and service operations safely and correctly. Read the instructions carefully before starting work.

Service literature covering more complicated operations is available from your Volvo Penta dealer.

Never carry out any work on the engine if you are unsure of how it should be done. Contact your Volvo Penta dealer who will be glad to offer assistance.

Stop the engine

Stop the engine before opening or removing engine hatches. Unless otherwise specified, all maintenance and service must be carried out with the engine stopped.

To prevent accidental starting, remove the ignition key, turn off the power supply to the engine at the main switches and lock them in the OFF position before starting work. Put up a warning sign in the control position that work on the engine is being carried out.

Approaching or working on an engine that is running is a safety risk. Loose clothing, hair, fingers or a dropped tool may catch in the rotating parts of the engine and cause serious personal injury. Volvo Penta recommends that all servicing with the engine running be undertaken by an authorised Volvo Penta workshop.

Safety precautions for operation and maintenance (cont.)

Lifting the engine

When lifting the engine, use the lifting eyes installed on the engine. Always check that lifting equipment is in good condition and is strong enough for the lift (engine weight plus any extra equipment). For safety's sake lift the engine using an adjustable lifting beam. All chains and cables should run parallel to each other and as perpendicular as possible in relation to the top of the engine. Bear in mind that extra equipment installed on the engine may alter its centre of gravity. Special lifting equipment may then be required in order to maintain the correct balance and make the engine safe to handle. Never carry out work on an engine suspended on a hoist.

Before starting the engine

Reinstall all guards removed during service operations before starting the engine. Check that no tools or other items have been left on the engine.

Never start a turbocharger engine without installing the air filter. The rotating compressor in the turbocharger can cause serious personal injury. Foreign objects can also be sucked in and cause mechanical damage to the unit.

Fire and explosion

Fuel and lubrication oil

All fuel, most lubricants and many chemicals are inflammable. Read and follow the instructions on the packaging.

When carrying out work on the fuel system, make sure the engine is cold. A fuel spill onto a hot surface or electrical components can cause a fire.

Store fuel-soaked rags and other flammable material so that there is no danger of them catching fire. In certain conditions oil-soaked rags can spontaneously ignite.

Do not smoke when filling fuel or oil, or in proximity of a filling station or in the engine room.

Use of components other than Volvo Original replacement parts

Components used in the fuel and electrical systems on Volvo Penta products are designed and constructed to minimise the risk of fire and explosion.

Using non-original Volvo Penta parts can result in fire or explosion.

Batteries

The batteries contain and give off oxyhydrogen gas, especially during charging. This gas is easily ignited and highly flammable.

Do not under any circumstances smoke or use naked flame or allow sparks in the vicinity of the batteries or battery compartment.

Incorrectly connecting a battery terminal cable or jump-start cable can cause a spark which in turn can cause an explosion.

Start spray

Never use start spray or similar agents to start an engine equipped with air pre-heating (glow plugs / starter element). The starter element may cause an explosion in the inlet manifold. Danger of personal injury.

Hot surfaces and fluids

There is always a risk of burns when working with a hot engine. Beware of hot surfaces. For example: the exhaust pipe, turbocharger (TC), oil pan, charge air pipe, starter element, hot coolant and hot oil in oil lines and hoses.

Chemicals

Most chemicals such as anti-freeze, rustproofing agent, inhibiting oil, degreasing agent etc. are hazardous to health. Read and follow the instructions on the packaging.

Some chemicals such as inhibiting oil are inflammable and also dangerous if inhaled. Ensure good ventilation and use a protective mask when spraying. Read and follow the instructions on the packaging.

Store chemicals and other hazardous materials out of the reach of children. To protect the environment please dispose of used or leftover chemicals at a properly designated disposal point.

Lubrication system

Hot oil can cause burns. Avoid skin contact with hot oil. Ensure that the lubrication system is not under pressure before commencing work on it. Never start or operate the engine with the oil filler cap removed, as oil can spray out.

Cooling system

Avoid opening the coolant filler cap when the engine is hot. Steam or hot coolant can spray out and cause burns.

If work must be carried out with the engine at operating temperature and the coolant filler cap or a cock open or a coolant hose disconnected, open the coolant filler cap carefully and slowly to release pressure before removing the cap completely. Note that the coolant may still be hot and can cause burns.

Fuel injection system

Always use protective gloves when tracing leaks. Liquids ejected under pressure can penetrate body tissue and cause serious injury. There is a danger of blood poisoning.

Always cover the generator if it is located under the fuel filter. The generator can be damaged by spilled fuel.

Electrical system

Cutting off power

Always stop the engine and break the current using the main switches before working on the electrical system. Isolate external power to the engine block heater, battery charger, or accessories mounted on the engine.

Batteries

The batteries contain an extremely corrosive electrolyte. Protect your skin and clothes when charging or handling batteries. Always use protective goggles and gloves.

If battery electrolyte comes into contact with unprotected skin, wash off immediately using plenty of water and soap. If battery acid comes into contact with the eyes, flush immediately with plenty of water and obtain medical assistance without delay.

Welding

Remove the positive and negative leads from the batteries. Then remove all leads to the generator.

Always connect the weld clamp to the component to be welded and as close to the welding point as possible. The clamp should never be connected to the engine or in such a manner that the current is able to pass across any bearings.

When welding is complete: Always connect the leads to the generator **before** replacing the battery leads.

Introduction

This Instruction Manual has been compiled to help you get the most from your Volvo Penta industrial engine. It contains all the information you need in order to operate and maintain your engine safely and correctly. Please read the Instruction Manual carefully and learn how to operate the engine, controls and other equipment safely.

⚠ IMPORTANT! This Instruction Manual describes engines and equipment sold by Volvo Penta. For some applications there may be variations (appearance and function) of components such as controls and instrumentation. If this is the case, see the Instruction Manual for the relevant application.

Care of the environment

We all want to live in a clean and healthy environment. Where we can breathe clean air, see healthy trees, have clean water in our lakes and oceans and enjoy the sunshine without worrying about our health. Unfortunately this is no longer something we can take for granted. We must work hard together for the environment.

As a manufacturer of engines Volvo Penta has a particular responsibility. This is why concern for the environment is one of the cornerstones of our product development. Today great advances have been made in reducing exhaust emissions, fuel consumption and engine noise in Volvo Penta's wide range of engines.

We hope that you will take care to maintain these properties. Always follow the advice in the Instruction Manual about fuel grades, operation and service and you will avoid unnecessary damage to the environment. If you notice changes such as increased fuel consumption or exhaust smoke, please contact your Volvo Penta dealer.

Always dispose of environmentally harmful waste such as engine and transmission oil, coolant, old paint, degreasing agents, cleaning residue and old batteries at proper disposal points.

Together we can work to make a valuable contribution to a clean environment.

Running-in

The engine must be "run in" for its first 10 operating hours as follows:

Operate the engine normally. Do not operate it at full load except for short periods. Never run the engine at a constant engine speed for long periods during the running-in period.

The engine can be expected to use more engine oil during the running-in period (100–200 hours) than would otherwise be normal. Check the oil level more often than is normally recommended.

Make additional checks on the disengageable clutch (if installed) for the first few days. It may be necessary to adjust it to compensate for wear to the plates.

Fuel and oil types

Only use the fuel and oils recommended in this Instruction Manual (see the chapter "Service" under the heading fuel and lubrication systems). Using other grades of fuel and oil can cause operating problems, increased fuel consumption and, in the long term, a shorter engine service life.

Always change oil, oil filters and fuel filters at the recommended intervals.

Maintenance and replacement parts

Volvo Penta engines are designed for maximum service life and reliability. They are built to survive in challenging environments, but also to cause as little environmental impact as possible. Regular servicing and the use of Volvo Penta Genuine parts will maintain these properties.

Volvo Penta have a world-wide network of authorised dealers. They are specialists in Volvo Penta products and have accessories and the original replacement parts, test equipment and special tools necessary for high quality service and repair work.

Always follow the service intervals contained in this Instruction Manual and remember to quote the engine / transmission identification number when ordering service and replacement parts.

Certified engines

If you own an engine certified for any area where exhaust emissions are regulated by law, the following is important:


Certification means that an engine type is inspected and approved by the authorities. The engine manufacturer guarantees that all engines manufactured of that type correspond to the certified engine.

This places special requirements for maintenance and service as follows:

- The maintenance and service intervals recommended by Volvo Penta must be observed.
- Only genuine Volvo Penta replacement parts may be used.
- The service of injection pumps and injectors or pump settings must always be carried out by an authorised Volvo Penta workshop.
- The engine must not be modified in any way except with accessories and service kits developed for it by Volvo Penta.

- No modifications to the exhaust pipes and air supply ducts for the engine may be undertaken.
- Seals may only be broken by authorised personnel.

In addition the general instructions contained in the Instruction Manual concerning operation, service and maintenance must be followed.

 **IMPORTANT!** Late or inadequate maintenance / service or the use of spare parts other than Volvo Penta original spare parts will invalidate AB Volvo Penta's responsibility for the engine specification being in accordance with the certified variant.

Volvo Penta accepts no responsibility or liability for any damage or costs arising due to the above.

Warranty

Your new Volvo Penta industrial engine is covered by a limited warranty according to the conditions and instructions contained in the Warranty and Service book.

Note that AB Volvo Penta's liability is limited to that contained in the Warranty and Service Book. Read this book as soon as you take delivery of the engine. It contains important information about warranty cards, service and maintenance which you, the owner, must be aware of, check and carry out. Otherwise, liability covered in the warranty may be refused by AB Volvo Penta.

Contact your Volvo Penta dealer if you have not received a Warranty and Service Book and a customer copy of the warranty card.

Presentation

The instruction book covers industrial and generator set engines from 4 to 16 liter swept volume.

The engines are four-cycle, 6-cylinder in-line diesel engines with direct diesel injection (420/520 are 4-cylinder diesel engines). The engines have replaceable wet cylinder liners (the 420 does not have liners and the 620 has dry liners), and have turbochargers. All engines have piston cooling.

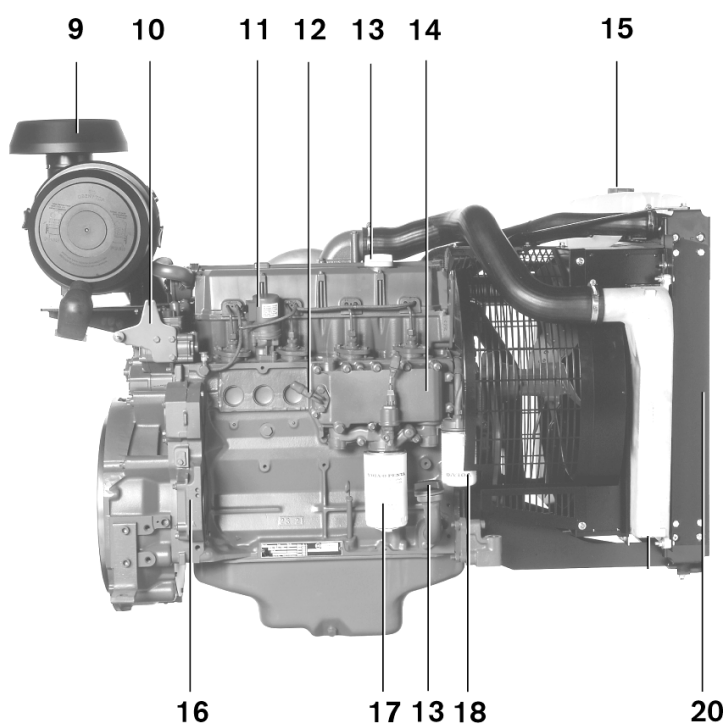
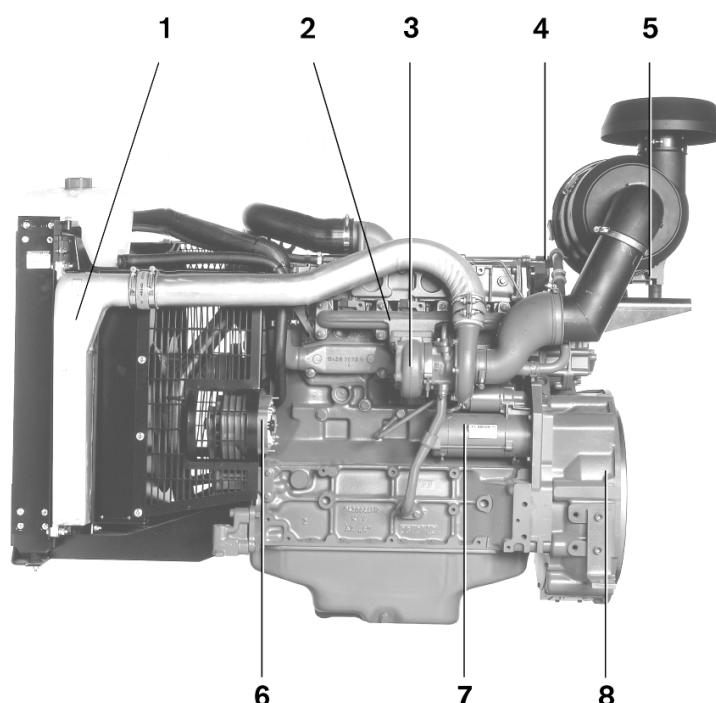
The TAD engines have an air-cooled intercooler, as distinct from the TWD engines, which have a water-cooled intercooler.

The charge air cooler (CAC) reduces the temperature of the intake air. This provides the cylinders with greater volumes of air. This makes a high power output possible while keeping the combustion and exhaust gas temperatures to appropriate levels. In addition, the emission of nitrous oxides is reduced.

The engines are equipped with an electrical starter element. This facilitates starting and reduces exhaust emissions in cold weather conditions. Does not apply for engines 520/720 (COM1).

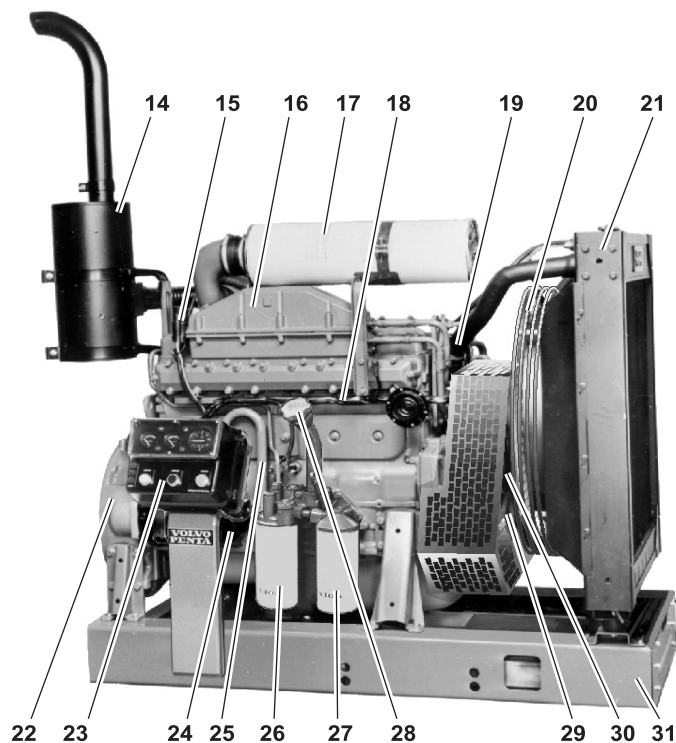
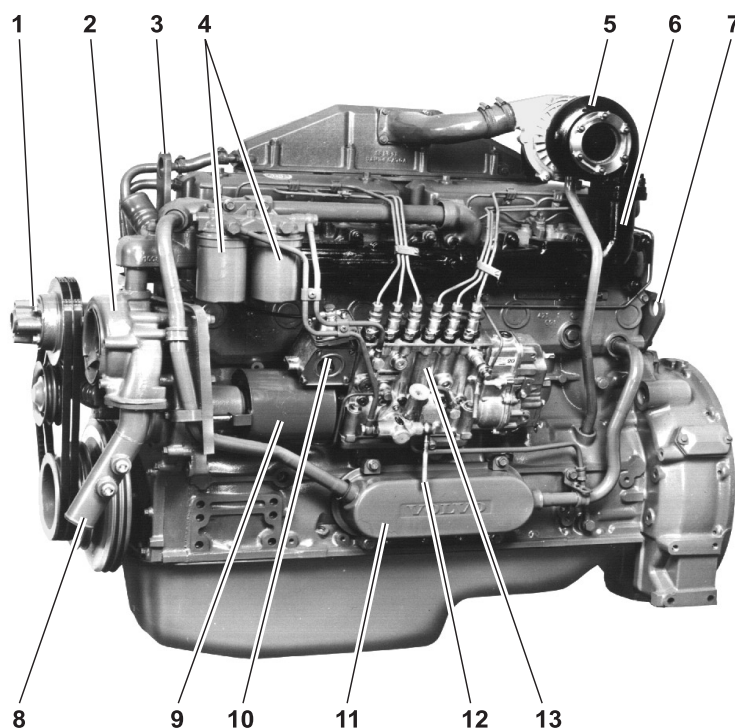
Examples of 4- and 5-litre engines

1. Charged air cooler
2. Exhaust manifold
3. Turbocharger
4. Closed crank case breather system
5. Air restriction indicator
6. Alternator
7. Starter motor
8. Flywheel housing SAE 3
9. Air filter
10. Fuel governor
11. Stop solenoid
12. Coolant heater (option)
13. Oil filling
14. Oil cooler
15. Exp. tank with filler cap
16. Engine transmission with PTO
17. Oil filter
18. Fuel filter
20. Radiator

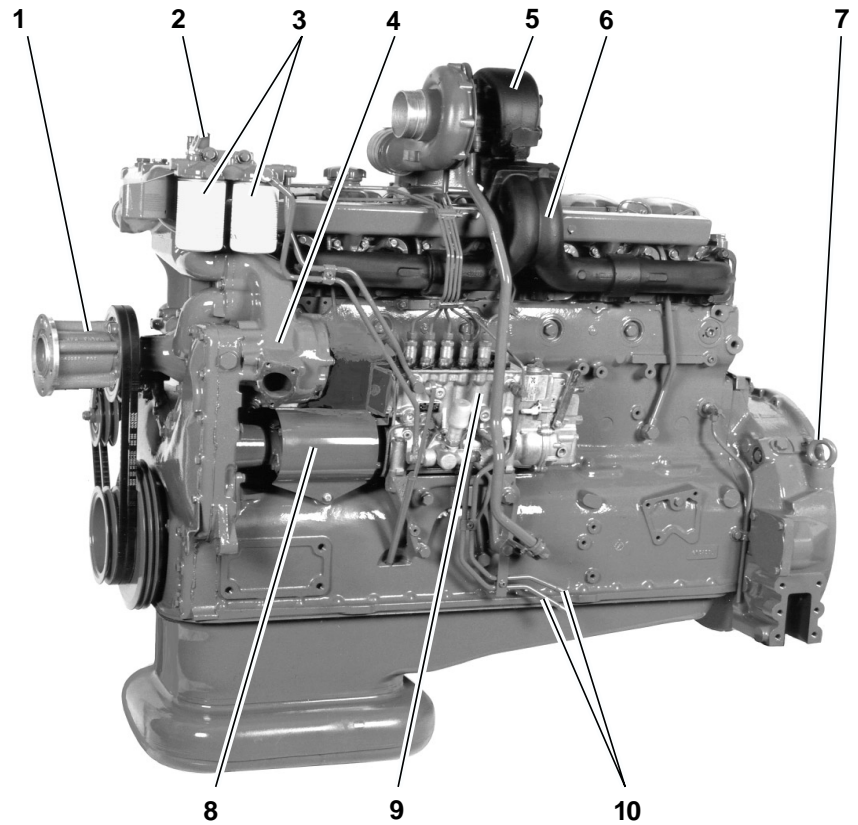


Examples of 6 and 7-litre engines

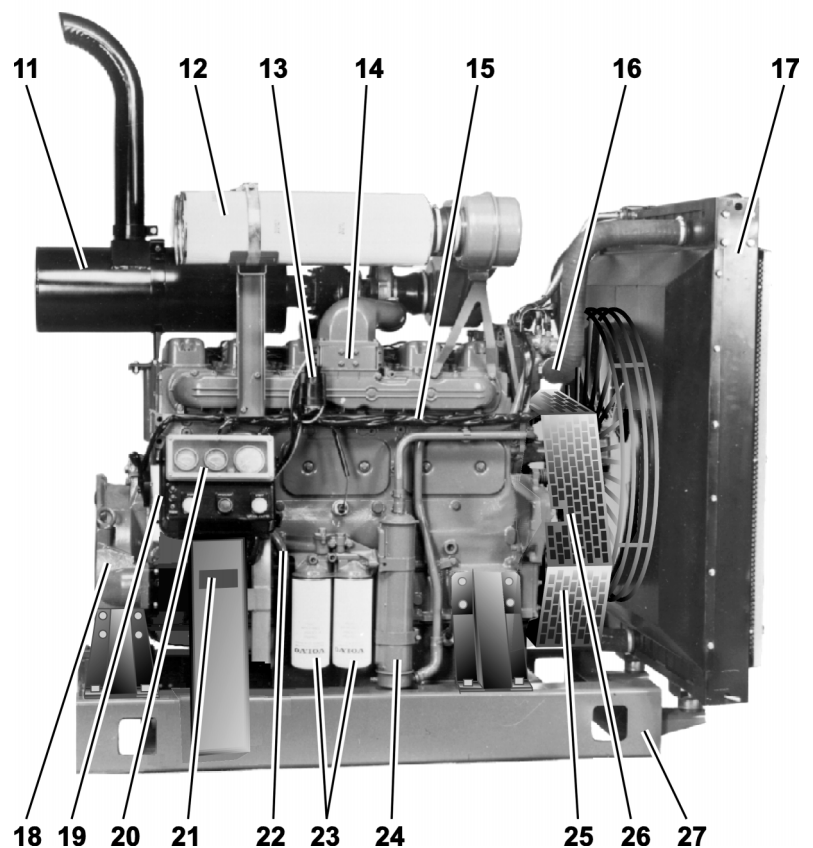
1. Fan hub
2. Gear-driven coolant pump
3. Lifting lug
4. Double fuel filter
5. Turbocharger
6. Air-cooled exhaust manifold
7. Lifting lug
8. Coolant pipe, inlet
9. Pump coupling guard
10. Smoke limiter
11. Oil cooler
12. Fuel line for tank connection
13. Injection pump
14. Muffler
15. Relay for electrical starter element
16. Electrical starter element
17. Air filter
18. Cable holder
19. Coolant pipe, outlet
20. Fan guard
21. Radiator
22. Flywheel cover
23. Instrument panel
24. Starter motor
25. Pipe for crankcase ventilation
26. Lubricating oil filter, full flow
27. Lubricating oil filter, part flow
28. Filler cap for lubricating oil
29. Vibration damper
30. Belt tensioner (automatic)
31. Frame



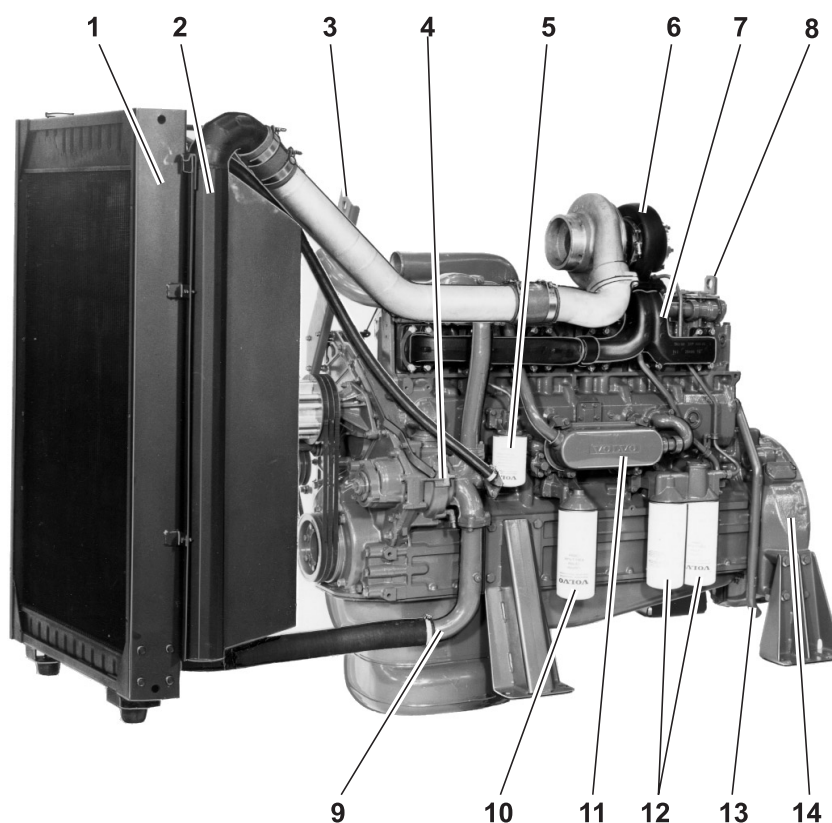
Examples of 10 and 12-litre engines



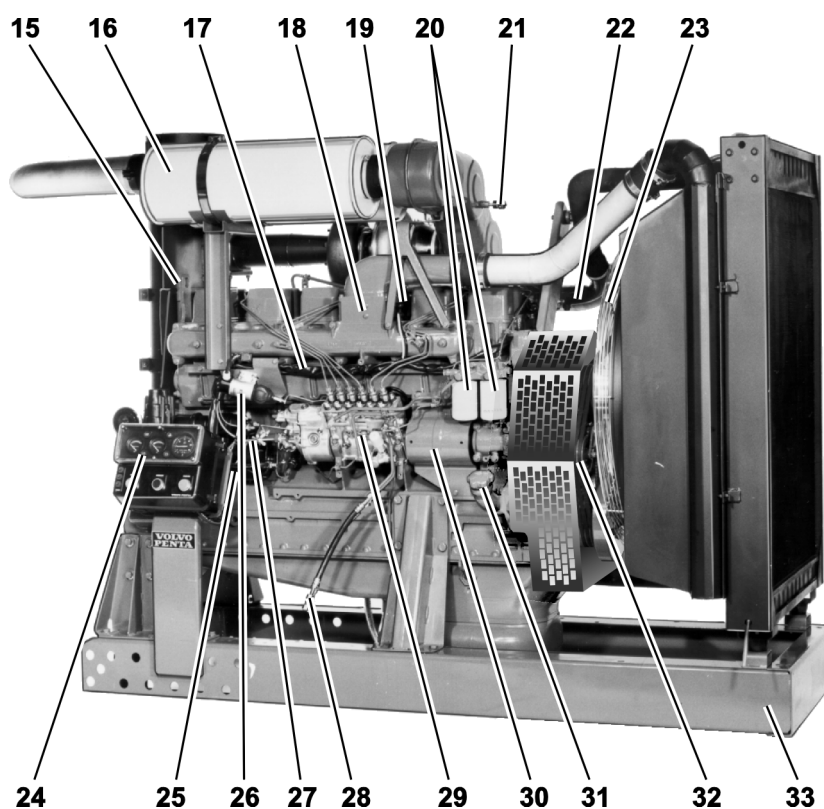
1. Fan hub
2. Lifting lug
3. Double fuel filter
4. Gear driven circulation pump
5. Turbocharger
6. Air-cooled exhaust manifold
7. Lifting lug
8. Pump coupling guard
9. Injection pump
10. Fuel line for tank connection
11. Muffler
12. Double air filters
13. Relay for electrical starter element
14. Electrical starter element
15. Cable holder
16. Coolant pipe, outlet
17. Radiator
18. Flywheel cover
19. Engine speed control
20. Instrument panel
21. Starter motor
22. Pipe for crankcase ventilation
23. Double lubricating oil filter, full flow
24. Oil cooler
25. Vibration damper
26. Belt tensioner (automatic)
27. Frame

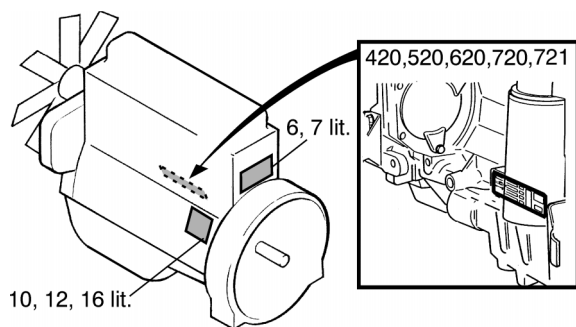


Examples of 16-litre engines



1. Radiator
2. Charge air cooler (CAC)
3. Bracket for radiator
4. Gear-driven coolant pump
5. Coolant filter
6. Turbocharger
7. Air-cooled exhaust manifold
8. Lifting lug
9. Coolant pipe, inlet
10. Lubricating oil filter, part flow
11. Oil cooler
12. Double lubricating oil filter, full flow
13. Pipe for crankcase ventilation
14. Flywheel cover
15. Muffler
16. Air filter
17. Cable holder
18. Electrical starter element
19. Relay for electrical starter element
20. Double fuel filter
21. Pressure drop indicator for air filter
22. Coolant pipe, outlet
23. Fan guard
24. Instrument panel
25. Starter motor
26. Stop solenoid
27. Engine speed control
28. Fuel line for tank connection
29. Injection pump
30. Pump coupling guard
31. Oil filler
32. Belt tensioner (automatic)
33. Frame





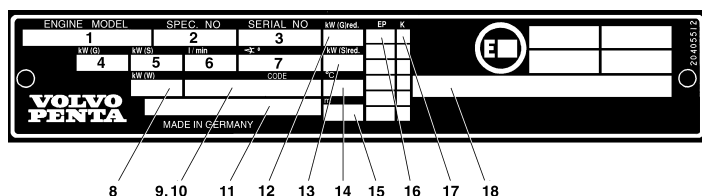
Identification numbers

The engines are supplied with two engine identification plates. One of these is supplied uninstalled so that it can be mounted in a suitable site close to the engine. The other plate is riveted to the cylinder block (see illustration).

The engine identification plate contains the serial number and engine designation. This information should always be used as a reference when ordering a service and replacement parts and when contacting your Volvo Penta workshop.

1	VOLVO PENTA	
2	ENGINE MODEL	XXXXXXXX
3	SPEC. NO.	XXXXXX
4	SERIAL NO.	XXXXXXXXXX
5	RATED NET POWER without fan kW/hp	XXX/XXX
6	with fan kW/hp	XXX/XXX
7	SPEED AT RATED POWER rpm	XXXX
	PRELIFT mm/INJ. TIMING	X,X+X,X/XX±X,X°
	MADE IN SWEDEN 3826077	

1. Engine designation
2. Product number
3. Serial No.
4. Rated gross power (without fan)
5. Rated net power (with fan), T(A)D420–721:Empty
6. Maximum engine speed (RPM)
7. Prelift/injection timing



Identification plates: TD/TAD420–721

8. Empty
- 9, 10. Manufacturer identification code
11. Indication of standard and/or regulation
12. Reduced "gross power", on-site conditions, items 14, 15
13. Reduced "continuous power", on-site conditions items 14, 15
14. Air temperature in °C. For the ambient conditions on site (but standard is 25°C)
15. Altitude above sea level in m. For the ambient conditions on site (but standard is 100 m)
16. Injection pump code
17. Piston class
18. kW (PRP), power

Engine designation

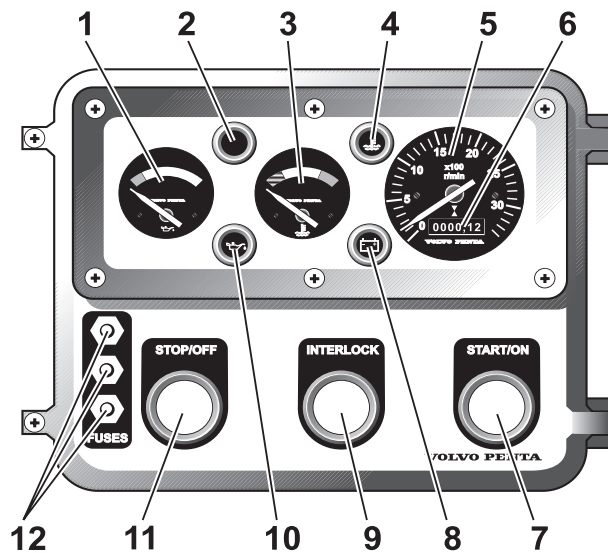
The following information can be read from the engine designation:

- T** = Turbocharged
- A** = Air-to-air charge air cooler (CAC)
- W** = Water-to-air charge air cooler (CAC)
- D** = Diesel engine
- 10** = Cylinder displacement, litres
- 3** = Generation
- 1** = Version
- V** = Engine for stationary and mobile application
- G** = Generating set engine
- E** = Emission certified engine

Instrumentation

This chapter describes the instrument box and the instrumentation in Volvo Penta's range. Variations in the appearance of instrumentation may occur in certain applications (mobile for example). If this is the case, see the Instruction Manual for the relevant application.

⚠ WARNING! If the instrument box does not have an ignition switch, the engine / operator compartment must have a lock to prevent unauthorised persons starting the engine. (Alternatively a lockable main switch can be used.)

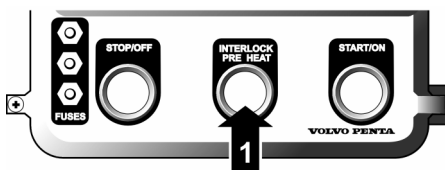
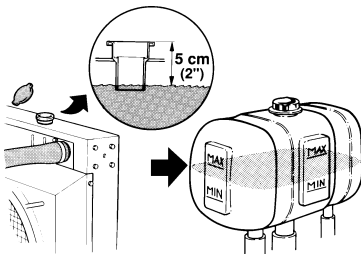
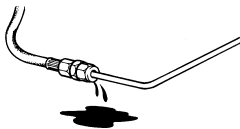
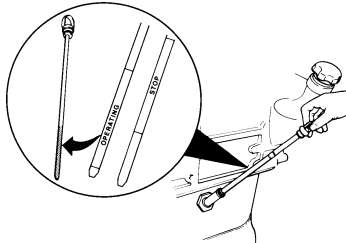


Instrument box

1. Oil pressure gauge. Normally within the green field (300–500 kPa).
2. Warning lamp: Low engine coolant level (accessory)
3. Engine coolant temperature gauge. Normally within the green field (70–95°C).
4. Warning lamp: High engine coolant temperature (accessory)
5. Tachometer
6. Operating hour counter
7. Starter button
8. Warning lamp: Generator not charging
9. Interlock: Press in the button to disengage the automatic stop for low oil pressure and to activate preheating.
10. Warning lamp: Low oil pressure (accessory)
11. Stop button
12. Semi-automatic fuses: Reset by pressing the button on the fuse

Starting the engine

Make a habit of checking the engine and engine compartment before starting the engine. This will help you to quickly detect anything unusual that has happened or is about to happen. Check that the instrument readings are normal after starting the engine.



Before starting the engine

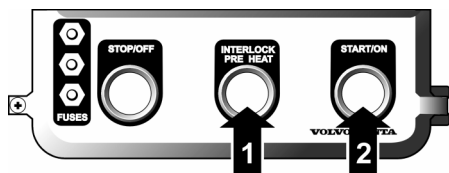
- Check that the oil level is between the MIN and MAX marks. See chapter "Maintenance, Lubrication system".
- Open the fuel cocks
- Check that there are no coolant, fuel or oil leaks.
- Check the air filter pressure drop indicator. See chapter "Maintenance, Engine, general".
- Check coolant level. Check that the outside of the radiator is not clogged. See chapter "Maintenance, Cooling system".
 - ⚠ **WARNING!** Do not open the engine coolant system filler cap when the engine is still hot. Steam or hot coolant may spray out.
- Switch on the main switches
 - ⚠ **IMPORTANT!** Never break the circuit with the main switch while the engine is running. This could damage the generator.
- Set the engine speed control to idle. Disengage the disengageable clutch/transmission.

Starting method

- ⚠ **WARNING!** Never use start spray or similar to start the engine. The starter element may cause an explosion in the inlet manifold. There is a risk of serious personal injury.

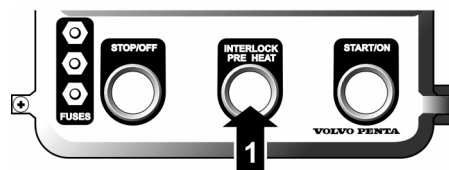
Instrument box:

1. Press the "Interlock button" (1) and check that the warning lamps in the instrument box are functioning. (This applies to engines equipped with alarm separators).



2. **If the engine is hot:** Press the “Interlock button” (1) and hold it in while pressing the Starter button (2).

If the engine is cold: Press the Interlock button (1) and hold it in for approximately 50 seconds to preheat the engine. Then press the “Start button” (2) as well.



3. Release the Start button immediately when the engine starts.

However the Interlock button must be held down for a further 5 seconds approximately. This is to allow the oil pressure to reach the correct level. Otherwise the automatic stop will engage and stop the engine.

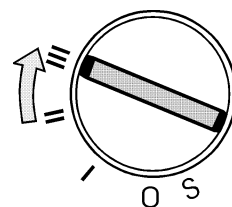
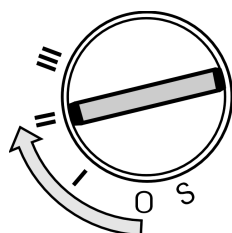
NOTE! In extreme cold, the preheating can be re-engaged for a few minutes after start if necessary. Hold the Interlock button (1) pressed in.

⚠ IMPORTANT! The start button must **never** be pressed in when the engine is running. The starter motor and starter gear on the flywheel may be seriously damaged.

4. Allow the engine to run at 500–700 rpm for the first 10 seconds. Then warm up the engine at low speed and low load.

⚠ IMPORTANT! Do not race the engine while it is cold.

NOTE! Generating set engines automatically rev up to the pre-set engine speed (1500 or 1800 rpm).



Volvo Penta starting lock:

1. **If the engine is hot:** Proceed directly to point 2.

If the engine is cold: Turn the ignition key to position “II” to engage the preheating. Hold the key in this position for approximately 50 seconds. (If the engine is equipped with a time relay for preheating, the key can be released. Preheating stops automatically after 50 seconds).

2. Turn the key to position “III”. Release the key to position “II” immediately when the engine starts. Hold the key in this position for approximately 5 seconds. This is to allow the oil pressure to reach the correct level. Otherwise the automatic stop will engage and stop the engine.

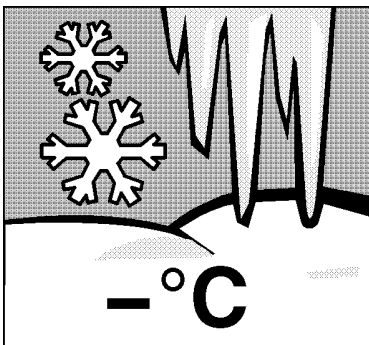
If the engine does not start, turn the key to the “O” position before trying again.

NOTE! In extreme cold, the preheating can be re-engaged for a few minutes after start if necessary. Hold the ignition key in position “II”.

3. Allow the engine to run at 500–700 rpm for the first 10 seconds. Then warm up the engine at low speed and low load.

⚠ IMPORTANT! Do not race the engine while it is cold.

NOTE! Generating set engines automatically rev up to the pre-set engine speed (1500 or 1800 rpm).



Starting the engine in extremely cold conditions

Preparations must be made to allow the engine to be started in extremely cold conditions.

Use a winter fuel (a proprietary brand) approved for the prevailing temperature. This reduces the risk of wax deposits in the fuel injection system. A fuel heater is recommended for extremely low temperatures.


Use a synthetic lubricating oil of a viscosity recommended for the prevailing temperature. See chapter “Lubrication system service”. Synthetic oils can withstand greater temperature ranges than mineral-based oils.

Preheat the engine coolant with a separate electrical engine block heater. In extreme cases a diesel engine block heater may be required. Ask your Volvo Penta service dealer for advice.


⚠ IMPORTANT! Ensure that the cooling system is filled with antifreeze. See chapter “Maintenance, Cooling system”.

Batteries must be in good condition. Cold reduces battery capacity. An increase in battery capacity may be necessary.


Starting the engine using auxiliary batteries

 **WARNING!** The batteries (auxiliary batteries in particular) contain extremely explosive oxyhydrogen gas. One spark, which may be formed if the auxiliary batteries are connected incorrectly, is sufficient to cause a battery to explode and cause damage and injury.

1. Check that the auxiliary batteries are connected (in series or in parallel) so that their rated voltage is the same as the engine's system voltage.
2. First connect the red jump lead (+) to the auxiliary battery, then to the discharged battery. Then connect the black jump lead (–) to the auxiliary battery, then to a **spot a short distance from the discharged batteries**, for example at the main switch on the negative cable or at the negative cable's connection to the starter motor.
3. Start the engine.

 **WARNING!** Do not shift the connections when attempting to start the engine (spark risk) and do not lean over any of the batteries.

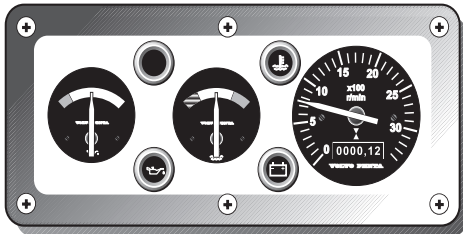
4. Remove the jump leads in exactly the opposite order to which you connected them.

 **WARNING!** Do not under any circumstances move the normal leads to the standard batteries.

Operation

Correct operation is the key to fuel economy and engine service life. Always allow the engine to achieve normal operating temperature before running it at full power. Avoid opening the throttle too quickly and running the engine at high engine speeds.

⚠ IMPORTANT! An automatic shut-off for oil pressure and engine coolant temperature (ECT) must be installed during unattended operation where the Volvo Penta instrument box is **not** being used.



Checking instruments

Check the instruments directly after starting the engine and then at regular intervals while operating the engine. The needles should be within the green range.

Engine coolant temperature: 75–95°C (167–203°F)

420, 620 VE: 83–95°C (181–203°F)

520, 720 GE: 83–95°C (181–203°F)

520, 720, 721 VE: 87–102°C (189–216°F)

Oil pressure, engine at operating temperature: 300–500 kPa. At engine idle this is normally lower.

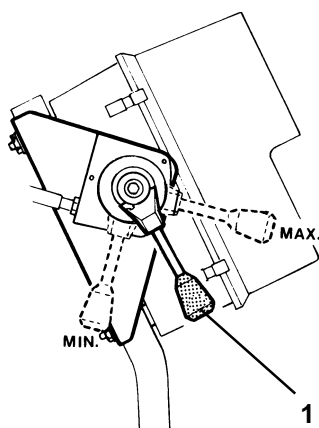
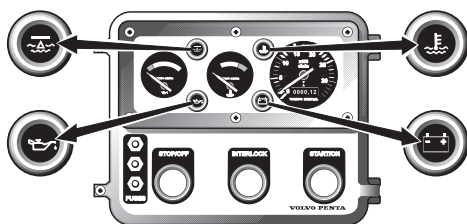
⚠ IMPORTANT! The lubricating oil level must be checked at least every eight hours if the engine is running continuously. See chapter “Maintenance, Lubricating system”.

Alarms and fault indications

If the Volvo Penta instrument box is used, the following applies:

- If oil pressure is too low or engine coolant temperature (ECT) too high, the engine stops automatically and the acoustic alarm goes off.
If the engine is equipped with an alarm separator, the relevant warning lamp also lights.
- If the engine coolant level is too low and the engine is equipped with an engine coolant level switch, the engine stops automatically and the acoustic alarm goes off. The warning lamp lights.
- If generator charging drops, the warning lamp lights.

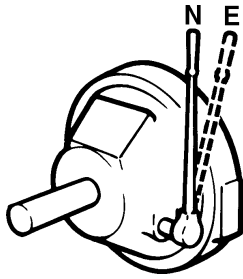
For other applications see the Instruction Manual for the relevant application.



Engine speed control

Power pack: The engine speed (RPM) is adjusted using the mechanical engine speed control (1). This is mounted on the instrument box.

Other engines: See the relevant instruction manual.



Disengageable clutch

The clutch is disengaged when the control lever is in position “N” and engaged when the lever is in position “E”.

⚠ IMPORTANT! The engine speed must not exceed 1000–1200 rpm during engagement and disengagement.

Operation at low loads

Avoid running the engine at idling speed or low loads for long periods. This can cause increased oil consumption and oil leakage from the exhaust manifold. (Oil passes the turbocharger seals and is drawn into the intake manifold with the charge air when turbocharger pressure is low.)

This leads to soot deposits on valves, piston crowns, exhaust outlets and the exhaust turbine.

At low loads the temperature of combustion is so low that fuel is not burnt up properly. This can lead to contamination of the lubricating oil with fuel and eventually leakage from the exhaust manifold.

In addition to normal inspections follow the points below to avoid operating problems caused by running the engine at low loads.

- Operate the engine at low loads as little as possible. (If the engine is tested without load each week, limit running time to approximately five minutes).
- Operate the engine at full load for approximately four hours once a year. This will burn off soot deposits in the engine and exhaust system.

Stopping the engine

In the case of extended inactivity, the engine must be run to operating temperature at least once every 14 days. This prevents corrosion in the engine. If the engine will not be used for more than two months, inhibiting should be carried out: Refer to chapter "Shut down".

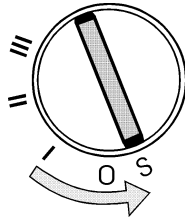
⚠ IMPORTANT! If there is a risk of frost, the cooling system coolant must have sufficient antifreeze. See chapter "Maintenance, Cooling system". A poorly charged battery may burst as a result of freezing.



Before stopping the engine

Let the engine run without load at 1300–1500 rpm for a few minutes before stopping. This will even out the engine temperature and prevent overheating.

⚠ IMPORTANT! This is especially important if the engine has been operated at high engine speeds and/or loads.

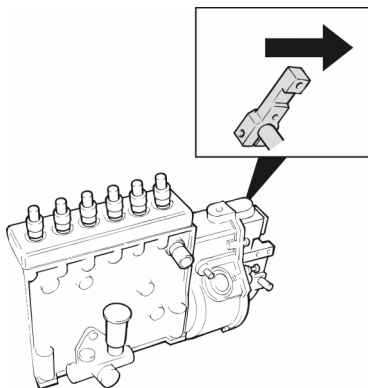
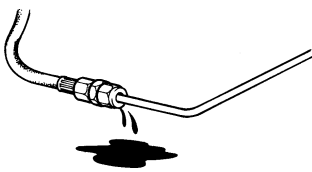


Stopping

- Disengage the engine (if possible).
- Press in the stop button and hold it depressed until the engine has stopped. Alternatively, turn the key to stop position "S". Release the key when the engine has stopped.

After stopping the engine

- Inspect the engine and engine compartment for any leaks.
- Close the fuel cocks.
- Switch off the main switch if the engine will not be used for some time.
- Read off the operating hour counter. Carry out the required service according to the maintenance schedule.




Emergency stop


If the engine cannot be stopped normally, it can be stopped by moving the lever on the fuel injection pump backwards.

⚠ WARNING! Approaching or working on a running engine is dangerous. Watch out for rotating components and hot surfaces.

Maintenance schedule

To achieve maximum operating safety and service life, it is vital that the engine is regularly serviced. By following the service recommendations, engine quality is retained and unnecessary environmental damage avoided.

 **WARNING!** Read the chapter on "Maintenance" carefully before starting service work. It contains instructions on how to carry out the work safely and correctly.

 **IMPORTANT!** Service operations marked ☐ must be carried out by an authorised Volvo Penta Service workshop.

DAILY BEFORE STARTING FOR FIRST TIME

- Engine oil. Level checks ¹⁾ page 27
- Coolant. Level checks page 30
- Radiator. External check and cleaning page 33
- Air filter indicator. Check ^{1, 2, 3)} page 23
- Leakage check. Engine not shown

¹⁾ When in continuous use the oil level should be checked every 8 hours.

²⁾ The air filter should be replaced when the gauge remains in the red field after the engine has been stopped.

³⁾ When operating in extremely dirty conditions special air filters must be used.

AFTER THE FIRST 100–200 OPERATING HOURS ¹⁾

- ☐ Valve clearance. Check not shown
- ☐ Injectors. Post tightening (50 Nm) not shown

¹⁾ 300 operational hours apply for TAD / TWD 1630 and 1631.

EVERY 50 HOURS

- Fuel pre-filter. Drain water page 35
- Battery. Check electrolyte level page 38
- Disengagement bearing. Lubricating ¹⁾ page 45

¹⁾ Applies to disengageable clutch when clutch operations exceed 15–20 operations per day. Otherwise every 400 hours.

EVERY 6 MONTHS

- Coolant filter. Replace ¹⁾ page 33

¹⁾ The filter should not be changed when replacing coolant.

EVERY 50-600 HOURS OR AT LEAST EVERY 12 MONTHS

- Engine oil and oil filter. Replace ¹⁾ page 26–27
- Disengageable clutch. Lubrication ²⁾ page 45
- Disengageable clutch. Adjustment ²⁾ page 45

¹⁾ Variable replacement intervals depending on oil quality and fuel sulphur content. See page 26.

²⁾ Every 200 hour.

EVERY 400 HOURS (420–720, EVERY 500 HOURS)

- Drive belts. Checking and adjusting not shown
- Fuel tank (sludge collector). Drain not shown

EVERY 500 HOURS

- Coolant (Anti-corrosion mixture). Addition ¹⁾ page 28–29

¹⁾ Add half a litre of anti-corrosion agent if the cooling system is filled with an anti-corrosion mixture.

EVERY 800 HOURS (420–720, EVERY 1000 HOURS)

- Fuel filter. Replace page 34
- Fuel pre-filter. Replace page 35
- Air lines. Leakage check. page 23

EVERY 1200 HOURS (420–720, EVERY 1500 HOURS)

- ☐ Valve clearance. Adjustment not shown

EVERY 2000 HOURS OR AT LEAST EVERY 12 MONTHS

- Air filter for air compressor. Replace page 45
- Charge air cooler. Cleaning (TAD-engines) ²⁾ page 33
- Coolant (Anti-corrosion mixture). Replace page 28–29

EVERY 2400 HOURS

- ☐ Injectors. Check ³⁾ not shown
- ☐ Turbocharger. Check not shown
- ☐ Engine and equipment. General check not shown

EVERY 5000 HOURS OR AT LEAST EVERY TWO YEARS

- Coolant (Glycol mixture). Replace ¹⁾ page 28–29

¹⁾ If the engine is equipped with coolant filters, extended intervals apply between replacement.
See pages 28-33.

²⁾ When operating in extremely dirty conditions, must cleaning be carried out often.

³⁾ 420–721 Every 3000 hours.

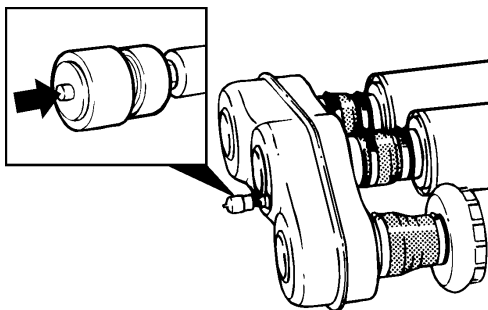
Maintenance

This chapter describes how to carry out the above maintenance. Read the instructions carefully before starting work. Maintenance intervals are contained in the chapter above. Maintenance schedule

⚠ WARNING! Read the safety precautions for maintenance and service in the chapter: Safety Information, before starting work.

⚠ WARNING! Unless otherwise specified all maintenance and service must be carried out with the engine stopped. Immobilise the engine by removing the ignition key, turning off the power supply with the main switch. Approaching or working on a running engine is dangerous. Watch out for rotating components and hot surfaces.

Engine, general



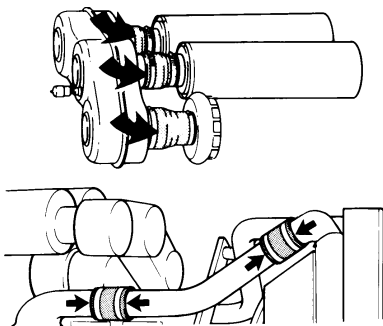
Air filter. Check / replace.

The air filter should be replaced when the indicator remains in the red field when the engine has stopped. Reset the gauge after replacing the indicator by pressing the button.

NOTE! The filter should not be touched until the indicator displays the red field. Scrap the old filter. Do not clean or reuse.

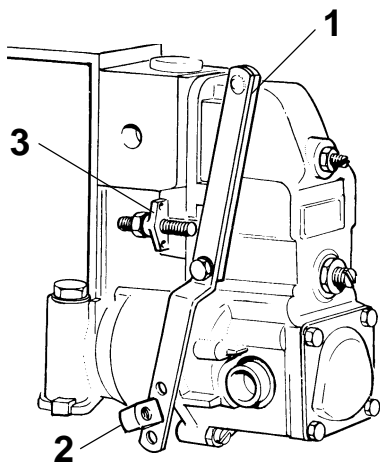
⚠ IMPORTANT! In continuous use the air cleaner should be checked every 8 hours.

When running in extremely dirty environments, coal mines and quarries for example, special air cleaners are required (not available from Volvo Penta).



Air lines. Leakage check.

Check the air lines for cracks or other damage. Replace if required. Checking all hose clamps.

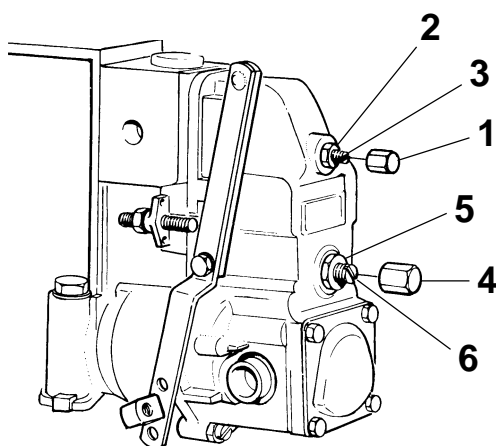


Idling speed. Adjustment

First check that the air filter is not clogged and that the throttle arm (1) on the fuel injection pump is against the idling speed stop (2) when the throttle mechanism is in idling position. Check also that the throttle arm presses against the max stop (3) when the throttle control is in the wide open throttle (WOT) position. Adjust the control if necessary.

Idling speed must only be checked and adjusted when the engine has reached normal operating temperature. For the correct idling speed, see the "Technical data" chapter.

⚠ WARNING! Approaching or working on a running engine is dangerous. Watch out for rotating components and hot surfaces.

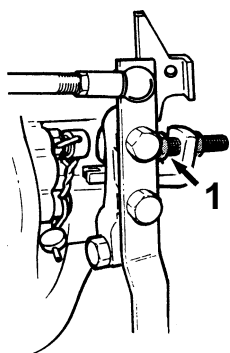


RSV governor

1. Allow the engine to operate at low idling speed.
2. If necessary, adjust the engine speed by removing the domed nut (1), slackening off the locknut (2) and adjusting the engine speed with the screw (3).

If the engine speed is uneven, the idle speed damping should be adjusted as follows:

1. Remove the domed nut (4) and slacken off the locknut (5). Carefully turn the damping screw (6) clockwise until the engine speed stabilises.
2. Check that the high idling speed has not changed. If it has changed, the damping screw (6) has been screwed in too far.
3. Lock the damping screw (6) and install the domed nut (4) when the adjustment is complete.



RQV, RQ governor

1. Allow the engine to operate at low idling speed.
2. If necessary, adjust the engine speed with the screw for low idling speed (1).

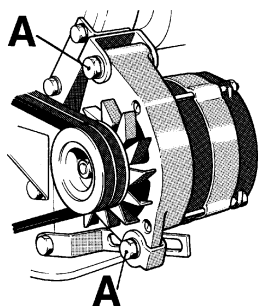
GAC governor

To adjust the idling speed on Generating set engines with GAC governor, refer to the separate documentation supplied with the GAC equipment.

Governor (Heinzmann)

The governors of the T(A)D 420–721 GE series engines are mechanical variable-speed governors with centrifugal measuring element of M/s Heinzmann.

All governor settings may only be conducted by trained specialists on a specifically laid out governor test bench.



Drive belts. Checking and adjusting

Inspection and adjustment should be carried out after running the engine when the belts are warm.

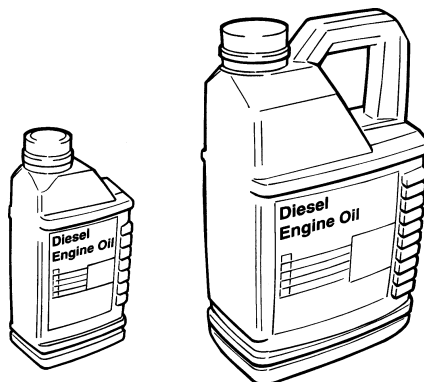
Undo the screws (A) before tensioning the generator belts. It should be possible to depress the belts 10 mm between the pulleys. Worn belts which work in pairs should be replaced at the same time.

The fan belts have an automatic belt tensioner and do not need adjusting. However, the condition of the belts must be checked. Replace if required.

Lubrication system

Oil change intervals can vary between **40 and 500 hours** depending on the quality of the lubricant and the sulphur content of the fuel. **Note that the oil change interval should never be longer than 12 months.**

If longer intervals are required than those stated in the table below, the condition of the oil must be tested regularly by the oil manufacturer.



Oil grade	Fuel sulphur content, % by weight		
	up to 0.5 %	0.5 – 1.0 %	more than 1.0 %
	Oil change interval: When running, first achieved		
VDS-2 (T(A)D420-721)	400 hours or 12 months. 500 hours or 12 months.	200 hours or 12 months. 250 hours or 12 months.	100 hours or 12 months. 125 hours or 12 months.
VDS (T(A)D420-721)	300 hours or 12 months. 500 hours or 12 months.	150 hours or 12 months. 250 hours or 12 months.	75 hours or 12 months.¹⁾ 125 hours or 12 months.¹⁾
ACEA E3, E2 API CD, CE, CF, CF-4, CG-4 (T(A)D420-721)	150 hours or 12 months. 500 hours or 12 months.	175 hours or 12 months. 250 hours or 12 months.	40 hours or 12 months.¹⁾ 125 hours or 12 months.¹⁾

NOTE! Mineral-based and semi and fully synthetic oils may be used as long as they fulfil the above requirements.

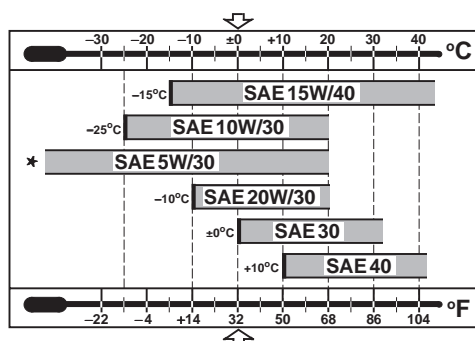
If the 6 and 7-litre engines are equipped with low profile type oil pans, the oil change interval must be halved.

¹⁾ Oil with TBN 14–20 must be used.

VDS = Volvo Drain Specification

ACEA = Association des Constructeurs Européenne d'Automobiles

API = American Petroleum Institute



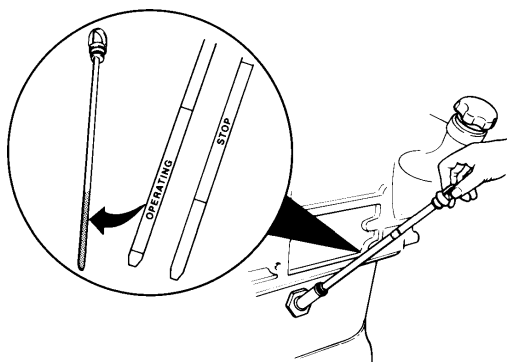
Viscosity

In a stable outside temperature viscosity should be selected from the table alongside.

*Refers to synthetic or semi-synthetic oil.

Oil change volumes

See chapter "Technical Data".



Oil level. Check

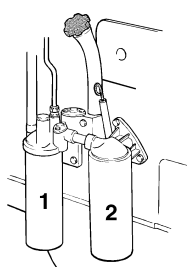
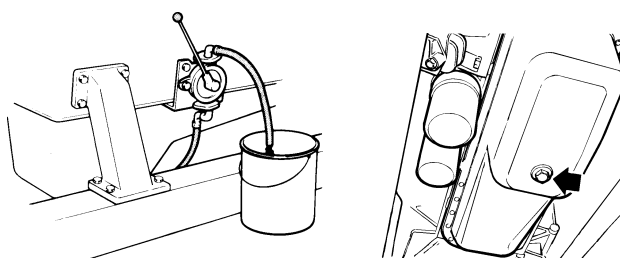
Ensure that the level lies between MIN and MAX markings.

⚠ IMPORTANT! In continuous use the oil level should be checked every 8 hours.

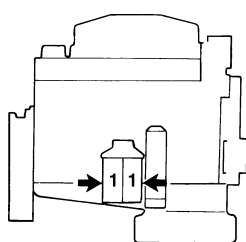
When checking the oil level on a stationary engine, read off the side of the dip stick marked "STOP" (**at earliest 3 minutes after engine stop**).

A check can also be carried out when the engine is running. Read off the dip stick side marked "OPERATING". (Does not apply for engines: TAD/TWD740GE, TD/TAD420-721, TAD1030GE)

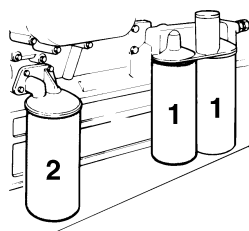
⚠ WARNING! Approaching or working on a running engine is dangerous. Watch out for rotating components and hot surfaces.



6, 7 lit.



10, 12 lit.



16 lit.

Oil and oil filters. Replace

Always follow the recommended oil change interval and always replace the oil filter at the same time. On stationary engines do **not** remove the bottom plug. Use an oil draining pump to suck up the oil.

1. Clean the oil filter bracket thoroughly to avoid dirt ingress when the new filter/s are installed.
2. Run engine to normal operating temperature.

⚠ WARNING! Hot oil and hot surfaces can cause burns.

3. Remove the bottom plug. Drain out engine oil.
4. Install the bottom plug together with a new gasket.
5. Remove the filters (1) and the bypass filter (2), where applicable. Check that the gaskets do not remain on the engine.
5. Fill the new filters with engine oil and spread oil on the gaskets. Screw the filter into place by hand until the gasket touches. Then twist a further half turn. **No more!**
6. Top up oil to correct level. **Do not fill above the MAX level.**
7. Start the engine and let it idle. Check that the oil pressure is normal.
8. Stop the engine. Check that there is no oil leakage around the filter. Top up if required.

Collect the old oil and oil filter and dispose of them at a proper disposal point.

Cooling system

The cooling system must be filled with a coolant that protects the engine against internal corrosion and from freezing if the climate requires it. **Never use water alone.**

The anti-corrosion additives become less effective over time. The coolant must be therefore be replaced. On the condition that Volvo Penta coolant recommendations are followed, the following replacement intervals apply.

Coolant	Replacement intervals
Volvo Penta coolant (glycol mixture) with coolant filter	Every 4 years or at least every 10.000 hours
Volvo Penta coolant (glycol mixture) without coolant filter	Every other year or at least every 5000 hours
Volvo Penta anti-corrosion agent	Every year

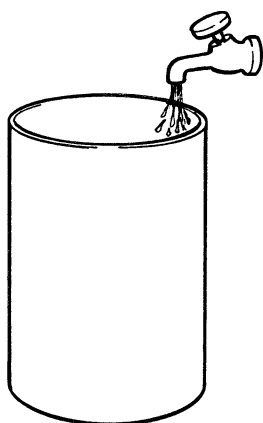
⚠ IMPORTANT! The cooling system must be flushed through when the coolant is replaced. See under heading "Cooling system Flushing". The coolant filter (accessory) must not be changed at the same time as the coolant. It must be replaced 6 months after the first coolant replacement and then every six months. See under heading "Coolant filter. Replace".

Coolant. General

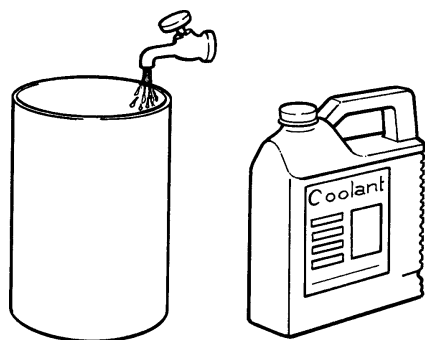
⚠ IMPORTANT! To avoid blockage and / or damage caused by freezing / corrosion to the engine and cooling system the following recommendations must be followed:

Water quality

Always use clean water which fulfils the requirements in ASTM D4985. If these requirements are not fulfilled, the cooling system will become blocked again with diminished cooling effect as a direct result. If water cannot be cleaned so these requirements are fulfilled, distilled water or ready mixed coolant **must** be used.



Total fixed particles	< 340 ppm
Total hardness	< 9.5° dH
Chloride	< 40 ppm
Sulphate	< 100 ppm
pH value	5.5–9
Silicon	< 20 mg SiO ₂ per l
Iron	< 0.10 ppm
Manganese	< 0.05 ppm
Conductivity	< 500 uS per cm
Organic content, COD _{Mn}	< 15mg KMnO ₄ per l



If there is a risk of freezing

Use a mixture of 50% Volvo Penta antifreeze (glycol) and 50% pure water (according to ASTM D4985). This mixture will protect against freezing to a temperature of approx. -40°C and should be used all year round.

⚠ IMPORTANT! Even if the temperature is never as low as -40°C , the above mixture ratios must be used. This is to ensure maximum anti-corrosion protection.

Mix the glycol with the water in a separate container before filling the cooling system.

⚠ WARNING! Glycol is harmful to health (dangerous if ingested).

⚠ IMPORTANT! Alcohol must not be used in the cooling system.



If there is no risk of freezing

When there is never a risk of freezing, water may (according to ASTM D4985) be used as coolant with the addition of the Volvo Penta anti-corrosion agent.

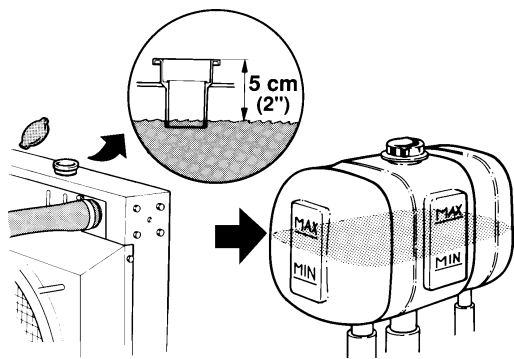
However, we recommend that a mixture of Volvo Penta glycol and pure water is used all year, regardless of the climate.

Mixture ratio 1:30. Run the engine to operating temperature after filling. This is to allow the additive to work as efficiently as possible.

If the operation time exceeds 500 hours per annum, the anti-corrosion agent for the coolant must be complemented with $\frac{1}{2}$ litre anti-corrosion agent every 500 hours.

⚠ WARNING! Anti-corrosion agents are harmful to health (dangerous if ingested).

⚠ IMPORTANT! Never mix antifreeze (glycol) and anti-corrosion agents. The two combined can produce foam and drastically reduce the coolant's effectiveness.



Coolant. Checking and topping up

⚠ WARNING! Except in an emergency, do not open the engine coolant system filler cap when the engine is still hot. Steam or hot coolant may spray out.

Check the coolant level daily before starting. Top up coolant if necessary. Fill to 5 cm below the filler cap sealing surface or between the MIN and MAX markings if a separate expansion tank is installed.

⚠ IMPORTANT! When topping up, use the same coolant mixture as is already in the cooling system.

Filling an empty system

Check that all the drain cocks are closed. Opening the bleed cock(s). 4–7 litre engines are self-venting. Therefore they have no bleed cock.

The locations of the drain and bleed cocks are displayed on the next page.

The engine must be stopped when filling. Fill slowly so that air is able to stream out through the bleed cock(s) and the filler opening.

If a heater system is connected to the engine's cooling system, the heater control valve must be opened and the unit vented during filling.

Fill with coolant to the correct level. **The engine must not be started until the system has been vented and completely filled.**

Start the engine and run it until the thermostat opens (this takes approximately 20 minutes). After start, open any bleed cocks briefly. This releases any trapped air. Check the coolant level and top up if necessary.

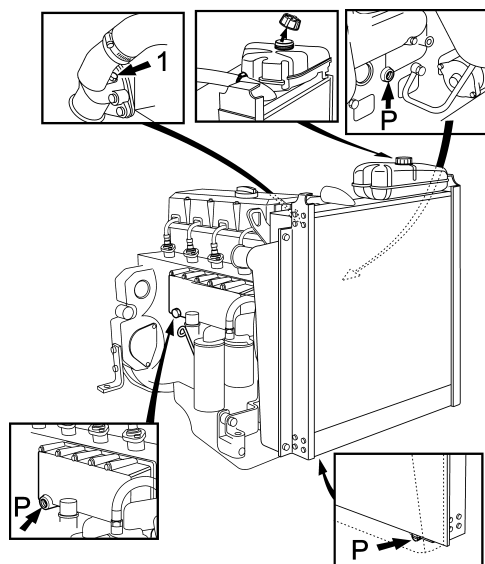
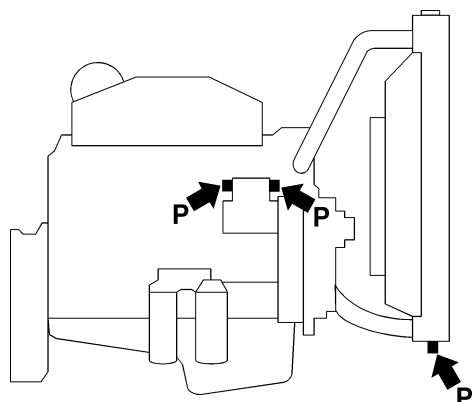
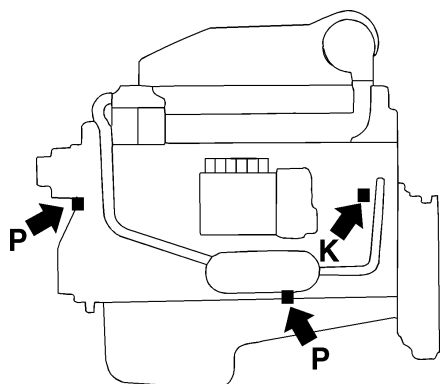
Coolant. Draining

Before draining the coolant, the engine must be stopped and the filler cap unscrewed.

⚠ WARNING! Except in an emergency, do not open the engine coolant system filler cap when the engine is still hot. Steam or hot coolant may spray out.

Open the drain cocks and remove the drain plugs (location is shown below). Unscrew and remove the coolant filter if one is installed.

⚠ IMPORTANT! There may be deposits inside the cocks/plugs. These must be removed. Check that all the coolant has drained out.



TD/TAD420–721

Drain/bleed cocks. Location

4–7 litre engines

Drain cock (K):

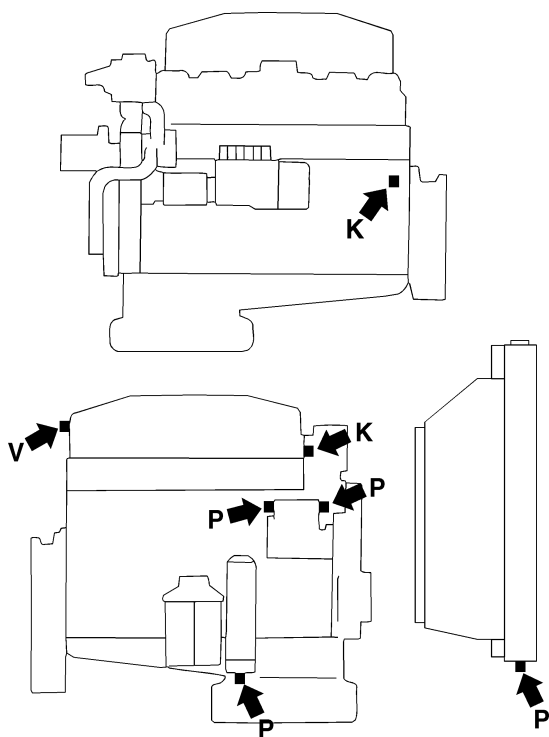
- on the left-hand side of the cylinder block, rear section (Does not apply for engine 420–721.)

Drain plugs (P):

- under the radiator
- beside cyl. 3 (TD/TAD420–721)
- under the coolant pump (Does not apply for 420–721)
- under the oil cooler
- 2 (at front and rear) on the air compressor, if installed (accessory) (Does not apply for 420–721)
- remove bottom radiator hose (Does not apply for 420–721)

Bleed cock (1):

- The engines are self-venting. Therefore they have no vent cock. (Does not apply for 420–721)
- On the coolant pump (TD/TAD420–721)



10–12 litre engines

Drain cocks (K):

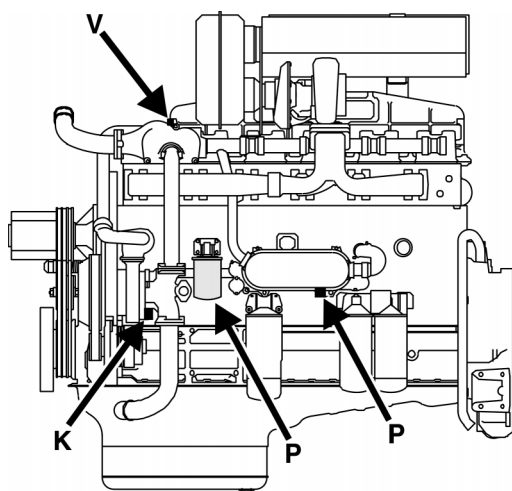
- at the rear of the left-hand side of the cylinder block
- charge air cooler, front (only TWD)

Drain plugs (P):

- under the radiator
- under the oil cooler
- 2 (at front and rear) on the air compressor, if installed (accessory)

Bleed cock (V):

- charge air cooler, rear (only TWD)



16 litre engines

Drain cocks (K):

- on the cylinder block above the starter motor
- under the rear edge of the coolant pump
- Charge air cooler, front end (only TWD)

Drain plugs (P):

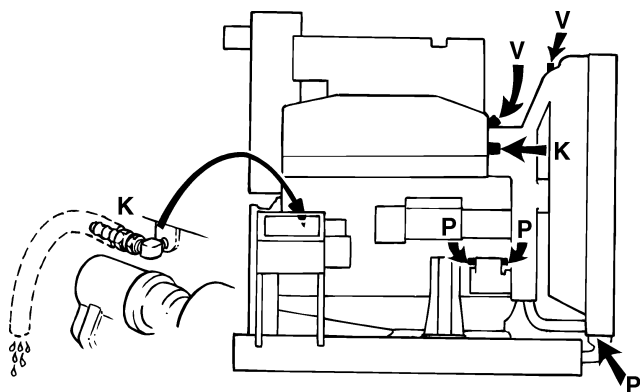
- under the radiator
- under the oil cooler
- 2 (at front and rear) on the air compressor, if installed

Coolant filter:

- behind the coolant pump

Bleed cock (V):

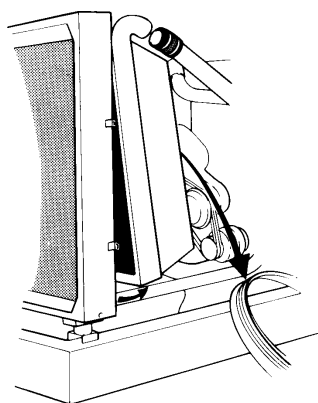
- TWD1630: Charge air cooler, at front
- TWD1630, TAD1630/1631: Radiator hose connection
- TAD1630/1631: Thermostat housing



Cooling system. Flushing

Cooling performance is reduced by deposits in the radiator and cooling channels. The cooling system must therefore be flushed through when the coolant is replaced.

1. Drain the coolant as above.
2. Insert a hose in the radiator filler opening and rinse out with freshwater until the water which runs out is completely clear.
3. Close the drain cock and plugs. Fill with new coolant according to the instructions in the section "Coolant. Checking and topping up"



Cooler (charge air cooler TAD). External cleaning

Remove the required guards to access the radiator.

Clean with water and a mild cleaning agent. Use a soft brush. Take care not to damage the cooling vanes. Reinstall components

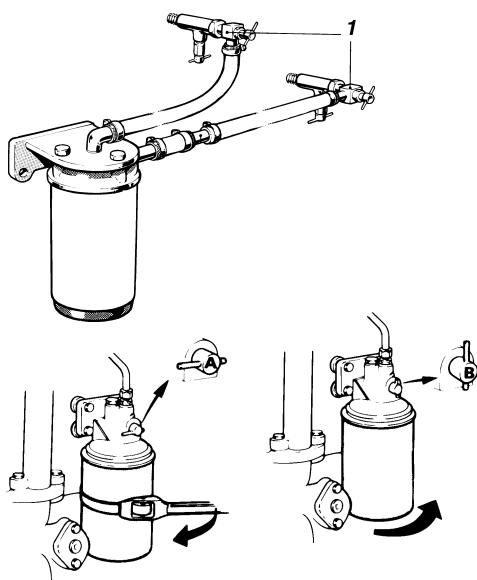
⚠ IMPORTANT! Do not use a high pressure hose.

Coolant filter. Replace

The coolant filter is only standard on 16-litre engines. For other engines, it is available as an optional extra. It has the task of filtering the coolant and providing anti-corrosion protection.

⚠ IMPORTANT! To prevent overdoses of anti-corrosion protection subsequently causing a blockage, the filter should **not** be replaced at the same time as the coolant, but 6 months after the first coolant replacement and then every 6 months.

Close the cocks (1) or turn the cock to position "A" (16-litre). Remove the filter with a suitable filter puller. Dampen the gasket and screw on new filter by hand. Tighten by 1/2 turn once the gasket is tight. Open the cocks (1) or turn the cock to position "B" (16-litre).



Fuel injection system

Only use recommended quality fuels according to the specifications below. Always observe strict cleanliness when refuelling and working on the fuel injection system.

All work on the engine injection pump or injectors must be carried out at an authorised workshop. **If the injection pump lead seal is broken, all warranties are invalid.**

⚠ WARNING! Fire risk. When carrying out work on the fuel system, make sure the engine is cold. A fuel spill onto a hot surface or an electrical component can cause a fire. Store fuel-soaked rags so that they cannot cause a fire.

Fuel specification

Fuel must meet national and international standards for marketed fuel, for example:

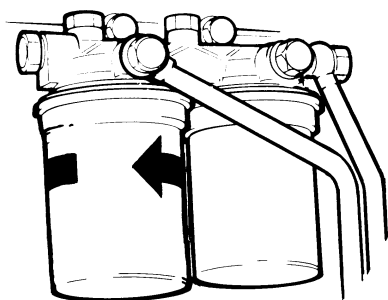
EN590 (with national environmental and cold weather standards)

ASTM-D975-No 1-D, 2-D

JIS KK 2204

Sulphur content: According to relevant national statutory requirement. If the sulphur content exceeds 0.5 % by weight the **oil change interval** should be changed, see section "Lubricating system".

Fuels with extremely low sulphur contents ("urban diesel" in Sweden and "city diesel" in Finland) may cause a drop in output of 5% and an increase in fuel consumption of 2–3%.



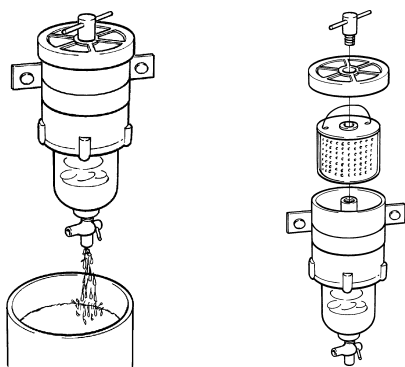
Fuel filter. Replace

Cleanliness! No dirt or contaminants may enter the fuel injection system.

⚠ WARNING! Fuel filter replacement should be carried out on a cold engine to avoid the risk of fire caused by fuel spilling onto hot surfaces.

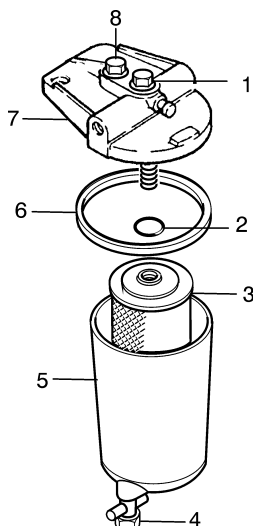
Remove the filters. Moisten the new filter gasket with a little oil. Screw the filter into place by hand until the gasket touches. And then a further half turn **but no more!** Bleed fuel system. **Take the old filter to a suitable disposal point.**

Start the engine and check for leaks.



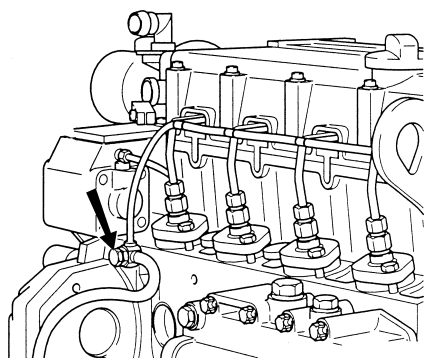
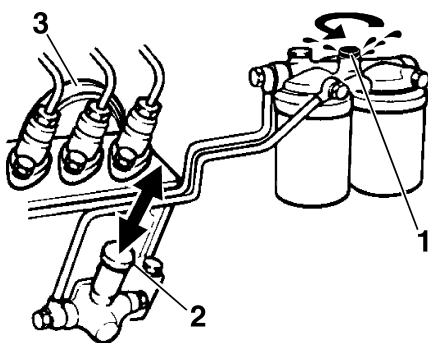
Cleaning: (Engines 420–721)

- Close fuel stopcock.
- Place the fuel pan beneath the preliminary fuel filter.
- Remove drain plug 4 and drain off fuel.
- Unscrew clamping screw 1, remove filter housing 5 with filter insert 3.
- Clean sealing surface of the filter bracket 7 and filter insert housing 5 of any dirt.
- Insert new sealing ring 6 and filter insert 3 (change as necessary).
– Push the filter insert up to approx. 3 cm over the edge of the housing onto the guide in the filter housing 5.
- Press filter housing 5 with filter insert 3 and sealing ring 6 against the filter console 7 and screw into place with clamping screw 1 (tightening torque 25 Nm).
Note: it must be possible to push the upper seal 2 on filter insert 3 over the guide bracket on filter console 7.
- Tighten drain plug 4.
- Open fuel stopcock.
- Check for leaks after the engine has been started.



Changing

- Replace defective filter insert 3.



TD/TAD520/720

Fuel pre-filter. Drain water (standard on 420–721)

The fuel pre-filter is an optional extra. Position a container under the fuel filter. Drain off water and contaminants using the cock/plug at the bottom.

⚠ IMPORTANT! Wait a few hours after the engine has been turned off before draining the filter.

Fuel pre-filter. Filter insert replacement

Close fuel cock at the fuel tank. Position a container under the fuel filter.

Unscrew the screw (1) to remove the cover. Replace insert and reinstall cover. Open fuel cock. Bleed fuel system. **Take the old filter to a suitable disposal point.**

Start the engine and check for leaks.

NOTE! Engines 420–721 have a fuel pre-filter that is possible to clean.

Fuel system Venting

The fuel system must be vented after fuel filters have been replaced or after refilling the fuel tank after it has been run dry.

Venting engines with stop solenoid/fuel shut-off valve connected to supply voltage at stop:

Ensure that the engine is in operational mode. Open the bleed screw (1). Pump with hand pump (2) until fuel containing no air flows out. Close screw while fuel is flowing out.

Then pump a further 15–20 times. Check for leaks.

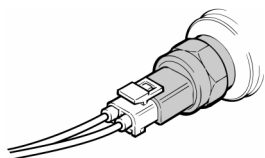
NOTE! For engines equipped with a fuel shut-off valve, the fuel injection pump often requires venting as well. This is done by slackening off the fuel injection pump pressure equaliser (3) (27 mm narrow U wrench). Pump with hand pump (2) until fuel containing no air flows out.

Engines 420–721:

Open the air-venting plug in the overflow valve. (See fig.) Crank the engine on the starter motor or use the manual feedpump (optional equip.) until the fuel flow is free from air. Close the plug while the fuel is still flowing.

NOTE! Do not loosen the injectors delivery pipes.

Venting engines with fuel shut-off valve connected to supply voltage during operation:



Is there “automatic stop in the event of too low oil pressure” with a Volvo Penta oil pressure switch? When the engine is off, this switch is closed (“Nc”- Normally closed).

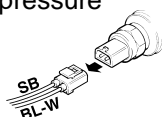
Yes

No

Disconnect the connector at the oil pressure switch.

SB= black

BL-W= blue-white



Is there “automatic stop in the event of too low oil pressure” with a non-Volvo Penta oil pressure switch that is open when the engine is off. (“No” = Normally open)

Yes

No

Is the engine equipped with a Volvo Penta instrument box?

Short-circuit the connector for the oil pressure switch with a loop.

Yes

No

Engines with a Volvo Penta instrument box

1. If there is a coolant level alarm – check the level. If the level is too low, the level alarm stops the engine.
2. Briefly press the “Starter button”. The instrumentation is now activated and the charge lamp lights. If there is a coolant level alarm: Hold in the “Interlock button” for approximately 4 seconds.
3. Vent the fuel system according to the instructions on the previous page.
4. Press the “Stop button”
5. Reconnect the connector
6. The engine is now operational

Engines with ignition switch

1. Turn the ignition switch to operating position / ignition. In Volvo Penta ignition switch position 1 (15+)
2. The solenoid valve is now activated for operation (not stop position)
3. Vent the fuel system according to the standard procedures (see the previous page).
4. The engine is now operational

Electrical system

⚠ WARNING! Always stop the engine and break the current using the main switch before working on the electrical system. Isolate battery charger, or other accessories mounted on the engine.

NOTE! NO ELECTRICAL SYSTEM AVAILABLE FOR ENGINES 420–721.

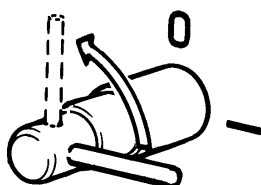


Fuses

The engine has automatic fuses located in the junction box. The fuses break the current when there is an overload in the electrical system.

If the engine cannot be started or the instruments stop operating during operation, the fuse may have tripped. Reset the fuse by pressing on the button on the fuse.

⚠ IMPORTANT! Always investigate the cause of an overload before resetting the fuse!



Main switch

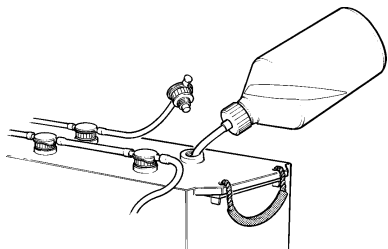
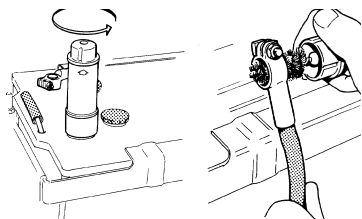
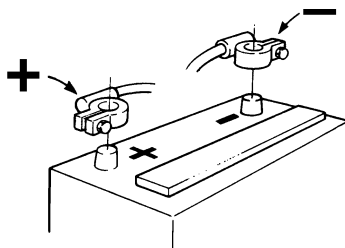
The main switch must never be turned off before the engine has stopped. If the circuit between the generator and the battery is cut off when the engine is running the generator can be seriously damaged.

⚠ IMPORTANT! Never break the circuit with the main switch while the engine is running.



Electrical connections

Also check that all electrical connections are dry and free of oxidation and that there are no loose connections. If necessary, spray these connections with a water-repellent spray (Volvo Penta Universal oil).



Battery. Maintenance and care

⚠ WARNING! Risk of fire and explosion. Never allow an open flame or electric sparks near the battery or batteries.

⚠ WARNING! Never mix up battery positive and negative terminals. This may cause sparks and an explosion.

⚠ WARNING! The battery electrolyte contains extremely corrosive sulphuric acid. Protect your skin and clothes when charging or handling batteries. Always use protective goggles and gloves. If battery electrolyte comes into contact with unprotected skin, wash off immediately using plenty of water and soap. If battery acid comes into contact with the eyes, flush immediately with plenty of water and obtain medical assistance without delay.

Connecting and disconnecting

First connect the red battery lead + to the battery + terminal. Then connect the black battery lead – to the battery – terminal.

When disconnecting the battery, disconnect the – lead (black) first and then the + lead (red).

Cleaning

Keep batteries dry and clean. Oxidation or dirt on the battery and battery terminals can cause short-circuits, voltage drop and discharge especially in damp weather. Clean the battery terminals and leads to remove oxidation using a brass brush. Tighten the cable terminals well and grease them with terminal grease or petroleum jelly.

Topping up

The electrolyte should be 5 – 10 mm over the plates in the battery. Top up using **distilled water** if necessary. Charge the battery after topping up for at least 30 minutes by running the engine at fast idle. **NOTE!** Certain maintenance-free batteries have special instructions which must be followed.

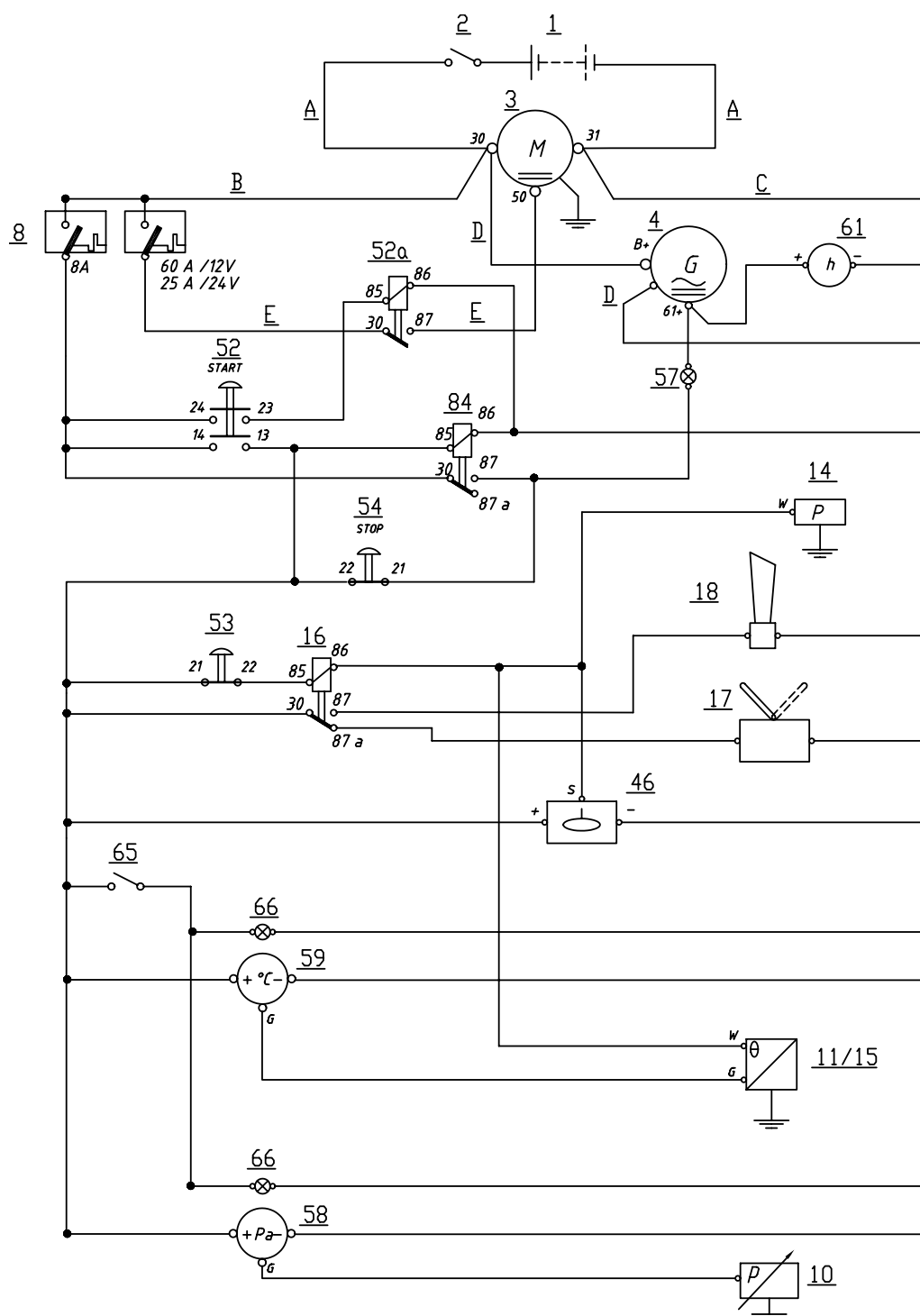
Wiring diagram, proposal (TD/TAD520, 720 engines)

1. Battery
2. Main switch
3. Starter motor
4. Alternator
8. Fuse
10. Oil pressur sender
11. Temp sender/switch engine
14. Oil pressure switch
15. Temp sender/switch engine
16. Relay
17. Stop solenoid

18. Signal horn
46. Water level switch (720-models)
52. Start button
- 52a. Start relay
53. Interlocking button
54. Stop button
57. Charging control lamp
58. Oil pressure gauge
59. Water temperature gauge
61. Hourmeter
65. Switch for instrument light
66. Instrument light
84. Holding current relay

Cable area

	12V	24V
A.	90 mm ²	70 mm ²
B.	10 mm ²	2.5 mm ²
C.	2.5 mm ²	2.5 mm ²
D.	10 mm ²	6 mm ²
E.	6 mm ²	2.5 mm ²
Not specified cable area 1 mm ²		

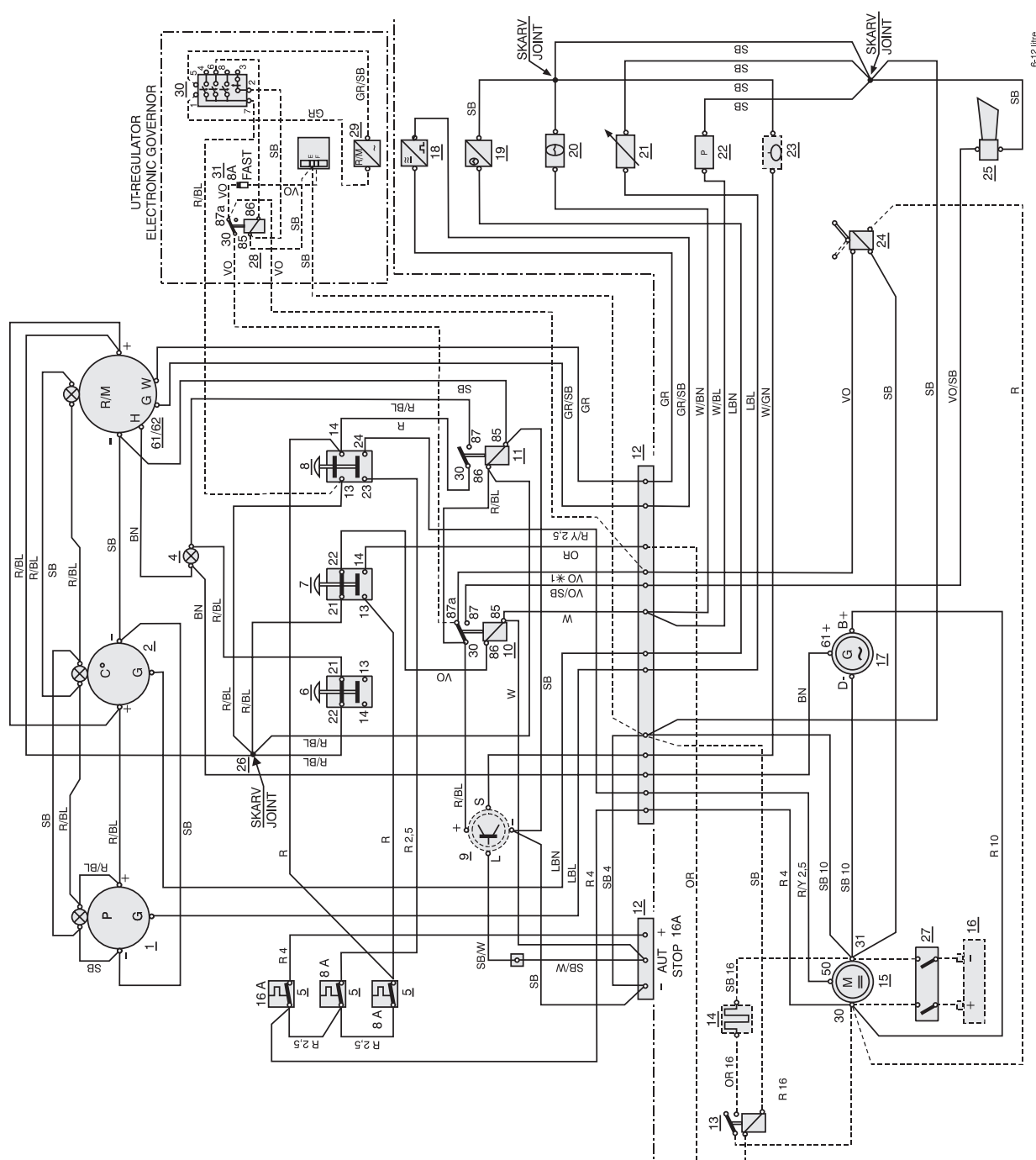


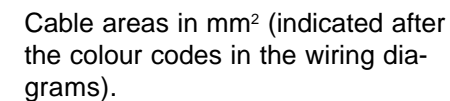
Wiring diagram (6–12 litre engines)

"Not for TD/TAD720"

1. Oil pressure gauge
2. Engine coolant temperature gauge
3. Tachometer with built-in hours run meter
4. Charge warning lamp
5. Semi-automatic fuses (manual resetting)
6. Stop button
7. Interlock
8. Starter button
9. Relay for engine coolant level switch (accessory)
10. Relay for engine coolant temperature (ECT) switch, oil pressure switch
11. Holding current relay (operating current and instruments)
12. Terminal block (auxiliary power output, with 16A fuse, output for automatic stop, closes in the event of a fault).
13. Relay for starter element
14. Starter element
15. Starter motor
16. Batteries
17. Generator
18. Engine speed (rpm) sensor
19. Engine coolant temperature sensor
20. Engine coolant temperature (ECT) switch (normally open)
21. Oil pressure sensor
22. Oil pressure switch (normally open)
23. Engine coolant level switch (accessory)
24. Stop solenoid (current bearing during operation)
25. Horn
26. Joint splice
27. Main switch
28. Engine speed (rpm) sensor
29. Relay
30. Engine speed governor
31. Fuse

*1 Remove when setting the UT governor





If no cable area is stated, the default is 1.5 mm²

Cable colour

BL = Blue
LBL = Light blue
BN = Brown
LBN = Light brown
GN = Green
GR = Grey
OR = Orange
VO = Violet
R = Red
SB = Black
W = White
Y = Yellow

The area of the battery leads depends on the location of the battery.

Distance starter motor – batteries

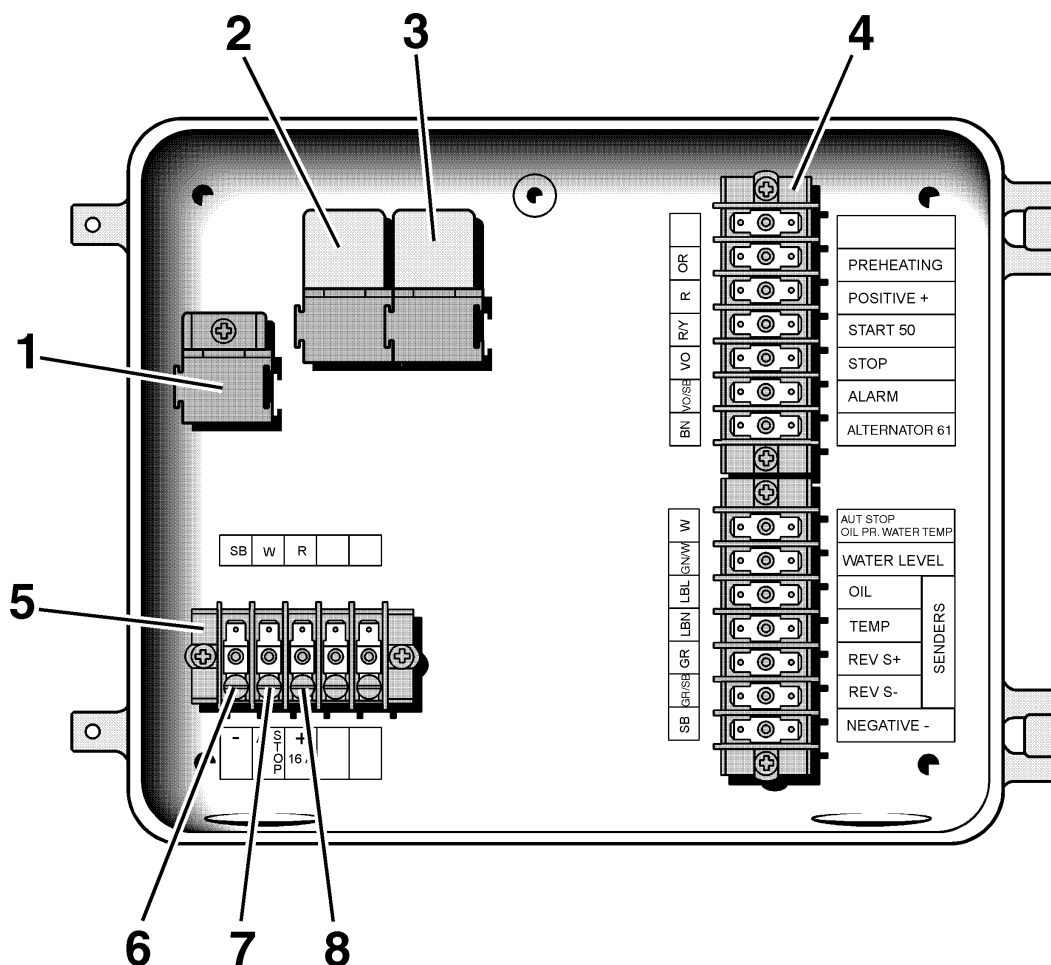
max. 2 m, area = 70 mm²
max. 4 m, area = 120 mm²

Conversions mm² / AWG*

* American Wiring Gauge

mm ²	AWG
1.0	16 (17)
1.5	15 (16)
2.5	13
10	7
16	5

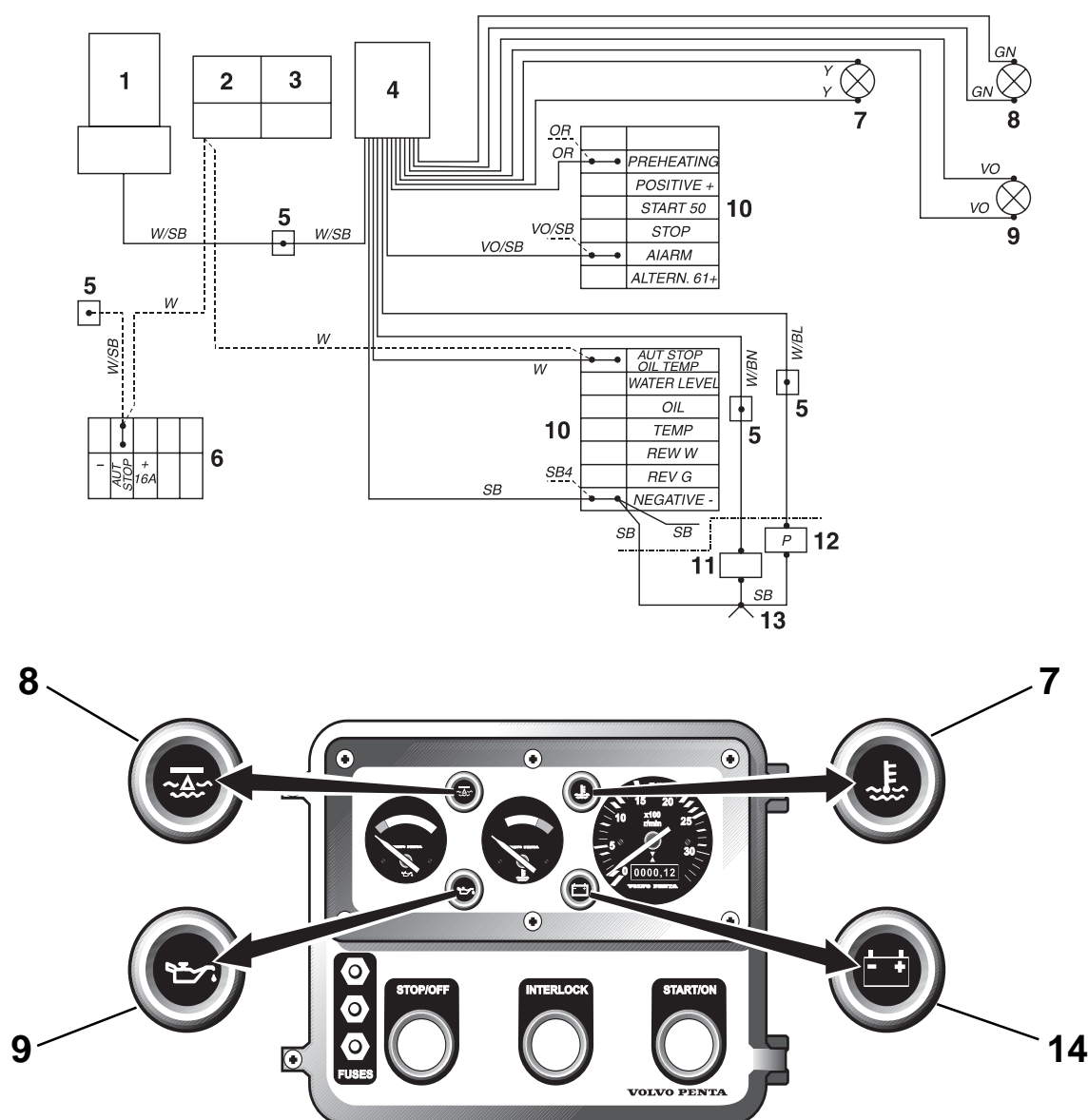
Instrument box



1. Location for level switch relay: coolant (accessory)
2. Relay for automatic stop: engine coolant temperature (ECT) switch, oil pressure switch and low coolant temperature switch (accessory).
3. Holding current relay (operating current and instruments)
4. Terminal block for engine cable harness

5. Terminal block for automatic stop and extra power output (maximum 16 A)
6. Negative (–) for extra power output (black cable)
7. Connection for any extra switches – automatic stop (white cable)
8. Positive (+) for extra power output (red cable) Maximum 16 A

Alarm separator for the instrument box (accessory)

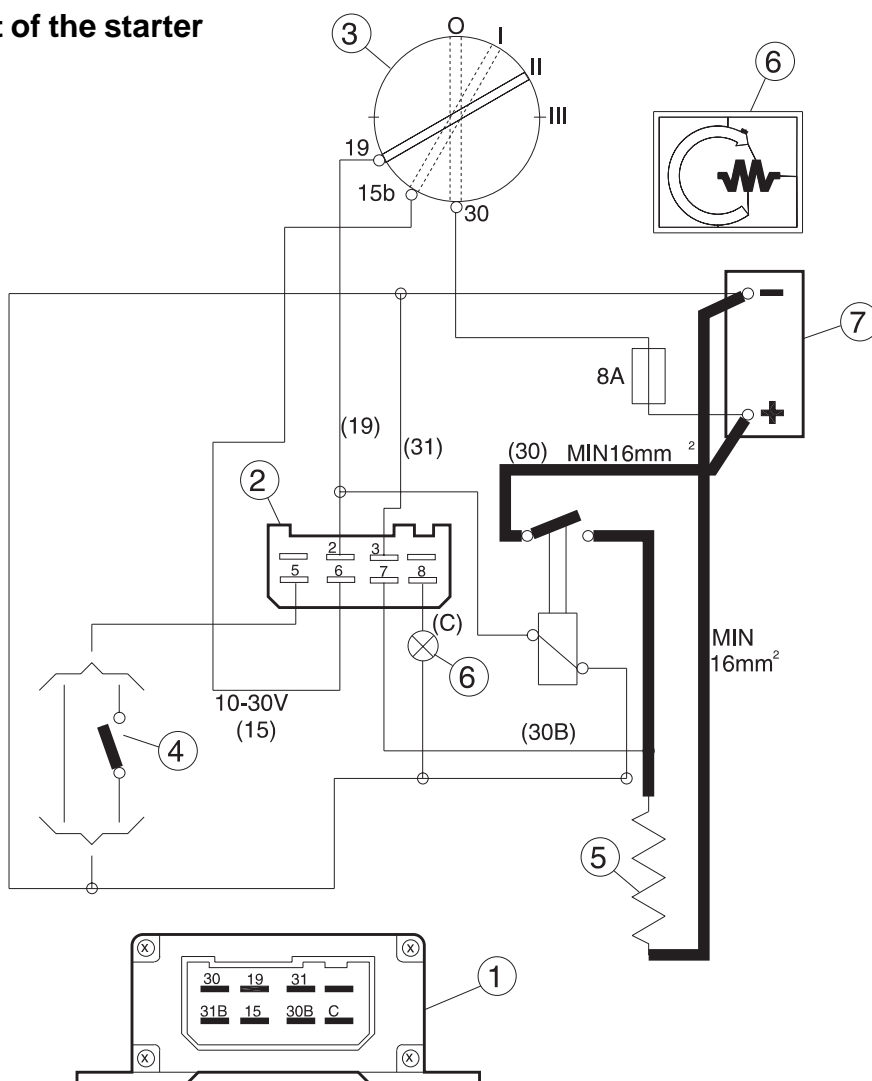


- | | |
|---|---|
| 1. Relay for engine coolant level switch (accessory) | 8. Warning lamp, low engine coolant level (accessory) |
| 2. Relay for engine coolant temperature (ECT) switch, oil pressure switch | 9. Warning lamp, low lubrication oil pressure (accessory) |
| 3. Holding current relay (operating current and instruments) | 10. Terminal block for engine cable harness |
| 4. Alarm separator | 11. Engine coolant temperature (ECT) switch (normally open) |
| 5. Splice section | 12. Oil pressure switch (normally open) |
| 6. Terminal block for auxiliary power output (16 A fuse) and output for automatic stop, (closes in the event of a fault). | 13. Joint splice |
| 7. Warning lamp, high engine coolant temperature (accessory) | 14. Warning lamp, generator not charging |

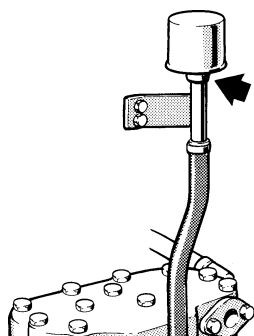
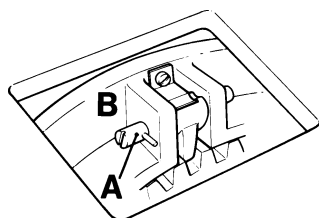
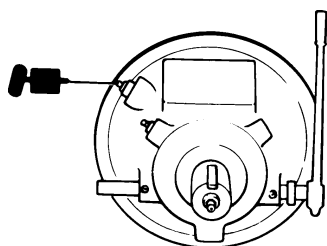
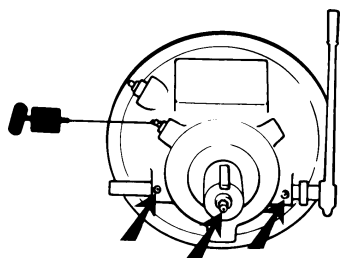
Cables displayed as a dashed lines are existing cables

Time relay kit for engagement of the starter element (accessory)

1. Time relay
2. Connector. 8 pin
3. Ignition switch
4. Temperature switch (accessory)
5. Starter element
6. Indicator lamp (engaged starter element)
7. Battery



Disengageable clutch and compressor



Disengageable clutch

Lubrication

Use lithium based grease, Mobilux EP2, Statoil Uniway EP2N, Texaco Multifak EP2, Q8 Rembrandt EP2 for example

Main bearing and clutch mechanism

Lubricate inner support bearing (when a grease nipple is installed), main bearings, disengaging shaft and moving parts of clutch. Lubricate sparingly (20–30 g for main bearings).

Lubricate the inner control arms with a few drops of oil.

Disengagement bearing

Lubricate sparingly so that no grease is squeezed out. Use a grease recommended above.

Checking and adjusting

⚠ WARNING! Adjustments may only be made on a stopped engine.

The clutch force at the end of the lever must be 34–41 kp (double clutch plates) or 36–45 kp (triple clutch plates) during engagement.

Adjustment: Remove the inspection cover. Disconnect catch (A) and turn the red adjuster (B) clockwise. Engage the catch. The clutch plates must not slip after engagement!

Air Compressor

Air filter. Replace

Slacken off hose clamp, remove the filter for disposal. Install a new filter and tighten the clamp.

Shut down

Inhibition should be carried out to ensure that the engine and other equipment are not damaged while shut down. It is important that this is done properly and that nothing is forgotten. We have therefore provided a checklist covering the most important points.

Before shutting down for a long period, an authorised Volvo Penta workshop should inspect the engine and other equipment. Have any necessary repairs or service work carried out so that the equipment is in good condition for the next time it is started.

⚠ WARNING! Read the chapter "Maintenance" carefully before starting work. It contains instructions on how to carry out the work safely and correctly.

Storage

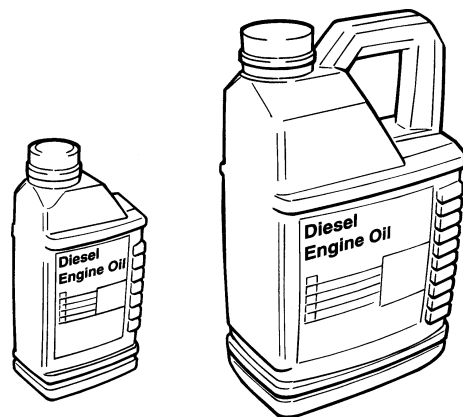
- Change engine oil and replace oil filter.
- Replace fuel filter. Replace fuel pre-filter if installed.
- Run engine to normal operating temperature.
- Check the condition of the engine coolant anti-freeze. Top up if required.

⚠ IMPORTANT! An anti-corrosion mixture in the engine coolant system provides no protection against freezing. If there is any possibility the engine will be subjected to freezing temperatures, the system must be drained.

- Drain any water and contaminants from the fuel tank. Fill the tank completely with fuel to avoid condensation.
- Clean the outside of the engine. Do not use a high pressure spray to clean the engine. Touch up any damaged areas of paintwork with Volvo Penta original paint.
- Disconnect the battery leads. Clean and charge the batteries. **NOTE!** A poorly charged battery may burst as a result of freezing.
- Spray electrical system components with moisture-repellent spray.

Bringing out of storage

- Check the engine oil level. Top up if necessary. If there is inhibiting oil in the system, drain and fill with new oil, change oil filter. For correct oil grade: See chapter "Maintenance", lubrication system.
- Close/tighten drain cocks/plugs.
- Check drive belts.
- Check the condition of rubber hoses and tighten hose clamps.
- Check engine coolant level and antifreeze protection. Top up if necessary.
- Connect the fully charged batteries.
- Start the engine. Check that there are no fuel, engine coolant or exhaust gas leaks and that all control functions are operating.



Fault tracing

A number of symptoms and possible reasons for engine problems are described in the table below. In case of faults or mishaps which you cannot solve, always contact the Volvo Penta dealership.

In the event of engine interference related to the GAC governor (Generating set engines), refer to the documentation delivered with the GAC governor.

⚠ WARNING! Read the safety precautions for maintenance and service in the chapter: "Safety Information", before starting work.

Symptoms and possible causes

Starter motor not turning (or turning slowly)	1, 2, 3, 21, 22, 23, 24
Engine will not start	4, 5, 6, 7, 25, 26, 31
Engine starts but stops again	4, 6, 7, 8, 25, 26
Engine difficult to start	4, 5, 6, 7, 25, 26, 31
Engine does not reach correct speed at wide open throttle (WOT)	4, 5, 6, 7, 8, 9, 29, 30, 31
Engine knocks	4, 5, 6, 7
Engine runs unevenly	4, 5, 6, 7, 8, 9, 31
Engine vibrates	13, 14
High fuel consumption	8, 10
Black exhaust smoke	8, 28
Blue or white exhaust smoke	10, 19, 28
Low oil pressure	11, 12
Engine coolant temperature too high	15, 16, 17, 18, 27, 28
No or poor charging	2, 20

- | | | |
|---|--|--|
| 1. Discharged battery | 12. Blocked fuel filter | 23. Defective starter motor / solenoid |
| 2. Loose connection / open-circuit | 13. Defective engine mounting | 24. Water in the engine |
| 3. Fuse tripped | 14. Worn clutch | 25. Preheating insufficient |
| 4. Lack of fuel | 15. Too little coolant | 26. Starter element defective / not connected |
| 5. Fouled fuel filter. | 16. Radiator blocked | 27. Defective temperature gauge / sensor |
| 6. Air in the fuel injection system | 17. Circulation pump defective | 28. Faulty injection timing |
| 7. Water / contaminants in the fuel | 18. Defective / incorrect thermostat | 29. Engine overloaded |
| 8. Insufficient air supply | 19. Lubricating oil level too high | 30. Excessive back pressure in exhaust system |
| 9. Engine coolant temperature too high | 20. Generator drive belt slipping | 31. Fault in the GAC unit (generating set engines) |
| 10. Engine coolant temperature is too low | 21. Defective ignition switch / starter button | |
| 11. Lubricating oil level too low. | 22. Defective start relay | |

Technical Data

General

Designation	No. of cylinders	Cylinder displacement (litres)	Weight (kg)*
TD420VE	4	4,04	380**
TAD420VE	4	4,04	380**
TD520GE	4	4,76	550**
TD520VE	4	4,76	430**
TAD520GE	4	4,76	575**
TAD520VE	4	4,76	532**
TAD620VE	6	5,07	495**
TWD630VE	6	5,48	665
TD640VE	6	5,48	655
TD71A	6	6,73	760
TWD710V	6	6,73	770
TD730VE	6	6,73	760
TWD731VE	6	6,73	770
TAD730V	6	6,73	876
TD710G	6	6,73	785
TWD710G	6	6,73	795
TD720GE	6	7,15	750**
TD720VE	6	7,15	570**
TAD720GE	6	7,15	760**
TAD720VE	6	7,15	572**
TAD721VE	6	7,15	572**
TWD740GE/VE	6	7,28	795
TAD740GE	6	7,28	901**
TAD741GE	6	7,28	901**
TD100G	6	9,6	945
TD1030VE	6	9,6	945
TWD1031VE	6	9,6	975
TAD1030V	6	9,6	1062
TAD1030GE	6	9,6	1107
TAD1031/32GE	6	9,6	1107
TD121G	6	11,98	1075
TWD1210V	6	11,98	1105
TWD1211V	6	11,98	1105
TWD1230VE	6	11,98	1105
TAD1230V	6	11,98	1215
TD1210G	6	11,98	1110
TWD1210G	6	11,98	1140
TWD1211G	6	11,98	1140
TAD1230G	6	11,98	1250
TAD1231GE	6	11,98	1250
TAD1232GE	6	11,98	1250
TD164KAE	6	16,12	1430
TWD1630V	6	16,12	1409
TAD1630V	6	16,12	1515
TWD1630G	6	16,12	1428
TWD1630GE	6	16,12	1428
TAD1630GE	6	16,12	1538
TAD1631G/GE	6	16,12	1538

* Engine only (without coolant and oil)

**Including radiator and charge air cooler (CAC)

General

Designation	Low idling speed (rpm)	Valve clearance, intake/exhaust (mm)*
TD420VE	875±50	0,35/0,55
TAD420VE	875±50	0,35/0,55
TD520GE	875±50	0,35/0,55
TD520VE	875±50	0,35/0,55
TAD520GE	875±50	0,35/0,55
TAD520VE	875±50	0,35/0,55
TAD620VE	875±50	0,35/0,55
TWD630VE	725±25	0,40/0,55
TD640VE	700±10	0,40/0,55
TD71A	600±25	0,40/0,55
TWD710V	600±25	0,40/0,55
TD730VE	650±25	0,40/0,55
TWD731VE	650±25	0,40/0,55
TAD730V	600±25	0,40/0,55
TD710G	1300±50	0,40/0,55
TWD710G	1300±50	0,40/0,55
TD720GE	875±50	0,35/0,55
TD720VE	875±50	0,35/0,55
TAD720GE	875±50	0,35/0,55
TAD720VE	875±50	0,35/0,55
TAD721VE	875±50	0,35/0,55
TWD740GE/VE	1300±50	0,50/0,65
TAD740GE	1300±50	0,50/0,65
TAD741GE	1300±50	0,50/0,65
TD100G	550±50	0,40/0,70
TD1030VE	600±25	0,40/0,70
TWD1031VE	675±25	0,40/0,70
TAD1030V	600±25	0,40/0,70
TAD1030GE	1300±50	0,40/0,70
TAD1031/32GE	1300±50	0,40/0,70
TD121G	600±50	0,40/0,70
TWD1210V	600±25	0,40/0,70
TWD1211V	600±25	0,40/0,70
TWD1230VE	600±25	0,40/0,70
TAD1230V	600±25	0,40/0,70
TD1210G	1300±50	0,40/0,70
TWD1210G	1300±50	0,40/0,70
TWD1211G	1300±50	0,40/0,70
TAD1230G	1300±50	0,40/0,70
TAD1231GE	1300±50	0,40/0,70
TAD1232GE	1300±50	0,40/0,70
TD164KAE	850±50	0,30/0,60
TWD1630V	500±25	0,30/0,60
TAD1630V	500±25	0,30/0,60
TWD1630G	1300±50	0,30/0,60
TWD1630GE	1300±50	0,30/0,60
TAD1630GE	1300±50	0,30/0,60
TAD1631G/GE	1300±50	0,30/0,60

* Applies to cold engine or at operating temperature (stopped)

Oil pressure*

Designation	At normal running engine speed (kPa)	At idling speed (kPa)
TD420VE	450	min. 80
TAD420VE	450	min. 80
TD520GE	400	min. 150
TD520VE	450	min. 80
TAD520GE	400	min. 150
TAD520VE	450	min. 80
TAD620VE	450	min. 80
TWD630VE	300-500	min. 150
TD640VE	300-500	min. 150
TD71A	300-500	min. 150
TWD710V	300-500	min. 150
TD730VE	250-550	min. 150
TWD731VE	250-550	min. 150
TAD730V	300-500	min. 150
TD710G	300-500	min. 150
TWD710G	300-500	min. 150
TD720GE	420	min. 150
TD720VE	450	min. 80
TAD720GE	420	min. 150
TAD720VE	450	min. 80
TAD721VE	450	min. 80
TWD740GE/VE	300-500	min. 150
TAD740GE	300-500	min. 150
TAD741GE	300-500	min. 300
TD100G	300-500	min. 150
TD1030VE	400-600	min. 150
TWD1031VE	400-600	min. 150
TAD1030V	300-500	min. 150
TAD1030GE	300-500	min. 150
TAD1031/32GE	300-500	min. 300
TD121G	300-500	min. 150
TWD1210V	300-500	min. 150
TWD1211V	300-500	min. 150
TWD1230VE	300-500	min. 150
TAD1230V	300-500	min. 150
TD1210G	300-500	min. 150
TWD1210G	300-500	min. 150
TWD1211G	300-500	min. 150
TAD1230G	300-500	min. 150
TAD1231GE	300-500	min. 150
TAD1232GE	300-500	min. 150
TD164KAE	300-500	min. 150
TWD1630V	300-500	min. 150
TAD1630V	300-500	min. 150
TWD1630G	300-500	min. 150
TWD1630GE	300-500	min. 150
TAD1630GE	300-500	min. 150
TAD1631G/GE	300-500	min. 150

* Applies to engine at operating temperature

Oil change capacity* for standard oil pan

Designation	Without oil filter (litres)	With oil filter (litres)	Volume difference (MIN-MAX)**
TD420VE	8	10	2
TAD420VE	8	10	2
TD520GE	11	13	2
TD520VE	11	13	2
TAD520GE	11	13	2
TAD520VE	11	13	2
TAD620VE	14	16	3
TWD630VE	20	24	6
TD640VE	20	24	6
TD71A	24	29	8
TWD710V	22	27	7
TD730VE	24	29	8
TWD731VE	24	29	8
TAD730V	22	27	7
TWD710G	24	29	7
TD720GE	18	20	3
TD720VE	18	20	3
TAD720GE	18	20	3
TAD720VE	18	20	3
TAD721VE	18	20	3
TAD730G	24	29	8
TWD740GE/VE	24	29	8
TAD740GE	24	29	8
TAD741GE	24	29	8
TD100G	21	25	9
TD1030VE	32	36	10
TWD1031VE	32	36	10
TAD1030V	30	34	8
TAD1030GE	32	36	10
TAD1031/32GE	32	36	10
TD121G	34	38	9
TWD1210V	34	38	9
TWD1211V	34	38	9
TWD1230VE	34	38	9
TAD1230V	34	38	9
TD1210G	34	38	9
TWD1210G	34	38	9
TWD1211G	34	38	9
TAD1230G	34	38	9
TAD1231GE	34	38	9
TAD1232GE	34	38	9
TD164KAE	57	64	3
TWD1630V	57	64	17
TAD1630V	57	64	17
TWD1630G	57	64	17
TWD1630GE	57	64	17
TAD1630GE	57	64	17
TAD1631G/GE	57	64	17

* Information about oil quality and viscosity can be found in the "Maintenance" chapter under the heading Lubrication system

** Difference in volume in litres between the MIN and MAX markings on the dipstick

Oil change capacity* for (shallow 10°) oil Pan

Designation	Without oil filter (litres)	With oil filter (litres)	Volume difference (MIN-MAX)**
TD610V	12	16	5
TD630VE	12	16	5
TWD630VE	12	16	5
TD71A	14	19	7
TID71A	14	19	7
TD730VE	14	19	7
TWD731VE	14	19	7

Oil change capacity* for (shallow) oil pan for large inclinations

Designation	Without oil filter (litres)	With oil filter (litres)	Volume difference (MIN-MAX)**
TD610V	15	19	3
TD630VE	15	19	3
TWD630VE	15	19	3
TD71A	19	24	3
TID71A	19	24	3
TD730VE	19	24	3
TWD731VE	19	24	3
TWD1230VE	30	34	12

Oil change capacity* for (deep) oil pan for large inclinations

Designation	Without oil filter (litres)	With oil filter (litres)	Volume difference (MIN-MAX)**
TD610V	18	22	6
TD630VE	18	22	6
TWD630VE	18	22	6
TD100G	27	31	9
TD1030VE	27	31	11
TWD1031VE	27	31	11
TD121G	30	34	12
TWD1230VE	30	34	12

* Information about oil quality and viscosity can be found in the "Maintenance" chapter under the heading Lubrication system

** Difference in volume between the MIN and MAX markings on the dipstick

Oil change capacity* for (vehicle type) oil pans

Designation	Without oil filter (litres)	With oil filter (litres)	Volume difference (MIN-MAX)**
TD71A	22	27	7
TID71A	22	27	7
TD730VE	22	27	7
TWD731VE	22	27	7

Oil change capacity* for (laminated) oil pan (soundproofed)

Designation	Without oil filter (litres)	With oil filter (litres)	Volume difference (MIN-MAX)**
TD630VE	20	24	6
TWD630VE	20	24	6
TD730VE	22	27	7
TWD731VE	22	27	7
TD1030VE	32	36	10
TWD1031VE	32	36	10
TWD1230VE	34	38	12

* Information about oil quality and viscosity can be found in the "Maintenance" chapter under the heading Lubrication system

** Difference in volume between the MIN and MAX markings on the dipstick

Cooling system

Designation	Coolant volume (litres)*	Thermostat begins to open/fully open at (°C)
TD420VE	17	83/95**
TAD420VE	17	83/95**
TD520GE	18	83/95**
TD520VE	18	87/102**
TAD520GE	20	83/95**
TAD520VE	20	87/102**
TAD620VE	21	83/95**
TWD630VE	22	75/88**
TD640VE	22	75/88**
TD71A	25	75/88**
TWD710V	34	75/88**
TD730VE	25	75/88**
TWD731VE	26	75/88**
TAD730V	37	75/88**
TWD710G	42	75/88**
TD720GE	22	83/95**
TD720VE	22	87/102**
TAD720GE	24	83/95**
TAD720VE	24	87/102**
TAD721VE	24	87/102**
TAD730G	37	75/88**
TWD740GE/VE	42	75/88**
TAD740GE	37	75/88**
TAD741GE	37	75/88**
TD100G	27	82/95**
TD1030VE	30	82/95**
TWD1031VE	30	75/88**
TAD1030V	38	82/95**
TAD1030GE	38	86/96**
TAD1031/32GE	38	86/96**
TD121G	34	82/95**
TWD1210V	49	75/88**
TWD1211V	55	82/95**
TWD1230VE	37	82/95**
TAD1230V	48	82/95**
TD1210G	49	75/88**
TWD1210G	52	75/88**
TWD1211G	59	75/88**
TAD1230G	48	82/95**
TAD1231GE	48	82/95**
TAD1232GE	48	82/95**
TD164KAE	90	82/95**
TWD1630V	59	75/88***
TAD1630V	52	82/95***
TWD1630G	59	75/88***
TWD1630GE	59	75/88***
TAD1630GE	52	82/95***
TAD1631G/GE	56	82/95***

* The coolant volumes listed apply to the use of Volvo Penta original coolants

** Number of thermostats: 1

*** Number of thermostats: 2

Fuel system*. Injectors

Designation	Opening pressure (MPa)	Adjusting pressure (MPa)	Nozzle hole diameter (mm)
TD420VE	22,0	23,0 +0,8	6 st 0,203
TAD420VE	22,0	23,0 +0,8	6 st 0,203
TD520GE	25,0	26,0 +0,8	5 st 0,30
TD520VE	25,0	26,0 +0,8	5 st 0,30
TAD520GE	25,0	26,0 +0,8	5 st 0,30
TAD520VE	25,0	26,0 +0,8	5 st 0,30
TAD620VE	22,0	23,0 +0,8	6 st 0,203
TWD630VE	25,0	26,0 +0,8	6 st 0,226
TD640VE	25,0	26,0 +0,8	6 st 0,226
TD71A	25,0	25,5 +0,8	4 st 0,34
TWD710V	25,0 +0,8	25,5 +0,8	4 st 0,38
TD730VE	25,5	26,0 +0,8	7 st 0,235
TWD731VE	25,0	26,0 +0,8	6 st 0,258
TAD730V	30,0 +0,8	30,5 +0,8	5 st 0,35
TWD710G	25,0 +0,8	25,5 +0,8	4 st 0,38
TD720GE	27,5 +0,8	28,0 +0,8	5 st 0,30
TD720VE	27,5 +0,8	28,0 +0,8	5 st 0,30
TAD720GE	27,5 +0,8	28,0 +0,8	5 st 0,30
TAD720VE	27,5 +0,8	28,0 +0,8	5 st 0,30
TAD721VE	27,5 +0,8	28,0 +0,8	5 st 0,30
TAD730G	30,0 +0,8	30,5 +0,8	5 st 0,32
TWD740GE/VE	29,0 +0,8	29,5 +0,8	6 st 0,29
TAD740GE	29,0 +0,8	29,5 +0,8	6 st 0,29
TAD741GE	29,0 +0,8	29,5 +0,8	6 st 0,29
TD100G	26,0 +0,8	26,5 +0,8	4 st 0,38
TD1030VE	25,0	26,0 +0,8	7 st 0,27
TWD1031VE	25,0	26,0 +0,8	6 st 0,25
TAD1030V	27,5 +0,8	28,0 +0,8	5 st 0,30
TAD1030GE	27,5	28,0	5 st 0,30
TAD1031GE	25,0 + 0,8	25,5 + 0,8	6 st 0,24
TAD1032GE	25,0 + 0,8	25,5 + 0,8	6 st 0,27
TD121G	27,0	27,5 +0,8	5 st 0,36
TWD1210V	27,0 +0,8	27,5 +0,8	5 st 0,38
TWD1211V	27,0 +0,8	27,5 +0,8	5 st 0,38
TWD1230VE	25,0	26,0 +0,8	6 st 0,28
TAD1230V	25,5 +0,8	26,0 +0,8	5 st 0,38
TD1210G	26,5	27,0	5 st 0,36
TWD1210G	27,0 +0,8	27,5 +0,8	5 st 0,38
TWD1211G	27,0	27,5 +0,8	5 st 0,38
TAD1230G	25,5	26,0 +0,2	5 st 0,38
TAD1231GE	25,5	26,0 +0,2	6 st 0,34
TAD1232GE	25,5	26,0 +0,2	6 st 0,34
TD164KAE	23,5	24,0 +0,2	7 st 0,31
TWD1630V	26,0	26,5 +0,2	7 st 0,31
TAD1630V	26,0	26,5 +0,2	7 st 0,31
TWD1630G	26,0	26,5 +0,2	7 st 0,31
TWD1630GE	26,0	26,5 +0,2	7 st 0,31
TAD1630GE	26,0	26,5 +0,2	7 st 0,31
TAD1631G/GE	28,5	29,0 +0,2	7 st 0,35

* Refer to the engine identification plate for information about injection timing and stroke position. See the chapter "Presentation", identification number.

Electrical system

Designation	System voltage (V)	Maximum battery capacity 24 V/12 V (Ah)
TD420VE	24 alt. 12	2x110/2x88
TAD420VE	24 alt. 12	2x110/2x88
TD520GE	24 alt. 12	2x110/2x88
TD520VE	24 alt. 12	2x110/2x88
TAD520GE	24 alt. 12	2x110/2x88
TAD520VE	24 alt. 12	2x110/2x88
TAD620VE	24 alt. 12	2x110/2x88
TWD630VE	24 alt. 12	2x135/2x110
TD640VE	24 alt. 12	2x135/2x110
TD71A	24 alt. 12	2x135/2x110
TWD710V	24 alt. 12	2x135/2x110
TD730VE	24 alt. 12	2x135/2x110
TWD731VE	24	2x135/ –
TAD730V	24	2x135/ –
TWD710G	24	2x143/ –
TD720GE	24 alt. 12	2x110/2x88
TD720VE	24 alt. 12	2x110/2x88
TAD720GE	24 alt. 12	2x110/2x88
TAD720VE	24 alt. 12	2x110/2x88
TAD721VE	24 alt. 12	2x110/2x88
TAD730G	24	2x143/ –
TWD740GE/VE	24	2x143/ –
TAD740GE	24	2x143/ –
TAD741GE		
TD100G	24	2x143/ –
TD1030VE	24	2x143/ –
TWD1031VE	24	2x143/ –
TAD1030V	24	2x143/ –
TAD1030GE	24	2x143/ –
TAD1031/32GE	24	2x143/ –
TD121G	24	2x143/ –
TWD1210V	24	2x143/ –
TWD1211V	24	2x143/ –
TWD1230VE	24	2x143/ –
TAD1230V	24	2x143/ –
TD1210G	24	2x152/ –
TWD1210G	24	2x152/ –
TWD1211G	24	2x152/ –
TAD1230G	24	2x152/ –
TAD1231GE	24	2x152/ –
TAD1232GE	24	2x152/ –
TD164KAE	24	2x176/–
TWD1630V	24	2x176/ –
TAD1630V	24	2x176/ –
TWD1630G	24	2x176/ –
TWD1630GE	24	2x176/ –
TAD1630GE	24	2x176/ –
TAD1631G/GE	24	2x176/ –

Generator. Voltage/Amperage/Power (V/A/W)

Designation	Alt. 1*	Alt. 2*	Alt. 3*	Alt. 4*	Alt. 5*
TD420VE	14/55/770	28/35/980	–	–	–
TAD420VE	14/55/770	28/35/980	–	–	–
TD520GE	14/55/770	28/35/980	–	–	–
TD520VE	14/55/770	28/35/980	–	–	–
TAD520GE	14/55/770	28/35/980	–	–	–
TAD520VE	14/55/770	28/35/980	–	–	–
TAD620VE	14/55/770	28/35/980	–	–	–
TWD630VE	28/55/1550	28/60/1700	28/80/2240	14/60/840	–
TD640VE	28/55/1550	28/60/1700	28/80/2240	14/60/840	–
TD71A	28/55/1550	28/60/1700	28/80/2240	–	14/90/1260
TWD710V	–	28/60/1700	–	–	14/90/1260
TD730VE	28/55/1550	28/60/1700	28/80/2240	–	14/90/1260
TWD731VE	28/55/1550	28/60/1700	28/80/2240	–	–
TAD730V	–	28/60/1700	–	–	–
TWD710G	–	28/60/1700	–	–	–
TD720GE	14/55/770	28/35/980	–	–	–
TD720VE	14/55/770	28/35/980	–	–	–
TAD720GE	14/55/770	28/35/980	–	–	–
TAD720VE	14/55/770	28/35/980	–	–	–
TAD721VE	14/55/770	28/35/980	–	–	–
TAD730G	–	28/60/1700	–	–	–
TWD740GE/VE	–	28/60/1700	–	–	–
TAD740GE	–	28/60/1700	–	–	–
TAD741GE	–	28/60/1700	–	–	–
TD100G	28/55/1550	28/60/1700	28/80/2240	–	–
TD1030VE	28/55/1550	28/60/1700	28/80/2240	–	–
TWD1031VE	28/55/1550	28/60/1700	28/80/2240	–	–
TAD1030V	–	28/60/1700	–	–	–
TAD1030GE	–	28/60/1700	–	–	–
TAD1031/32GE	–	28/60/1700	–	–	–
TD121G	28/55/1550	28/60/1700	28/80/2240	–	–
TWD1210V	–	28/60/1700	–	–	–
TWD1211V	–	28/60/1700	–	–	–
TWD1230VE	28/55/1550	28/60/1700	28/80/2240	–	–
TAD1230V	–	28/60/1700	–	–	–
TD1210G	–	28/60/1700	–	–	–
TWD1210G	–	28/60/1700	–	–	–
TWD1211G	–	28/60/1700	–	–	–
TAD1230G	–	28/60/1700	–	–	–
TAD1231GE	–	28/60/1700	–	–	–
TAD1232GE	–	28/60/1700	–	–	–
TD164KAE	–	28/60/1700	–	–	–
TWD1630V	–	28/60/1700	–	–	–
TAD1630V	–	28/60/1700	–	–	–
TWD1630G	–	28/60/1700	–	–	–
TWD1630GE	–	28/60/1700	–	–	–
TAD1630GE	–	28/60/1700	–	–	–
TAD1631G/GE	–	28/60/1700	–	–	–

* Alt.1=Generator 55 A/28 V, Alt.2=Generator 60 A/28 V, Alt.3=Generator 80 A/28 V, Alt.4=Generator 60 A/14 V, Alt.5=Generator 90 A/14 V

Disengageable clutch (accessory)

Designation	Type	Gear ratio	Size (mm)	Weight (kg)
AP S11A2	Single plate	1:1	292 (11 1/2")	66
AP D11A2	Double plate	1:1	292 (11 1/2")	83
AP T14A2	Triple plate	1:1	355 (14")	209

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GENERATOR PARTS LISTS

GENERATOR MODEL G220

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A breakdown view exists for this item

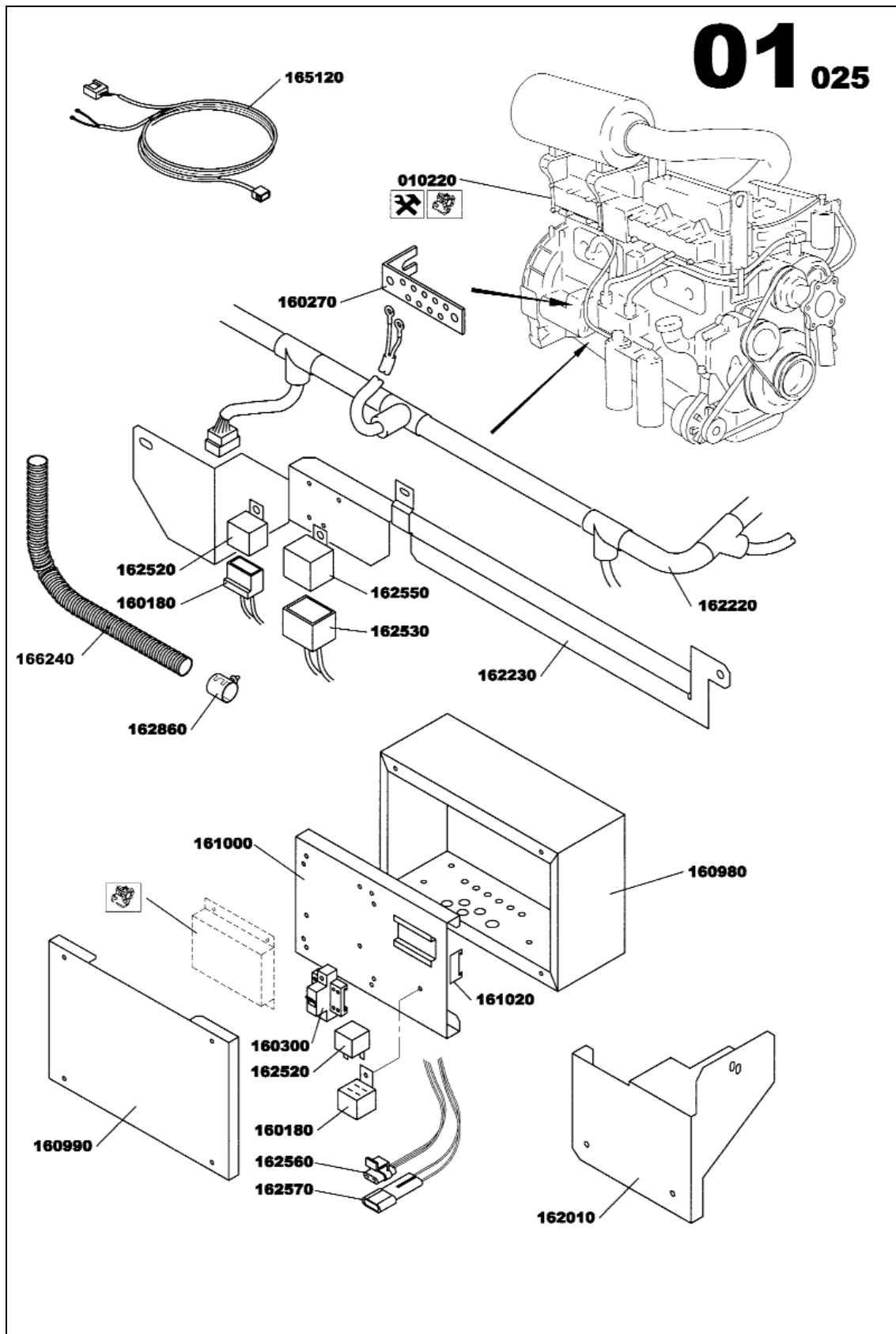


A supplier spare parts documentation exists for this item.

Some items drawing on the breakdown view are not mounted on this genset, so they are not in the part list.

ENGINE ASSEMBLY

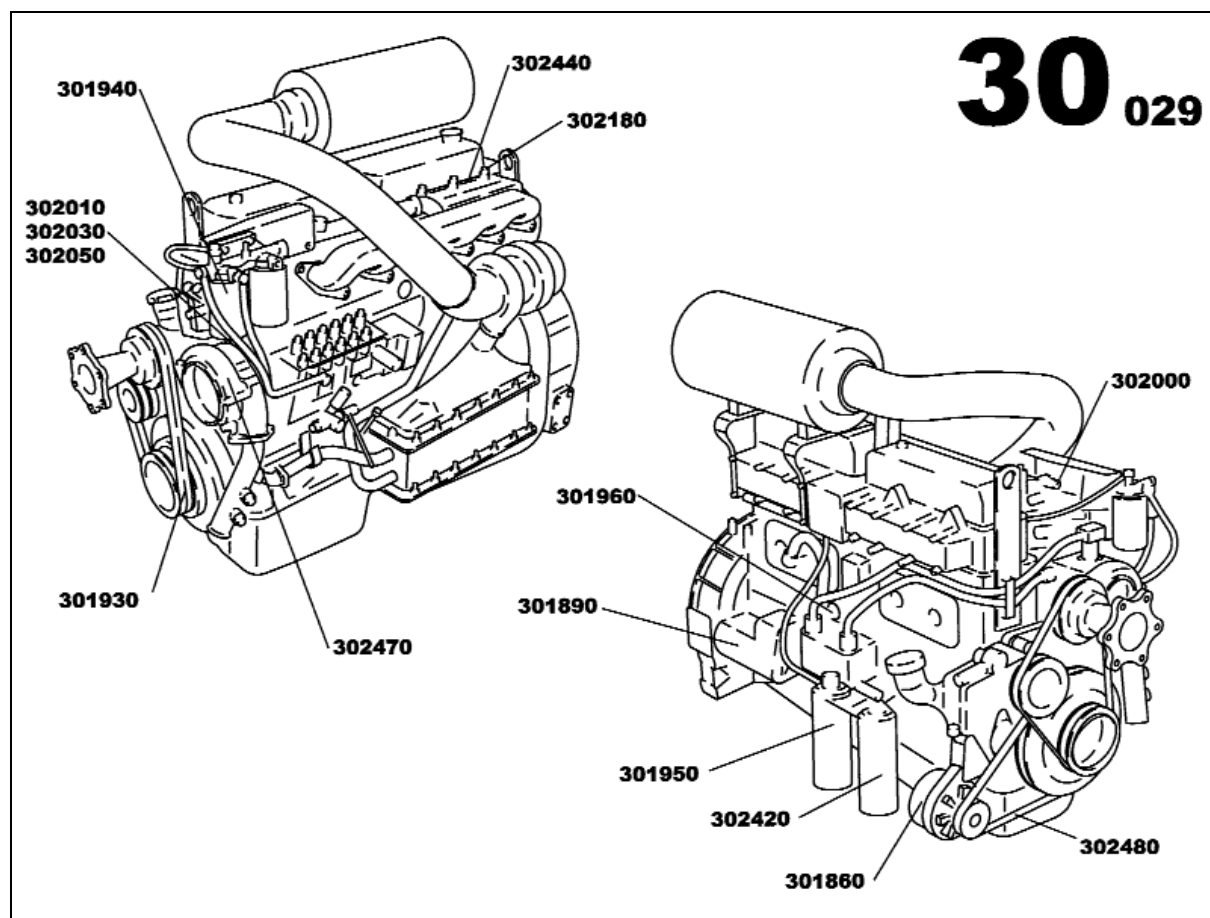
F01025



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
010220	85422046	VOLVO ENGINE TWD740 SAE 2/11.5	1.0	UN
162010	85423663	ELECTRONIC REGULATOR HOUSING BRACKET	1.0	UN
162220	85421352	ENGINE WIRING LOOM VOLVO 740	1.0	UN
162230	85423697	WIRING BRACKET VO TxD740G	1.0	UN
160270	85408078	COPPER BAR 5x25 COMMON EARTH BAR	1.0	UN
162520	85423366	RELAY 24V 10/20A	1.0	UN
162530	85413292	AUTOMOBILE RELAY BASE	1.0	UN
160180	85408912	AUTOMOBILE RELAY BASE	1.0	UN
162550	85423374	RELAY 24V 50A	1.0	UN
160980	85407237	ELECTRONIC REGULATION HOUSING	1.0	UN
160990	85407245	HOUSING ELECTRONIC REGULATION	1.0	UN
161000	85407336	ELECTRONIC REGULATOR BRACKET	1.0	UN
161020	85408706	STOP	1.0	UN
162520	85423366	RELAY 24V 10/20A	1.0	UN
160180	85408912	AUTOMOBILE RELAY BASE	1.0	UN
160300	85408920	MOULDED CASE CIRCUIT BREAKER 1x16A	1.0	UN
162560	85412989	2 POLE CONNECTOR	1.0	UN
162570	85412997	2 POLE CONNECTOR	1.0	UN
165120	85410652	INTELLISYS TM WIRING LOOM 010 L1=3500 L2=400	1.0	UN
166240	85427268	ELECTRICAL SHAFT D29	3.9	ML
162860	85427276	CLIP D29	6.0	UN

ENGINE DETAILS

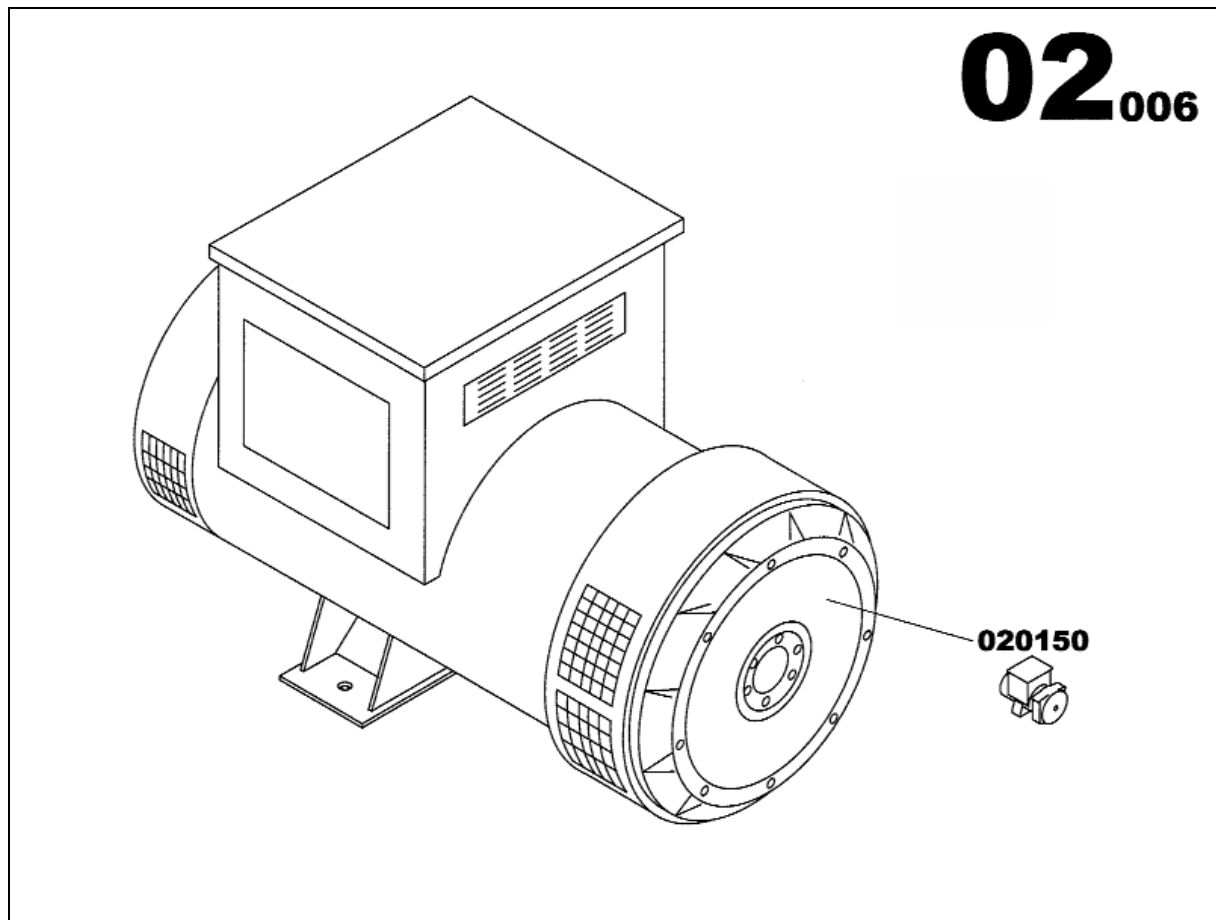
F30029



Item	Part number	Description	Quantity	Units
301950	85401909	OIL FILTER	1.0	UN
302420	85401917	OIL BY-PASS FILTER	1.0	UN
301940	85401636	FUEL FILTER	2.0	UN
301930	85401610	FAN BELT	1.0	UN
302480	85401388	ALTERNATOR BELT	1.0	UN
302180	85425502	INJECTOR	6.0	UN
301890	85401487	ELECTRIC STARTER	1.0	UN
301860	85401404	CHARGING ALTERNATOR	1.0	UN
302470	85426161	WATER PUMP REPAIR KIT	1.0	UN
301960	85401990	PRESSURE SWITCH	1.0	UN
302000	85402147	TEMPERATURE SWITCH	1.0	UN
302050	85402196	THERMOSTAT SEAL	1.0	UN
302030	85402170	THERMOSTAT SEAL	1.0	UN
302010	85402154	THERMOSTAT	1.0	UN
302440	85502797	ROCKER COVER GASKET	2.0	UN

ALTERNATOR ASSEMBLY

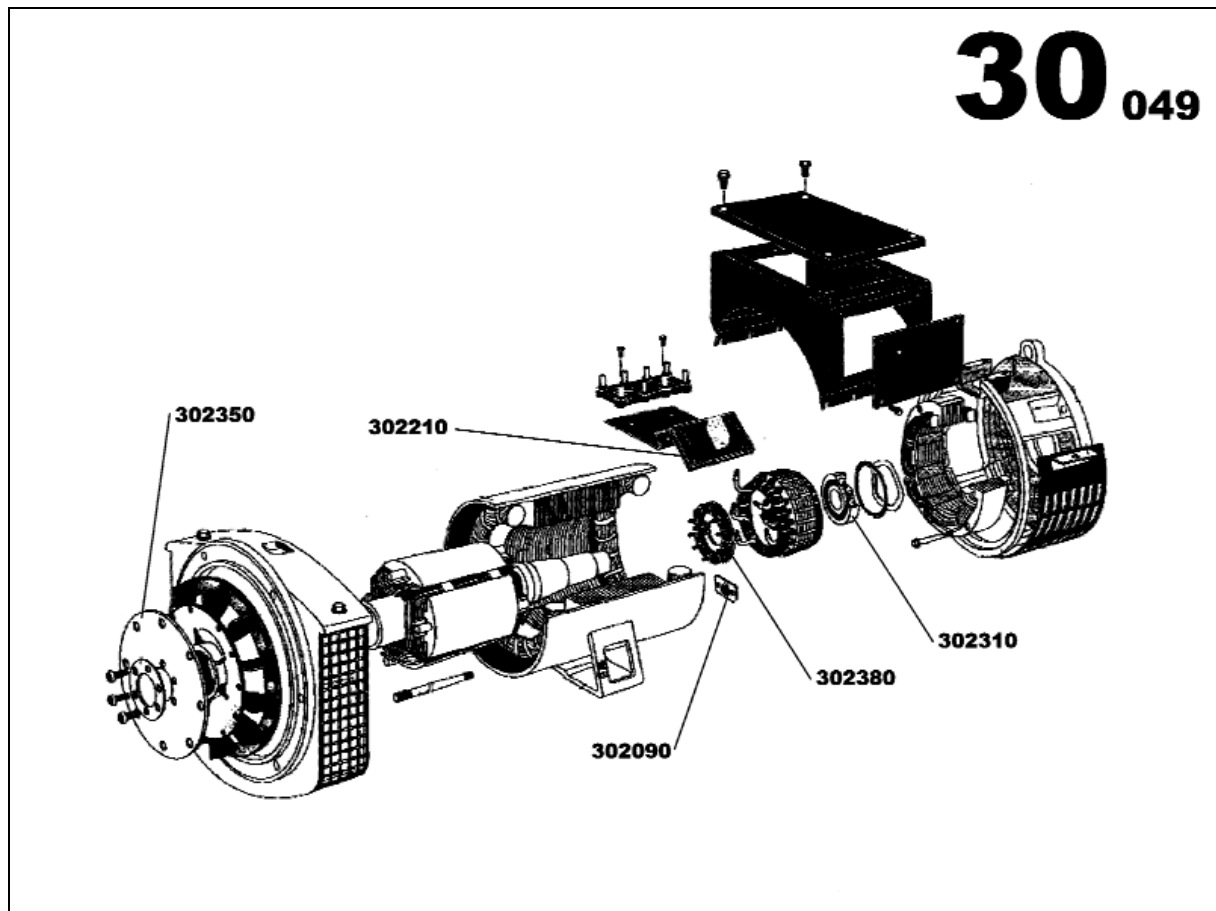
F02006



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
020150	85416626	LS 462M5 ALTERNATOR	1.0	UN

ALTERNATOR DETAILS

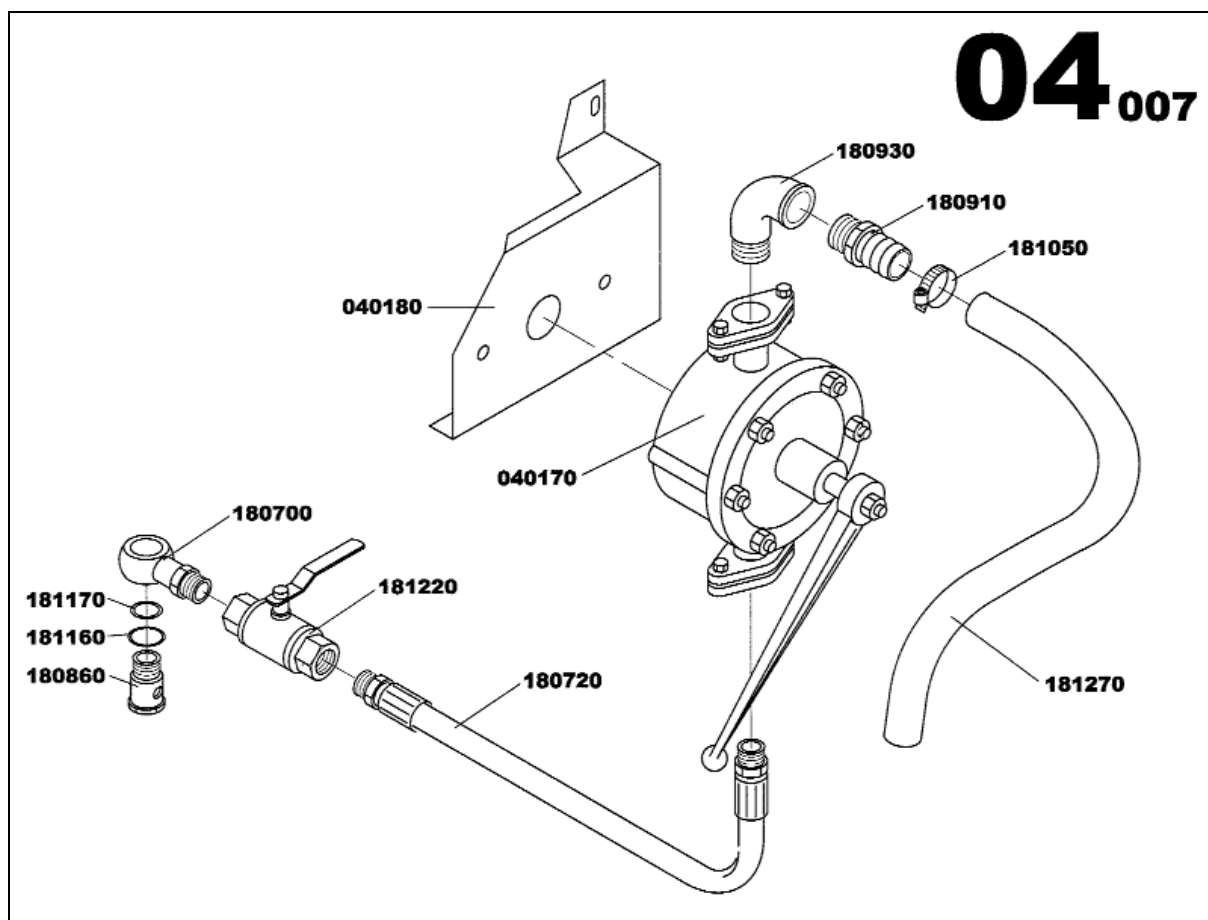
F30049



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
302210	85425577	VOLTAGE REGULATOR	1.0	UN
302310	85425916	BEARING	1.0	UN
302350	85425940	DRIVE DISC	1.0	UN
302380	85426179	DIODE BRIDGE	1.0	UN
302090	85402444	SURGE SUPPRESSOR	1.0	UN

OIL SUMP DRAIN PUMP TAD/TWD740G ASSEMBLY

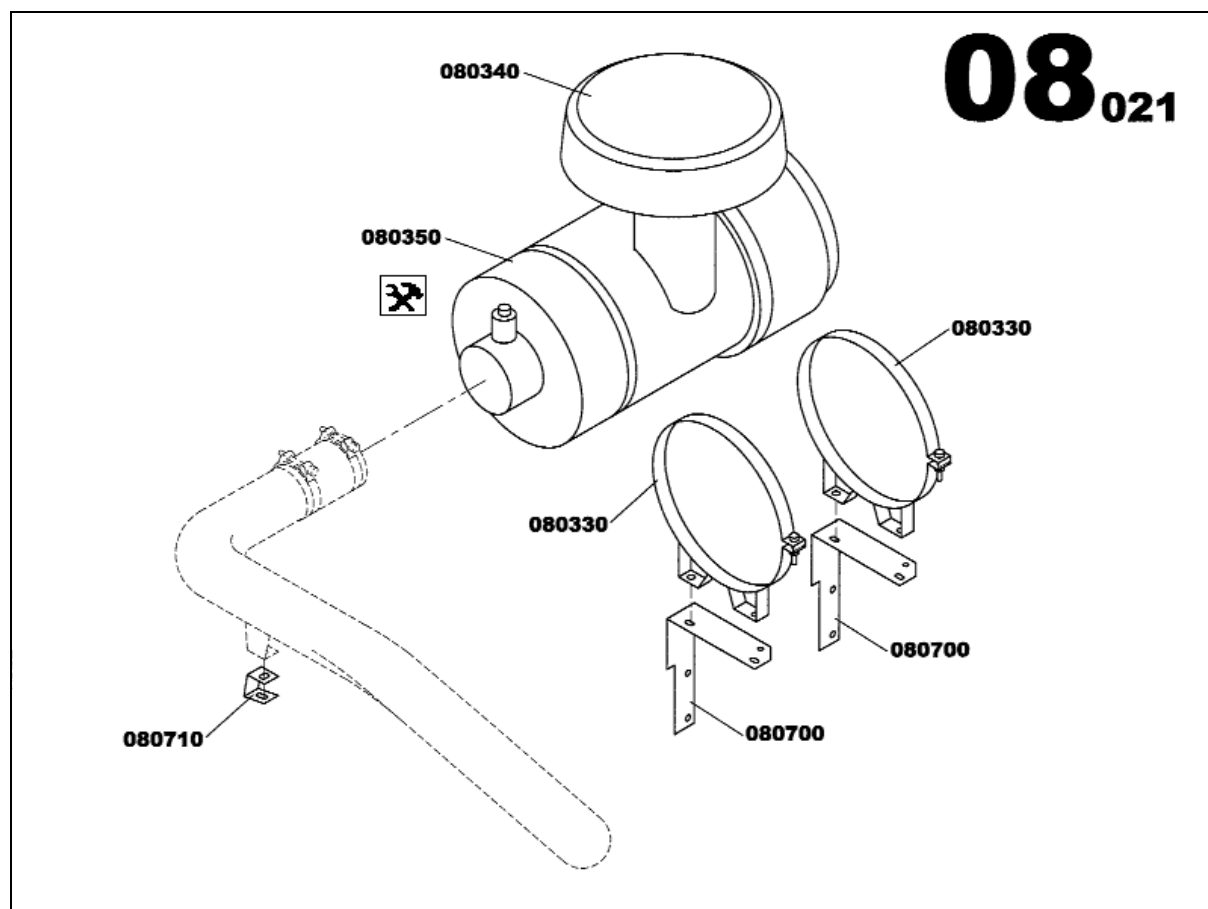
F04007



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
040170	85422616	HYDRAULIC MANUAL PUMP	1.0	UN
040180	85424034	OIL SUMP PUMP BRACKET VOLVO TxD740G	1.0	UN
180700	85423119	BANJO CONNECTOR ELBOW 3/4" BSP	1.0	UN
180720	85421493	HYDRAULIC HOSE L600	1.0	UN
180860	85424893	BANJO SCREW L45	1.0	UN
180910	85423242	PIPE UNION REDUCER MALE/MALE 3/4" GAS	1.0	UN
180930	85423093	PIPE UNION ELBOW 90° MALE/FEMALE 3/4" GAS	1.0	UN
181050	85417749	HOSE CLIP D25/40	1.0	UN
181160	85421758	GASKET D26x32 Th2	1.0	UN
181170	85421725	GASKET D22x27 Th1.5	1.0	UN
181220	85424885	2 WAY VALVE	1.0	UN
181270	85424836	FLEXIBLE HOSE D25x32	1.0	ML

AIR FILTER HEAVY DUTY ASSEMBLY

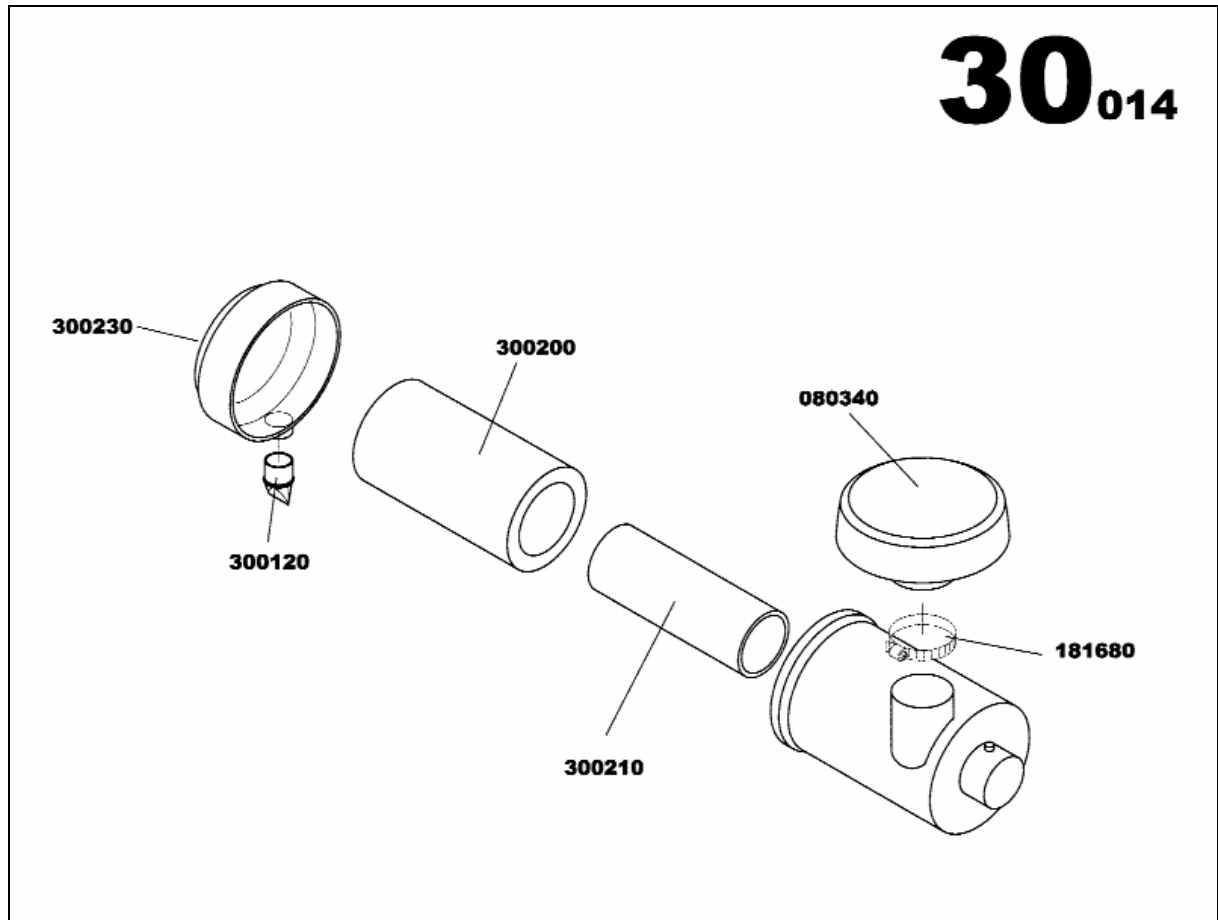
F08021



Item	Part number	Description	Quantity	Units
080330	85403848	AIR CLEANER CLAMP D330	2.0	UN
080340	85403863	RAIN CAP D154	1.0	UN
080350	85403921	AIR FILTER HEAVY DUTY	1.0	UN
080700	85423887	AIR FILTER BRACKET VOLVO TxD740G	2.0	UN
080710	85424257	HEAVY DUTY INLET PIPE BRACKET	1.0	UN

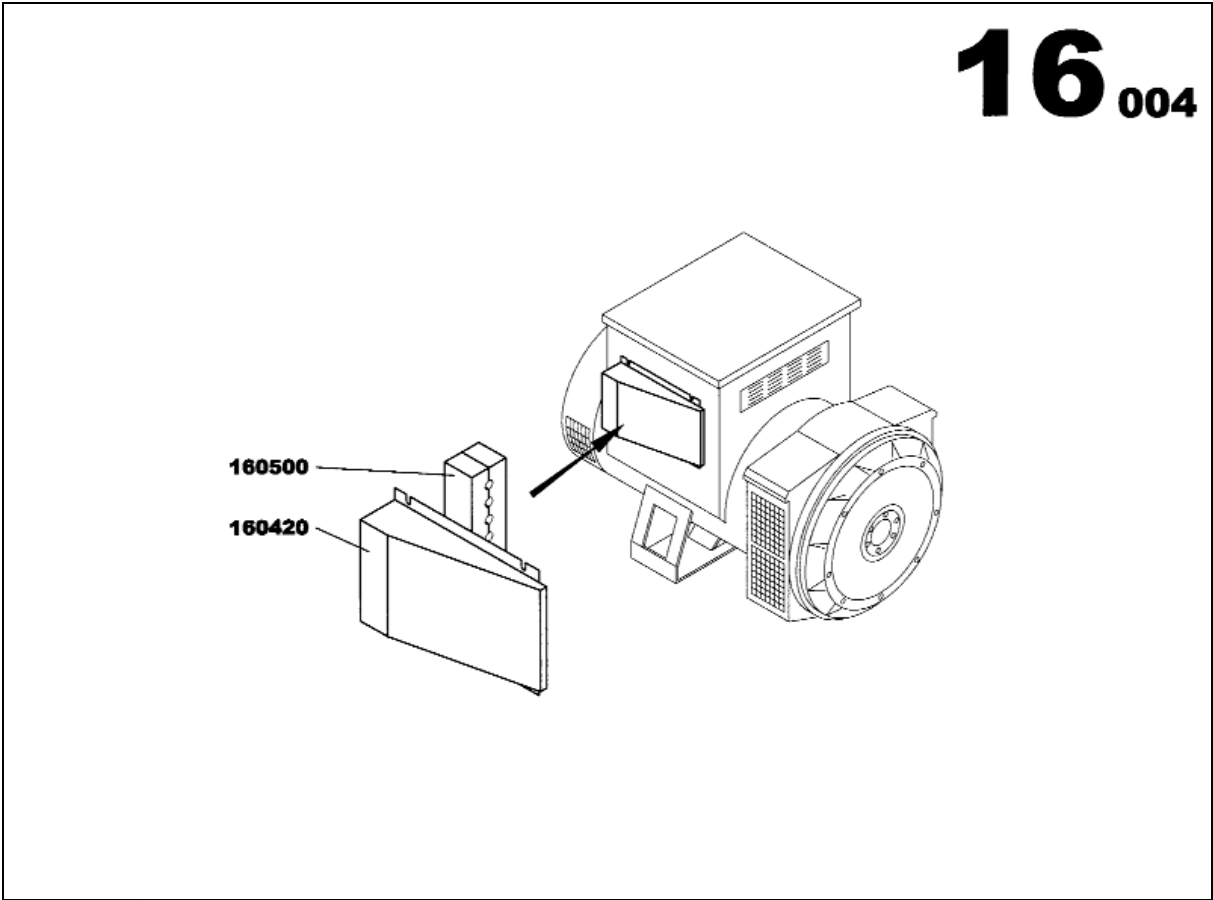
AIR FILTER 080350 DETAILS

F30014



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
300200	85400737	OUTER AIR FILTER	1.0	UN
300210	85400786	INNER AIR FILTER	1.0	UN
300120	85501229	VACUATOR VALVE	1.0	UN
300230	85501294	DUST CUP	1.0	UN
080340	85403863	RAIN CAP D154	1.0	UN
181680	85501872	HOSE CLIP D140/160	1.0	UN

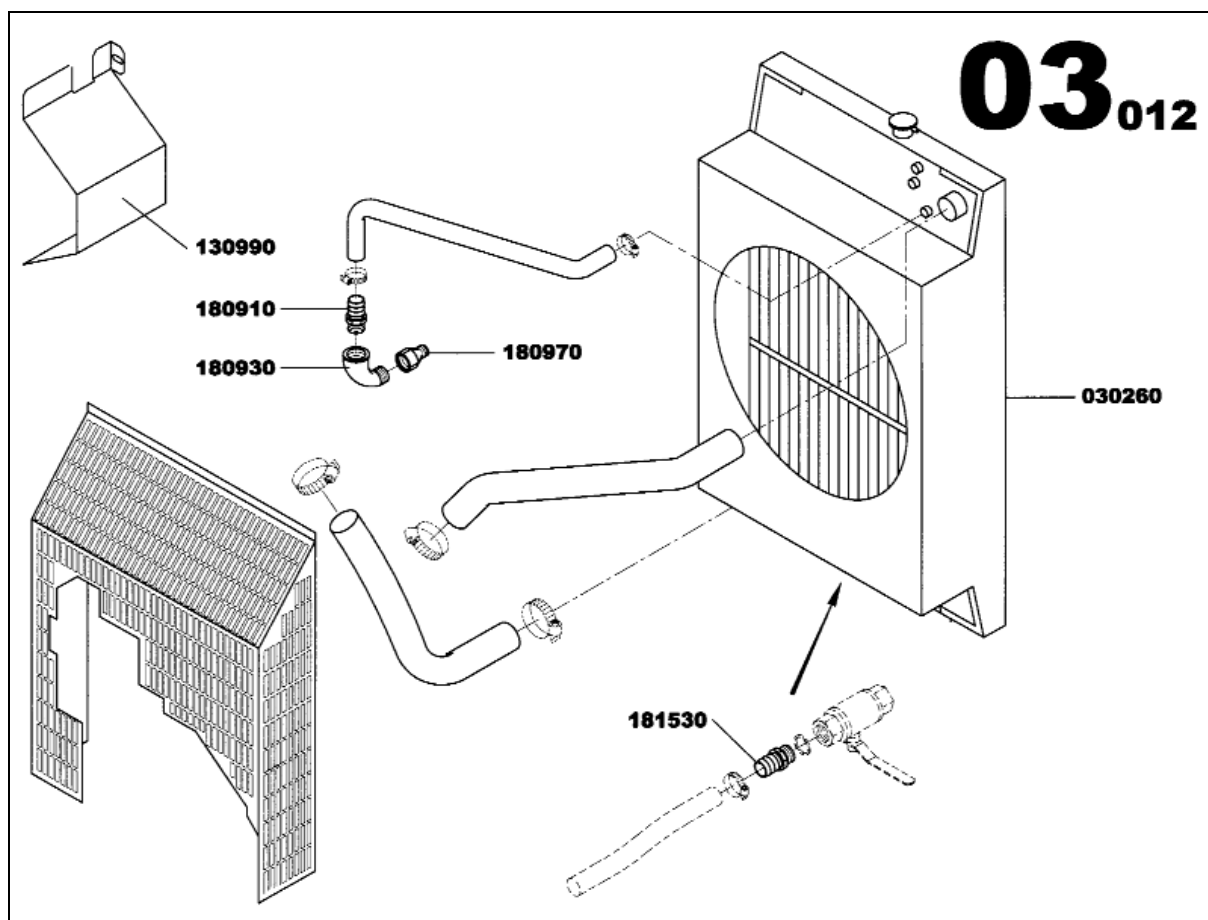
OUTPUT CABLES ALTERNATOR 80A<=480A ASSEMBLY
F16004



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
160420	85406742	CABLE OUTLET PLATE NW UCD224/UC274	1.0	UN
160500	85406874	FOAM CABLE PROTECTION 170x40x40	2.0	UN

RADIATOR VO TWD740G ASSEMBLY

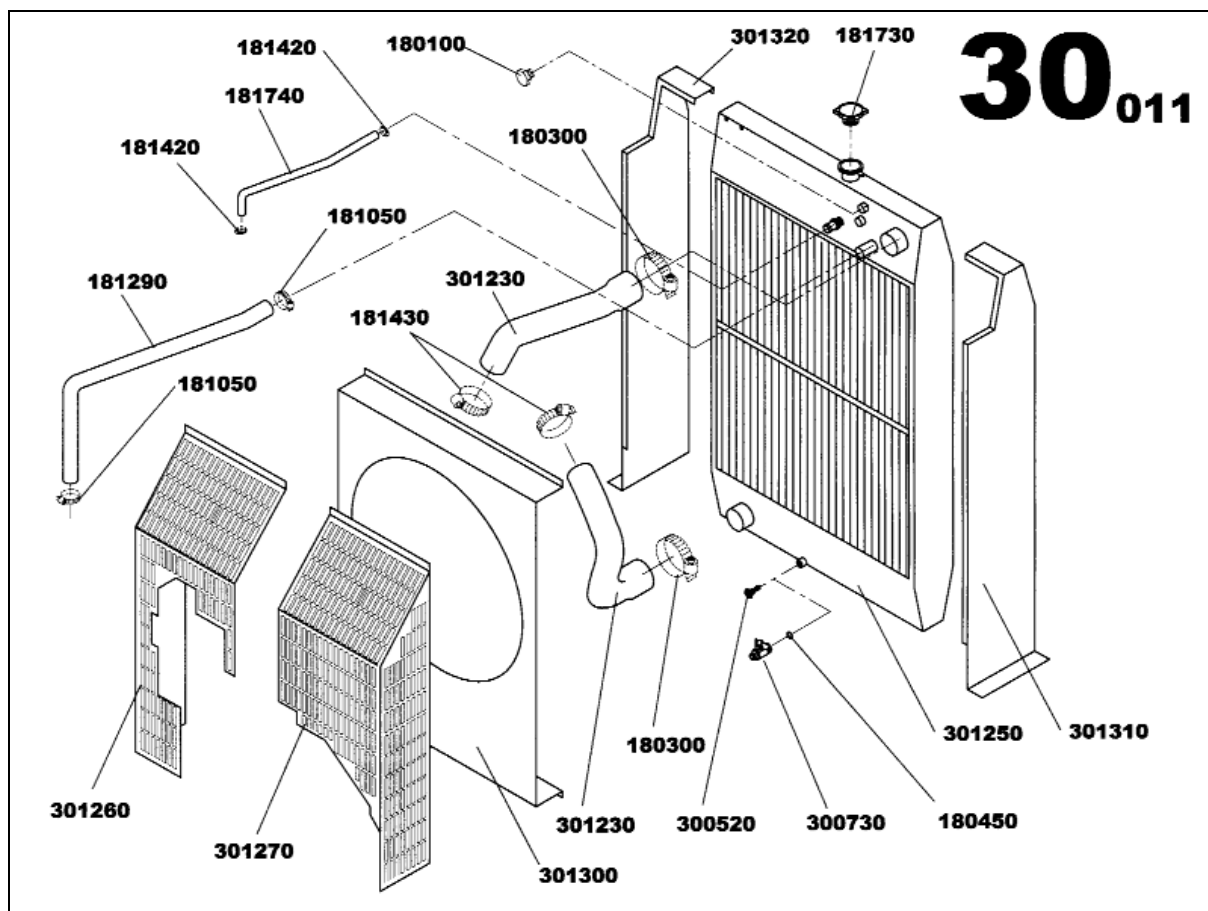
F03012



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
030260	85423333	RADIATOR VOLVO TWD740G	1.0	UN
130990	85422798	ALTERNATOR PROTECTION	1.0	UN
180910	85423242	PIPE UNION REDUCER MALE/MALE 3/4" GAS	1.0	UN
180930	85423093	PIPE UNION ELBOW 90° MALE/FEMALE 3/4" GAS	1.0	UN
180970	85423168	PIPE UNION 3/4 G	1.0	UN
181530	85427110	PIPE UNION REDUCER FEMALE/MALE 1/4G	1.0	UN

RADIATOR 030260 DETAILS

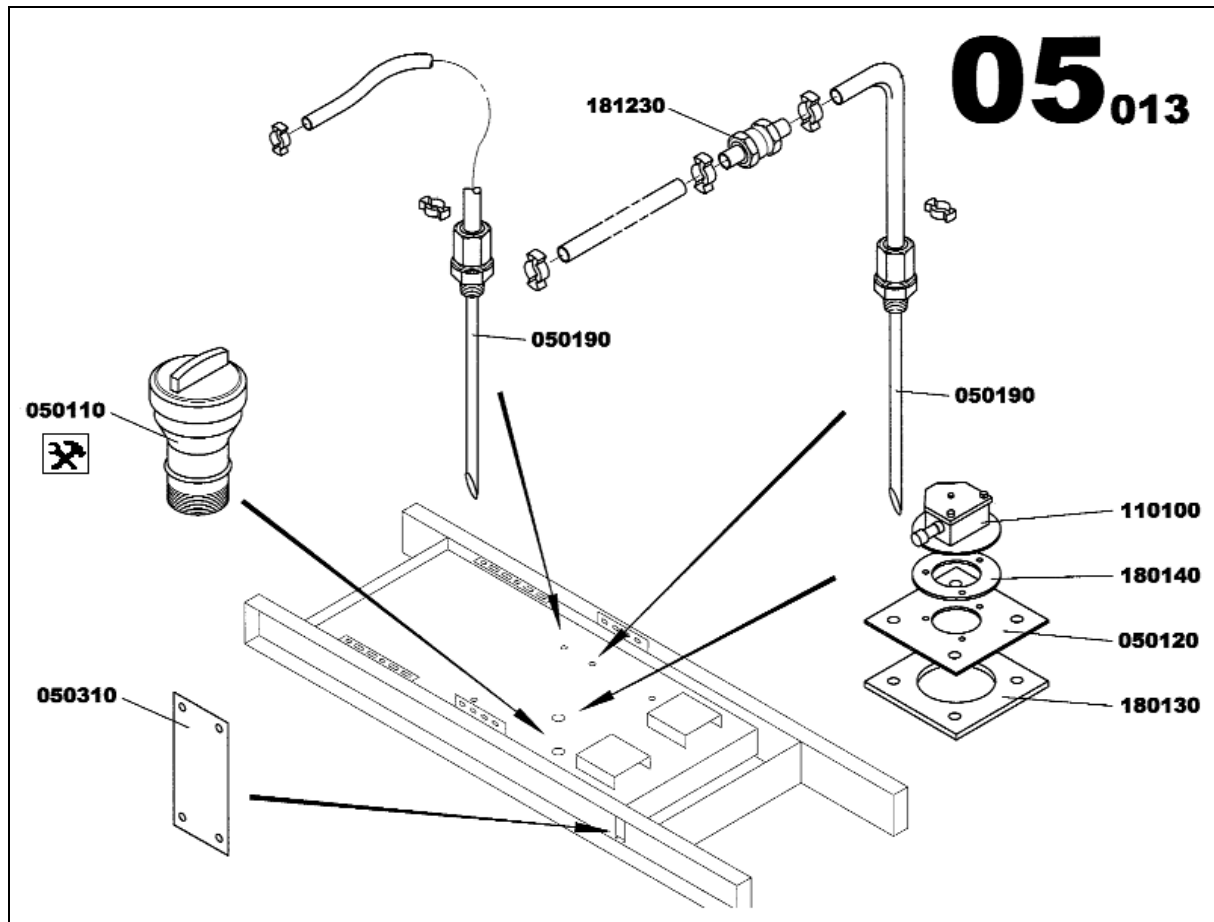
F30011



Item	Part number	Description	Quantity	Units
301230	85425767	RADIATOR BOTTOM HOSE	1.0	UN
301240	85425759	RADIATOR TOP HOSE	1.0	UN
181740	85430643	FLEXIBLE HOSE D9x15	0,7	ML
181290	85424869	FLEXIBLE HOSE D25x37	1.25	ML
301250	85500643	WATER RADIATOR	1.0	UN
181730	85500536	PLUG RADIATOR +0,70B/-0,04B	1.0	UN
181050	85417749	HOSE CLIP D25/40	2.0	UN
181430	85412922	HOSE CLIP D50/70	2.0	UN
180300	85409399	HOSE CLIP D60/80	2.0	UN
181420	85412914	HOSE CLIP D12/22	2.0	UN
301260	85500809	LEFT FAN PROTECTION	1.0	UN
301270	85500932	RIGHT FAN PROTECTION	1.0	UN
301300	85501013	PLENUM	1.0	UN
301310	85501096	RADIATOR RIGHT UPRIGHT	1.0	UN
301320	85501179	RADIATOR LEFT UPRIGHT	1.0	UN
180100	85409316	PLUG 1/2G	1.0	UN
180820	85502540	PIPE UNION REDUCER MALE/MALE 1/4" GAS	1.0	UN

FUEL TANK M413B ASSEMBLY

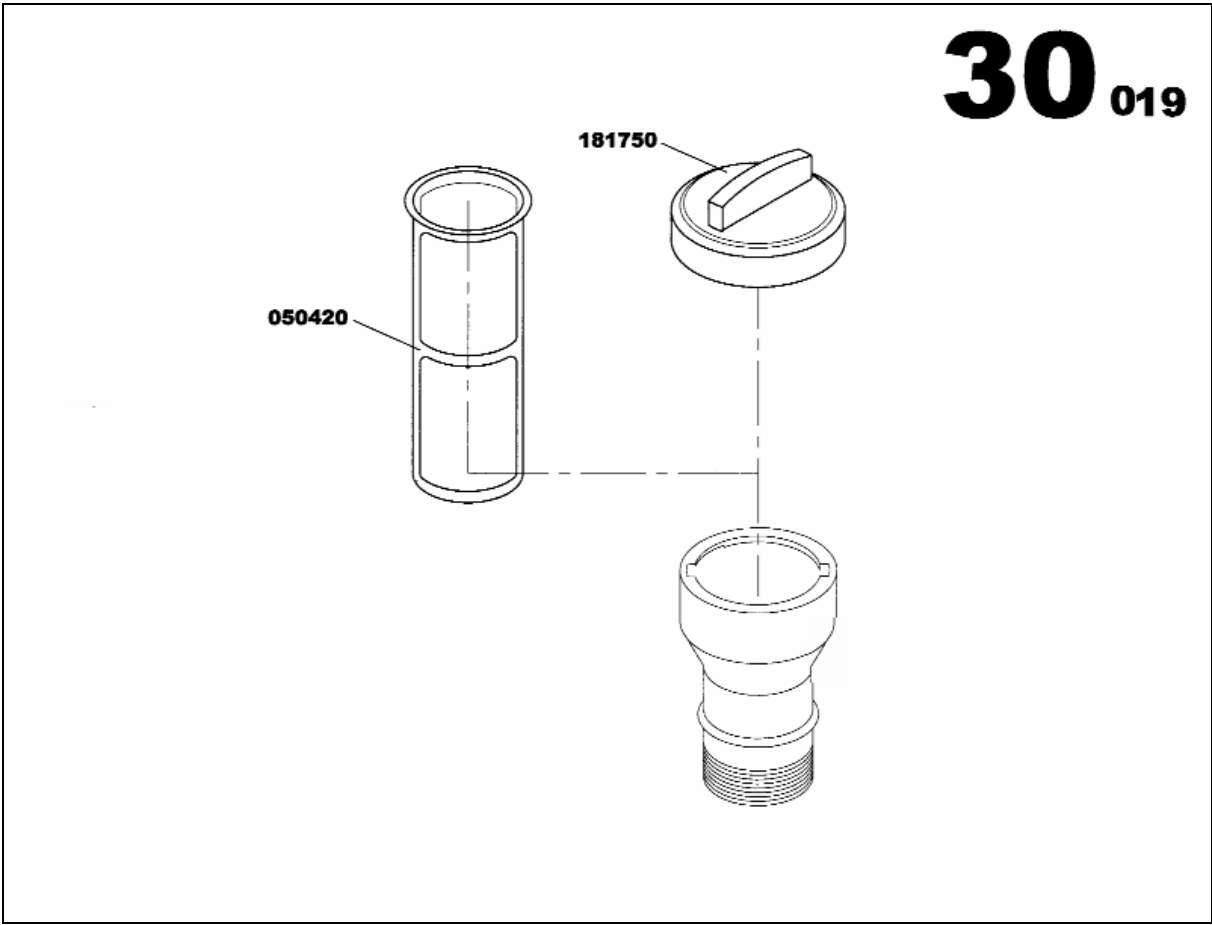
F05013



Item	Part number	Description	Quantity	Units
050190	85417400	FUEL SUCTION PIPE L280 D10 1/2G	2.0	UN
050310	85422517	FUEL FILLING CUTOUT FRAME CLOSING PANEL	1.0	UN
050110	85403517	FUEL FILLER BASE FUEL TANK	1.0	UN
050120	85403509	LEVEL SENSOR ADAPTER	1.0	UN
110100	85404572	LEVEL SENSOR	1.0	UN
180130	85409068	SQUARE FLANGE GASKET 95x95 Th3	1.0	UN
180140	85409076	ROUND FLANGE GASKET 36x56 Th1	1.0	UN
181230	85417632	NON RETURN VALVE D10	1.0	UN

FUEL FILLER 050110 DETAILS

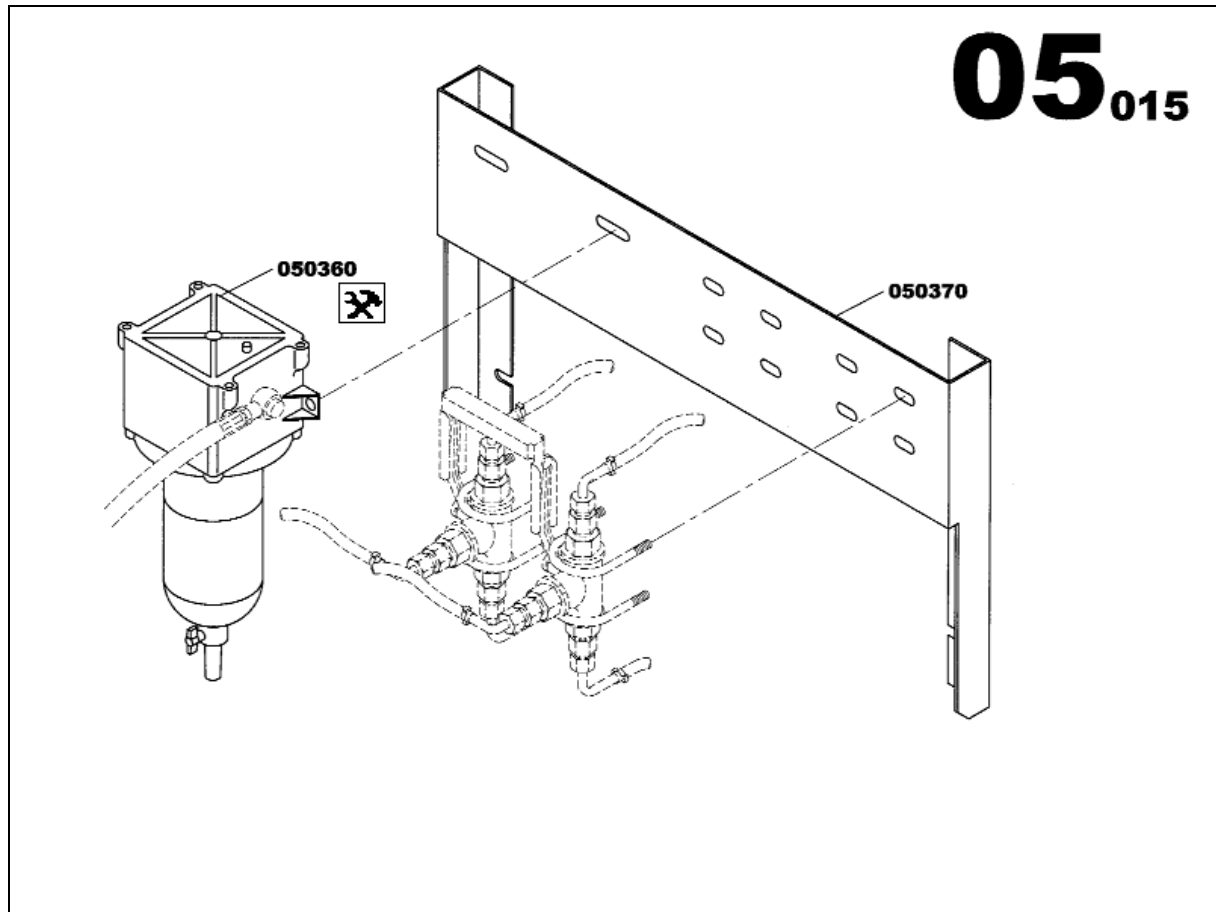
F30019



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
181750	85503035	TANK PLUG	1.0	UN
050420	85431120	FUEL FILTER	1.0	UN

FUEL PREFILTER KIT ASSEMBLY

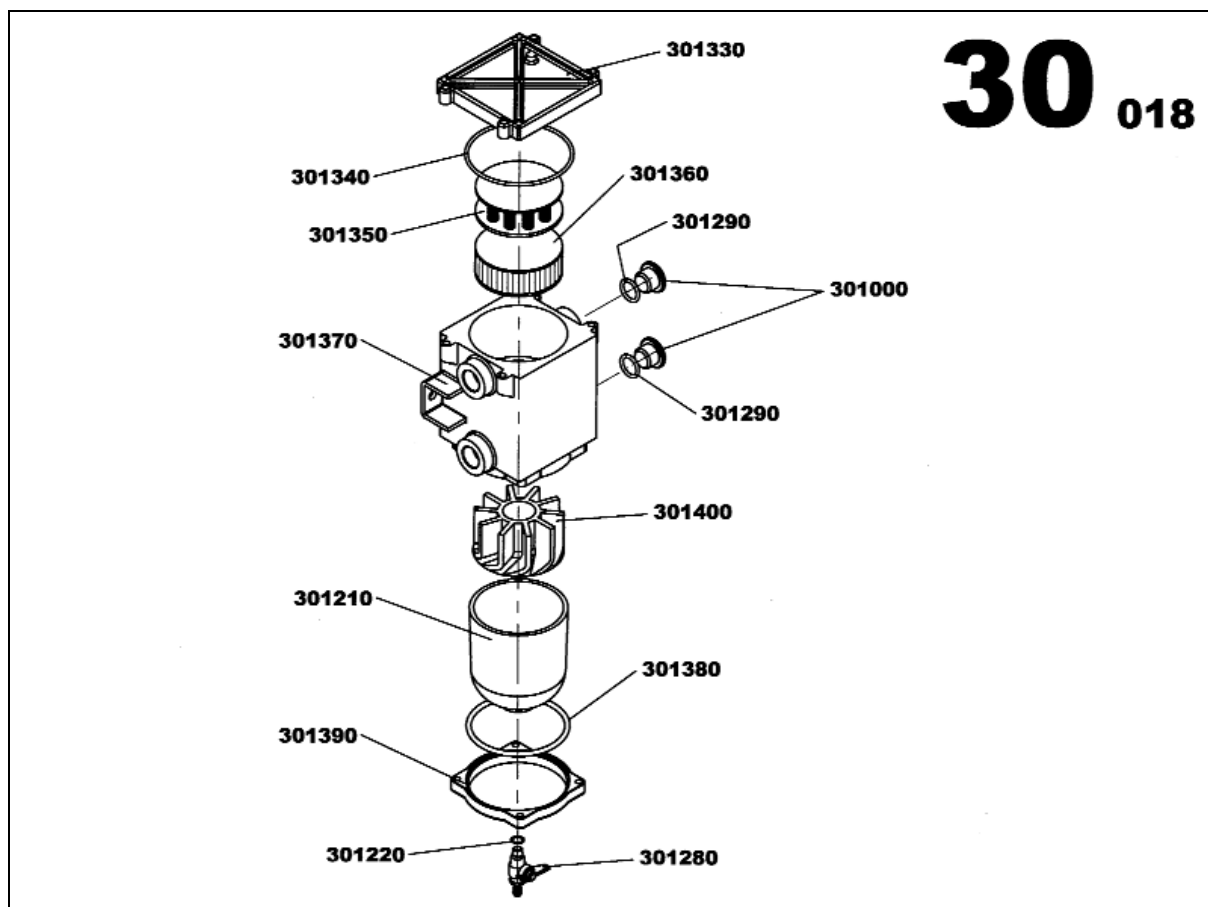
F05015



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
050360	85421451	DECANTATION CARTRIDGE FILTER	1.0	UN
050370	85424299	3 WAY FUEL VALVE BRACKET	1.0	UN

SEPARATOR FILTER 050360 DETAILS

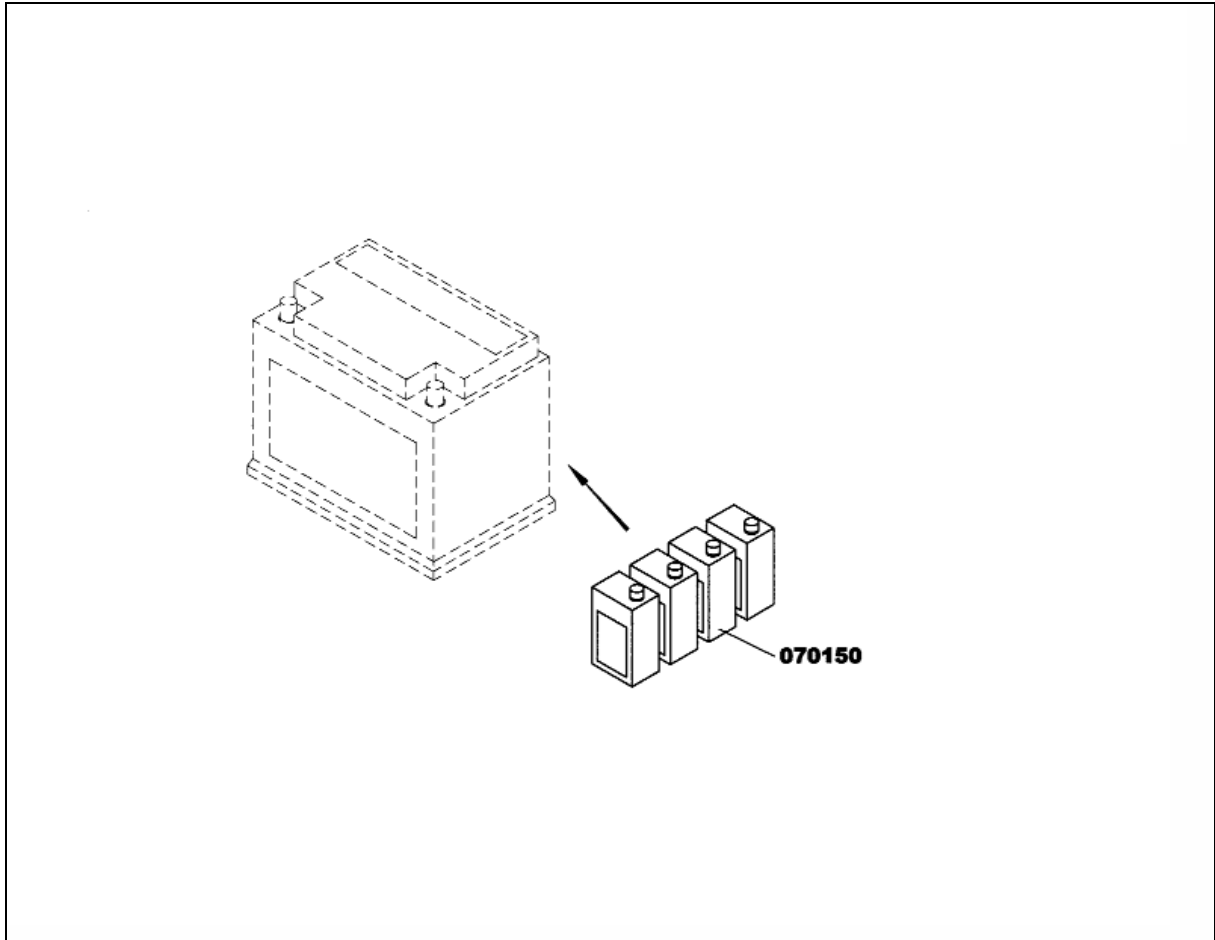
F30018



Item	Part number	Description	Quantity	Units
301330	85502557	SEPARATOR FILTER LID	1.0	UN
301340	85502581	SEPARATOR FILTER LID GASKET	1.0	UN
301350	85502599	SEPARATOR FILTER SPRING CASSETTE	1.0	UN
301360	85503027	SEPARATOR FILTER ELEMENT	1.0	UN
301370	85502938	SEPARATOR FILTER HOUSING	1.0	UN
301380	85502946	SEPARATOR FILTER BOWL GASKET	1.0	UN
301390	85502953	SEPARATOR FILTER BOWL RETAINER RING	1.0	UN
301400	85502961	SEPARATOR FILTER CENTRIFUGE	1.0	UN
301000	85502979	SEPARATOR FILTER BLIND SCREW	2.0	UN
301210	85502987	SEPARATOR FILTER BOWL	1.0	UN
301220	85502995	SEPARATOR FILTER O-RING	1.0	UN
301280	85503001	SEPARATOR FILTER DRAIN COCK	1.0	UN
301290	85503019	SEPARATOR FILTER GASKET POSITION 14	2.0	UN

BATTERY ELECTROLYTE

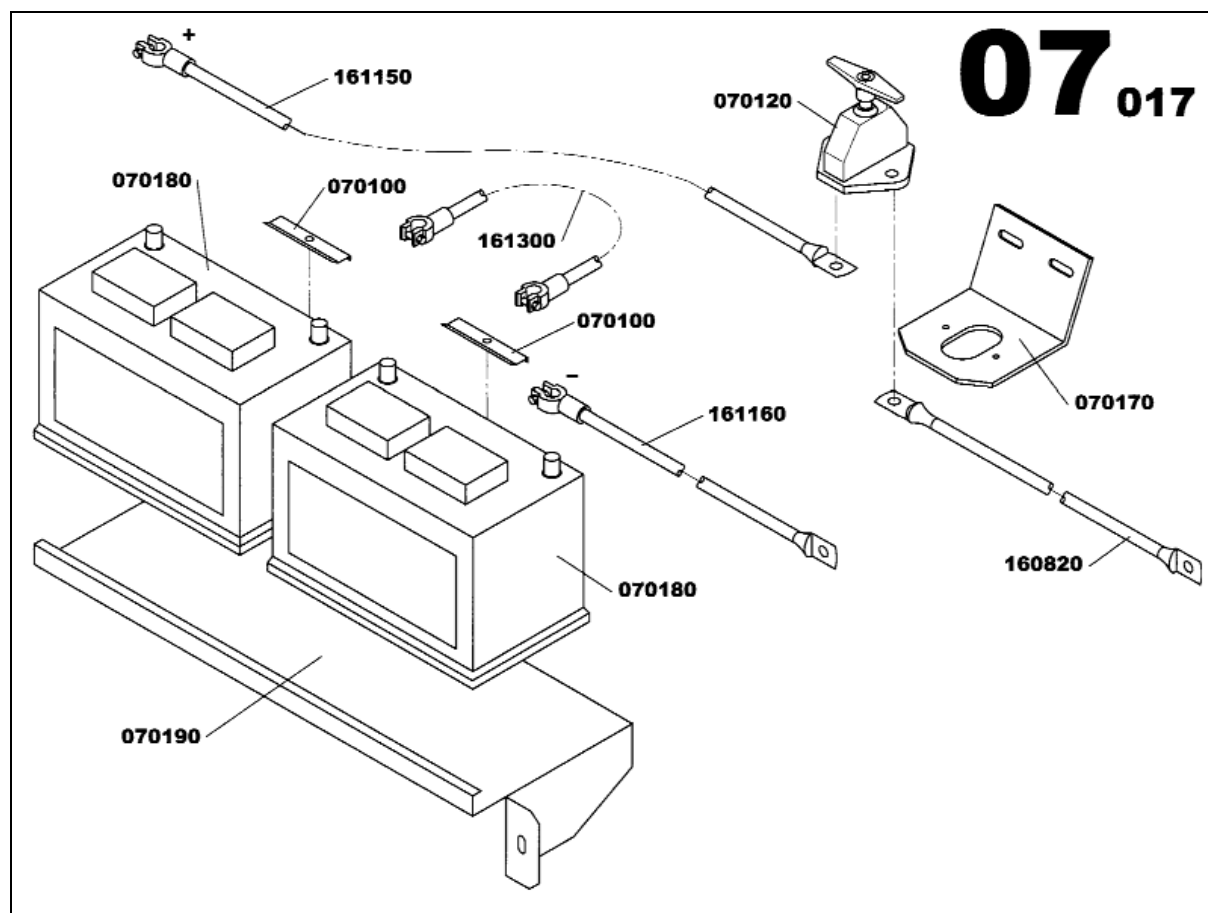
F99002



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
070150	85403756	BATTERY ELECTROLYTE	3.0	UN

ELECTRIC STARTER M413B ISOLATED ASSEMBLY

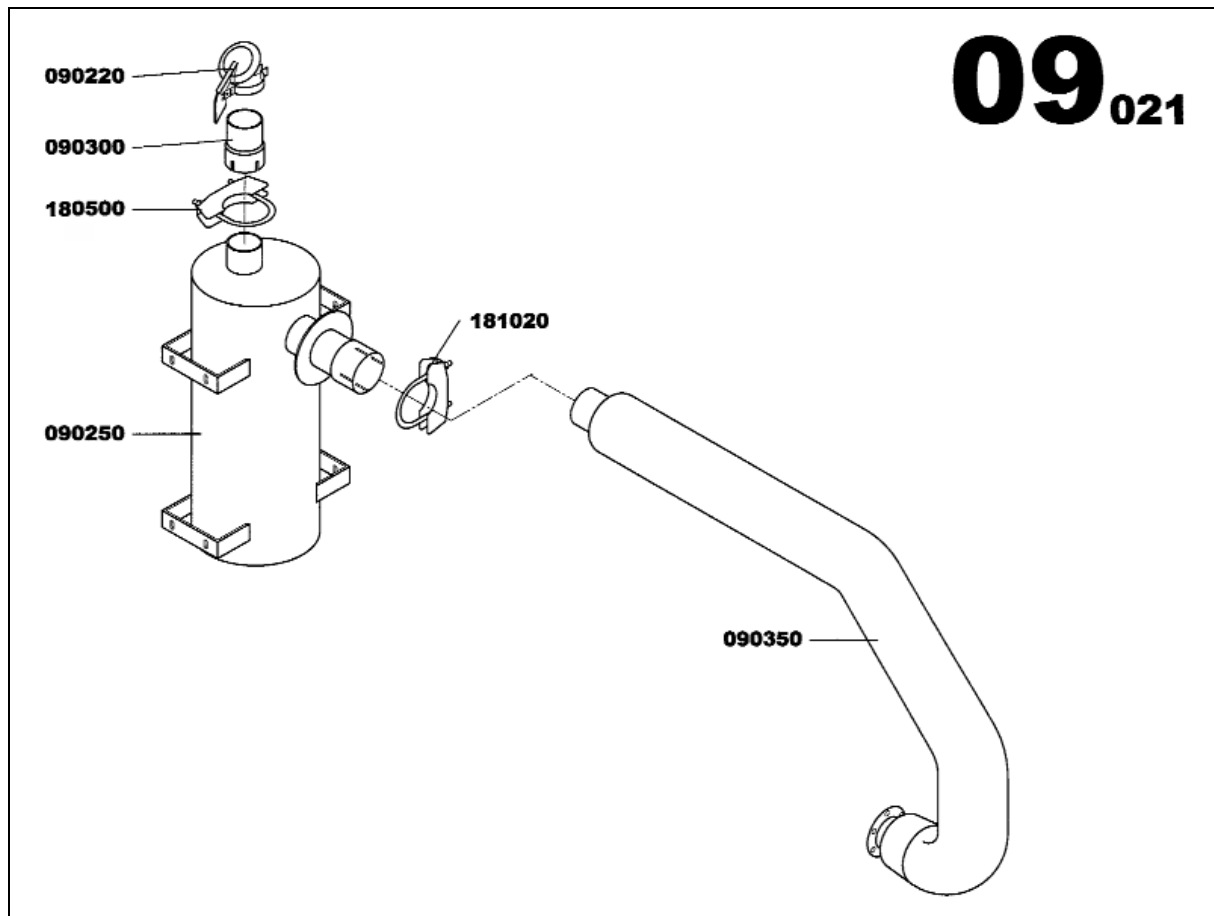
F07017



Item	Part number	Description	Quantity	Units
070100	85403699	BATTERY FIXING BRACKET	2.0	UN
070170	85403707	BATTERY ISOLATOR BRACKET	1.0	UN
070190	85423630	BATTERY SUPPORT BRACKET M413BESI	1.0	UN
070120	85403723	BATTERY ISOLATOR SWITCH	1.0	UN
070180	85403731	STARTING BATTERY 12V 100Ah 450A	2.0	UN
161150	85417293	BATTERY CABLE(+) 50mm2 L1000 RED	1.0	UN
161160	85417244	BATTERY CABLE(-) 70mm2 L1000 BLACK	1.0	UN
160820	85426351	BATTERY CABLE 70mm2 L700 RED	1.0	UN
161300	85417202	BATTERY CABLE 50mm2 L195 BLACK	1.0	UN

EXHAUST SYSTEM M413BESI ASSEMBLY

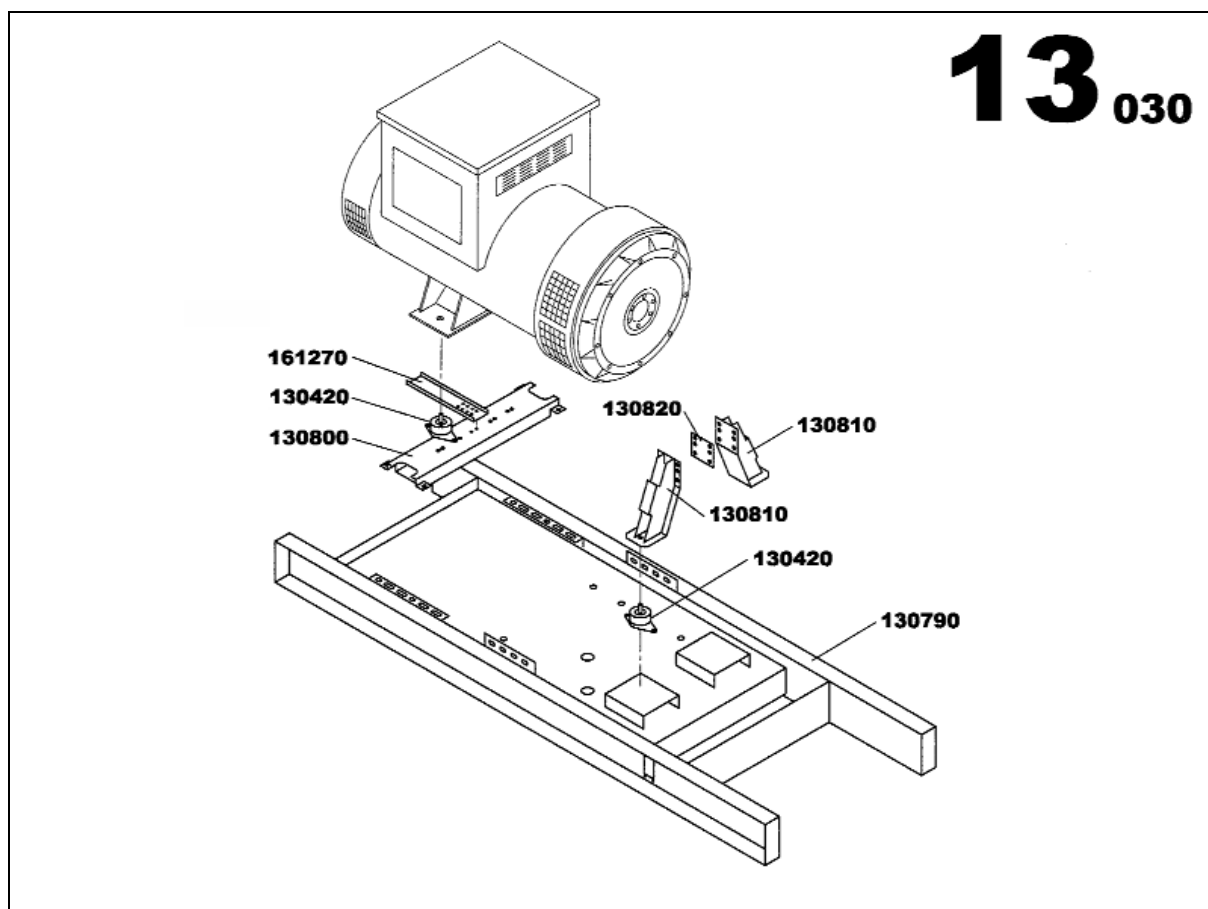
F09021



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
090250	85423606	29dB MUFFLER	1.0	UN
090300	85422772	MUFFLER EXTENSION D114XL170	1.0	UN
090220	85404341	EXHAUST RAIN FLAP D114	1.0	UN
090350	85421857	EXHAUST PIPE M413B D102 VOLVO	1.0	UN
181020	85417798	HOSE CLAMP D105	1.0	UN
180500	85409381	HOSE CLAMP D120	1.0	UN

FRAME M413B VO TWD7L ASSEMBLY

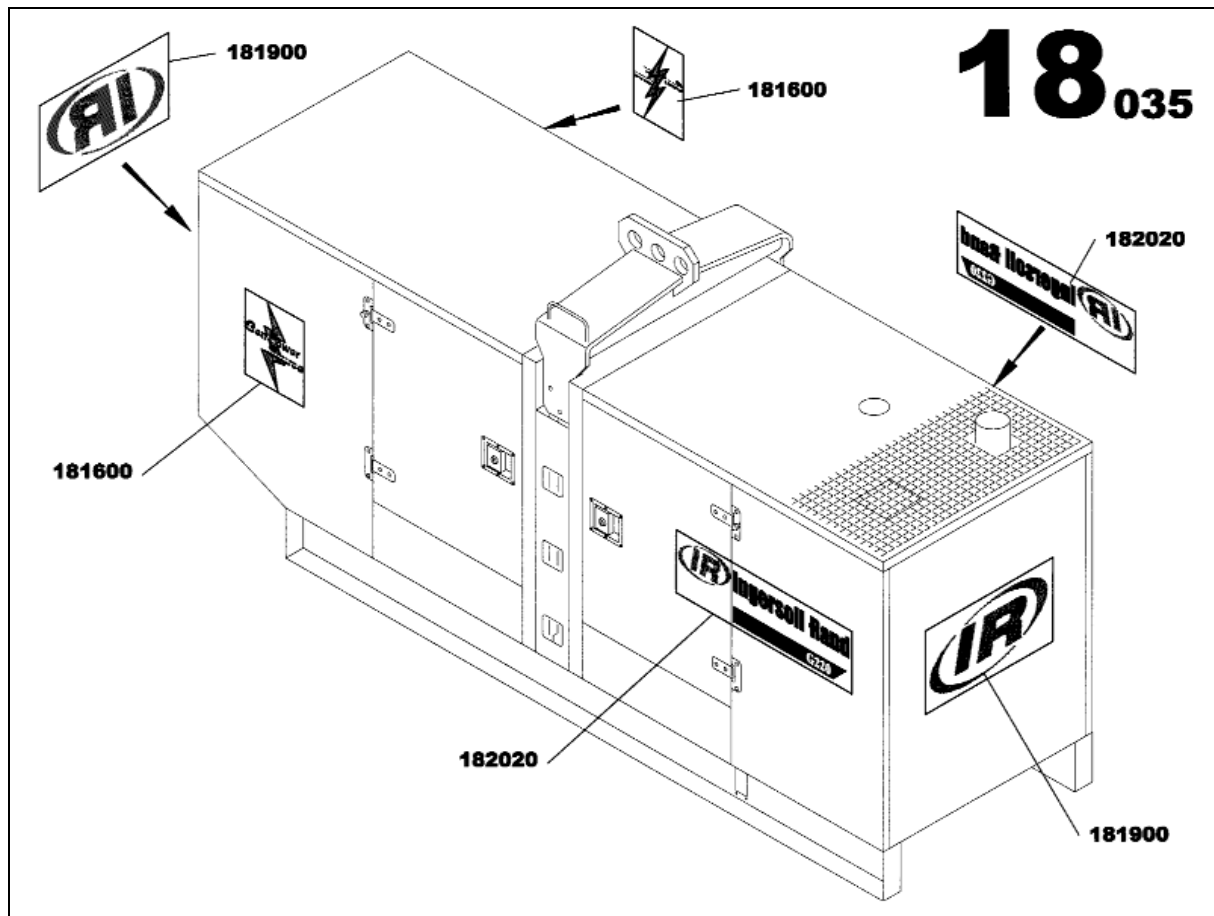
F13030



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
130800	85424760	ALTERNATOR TRAVERSE M413B	1.0	UN
130810	85423960	ENGINE SUPPORT VOLVO 6/7L LEFT RIGHT SIDE	2.0	UN
130820	85417392	RECTANGULAR ENGINE SHIM 7L VOLVO ENGINE	1.0	UN
130790	85417624	M413BESI FRAME TANK FOR VOLVO 7L	1.0	UN
130420	85401883	ANTI-VIBRATION MOUNT 330daN 3.5mm	4.0	UN
161270	85423846	ELECTRIC WIRING BRACKET T921	1.0	UN

G220 DECALS

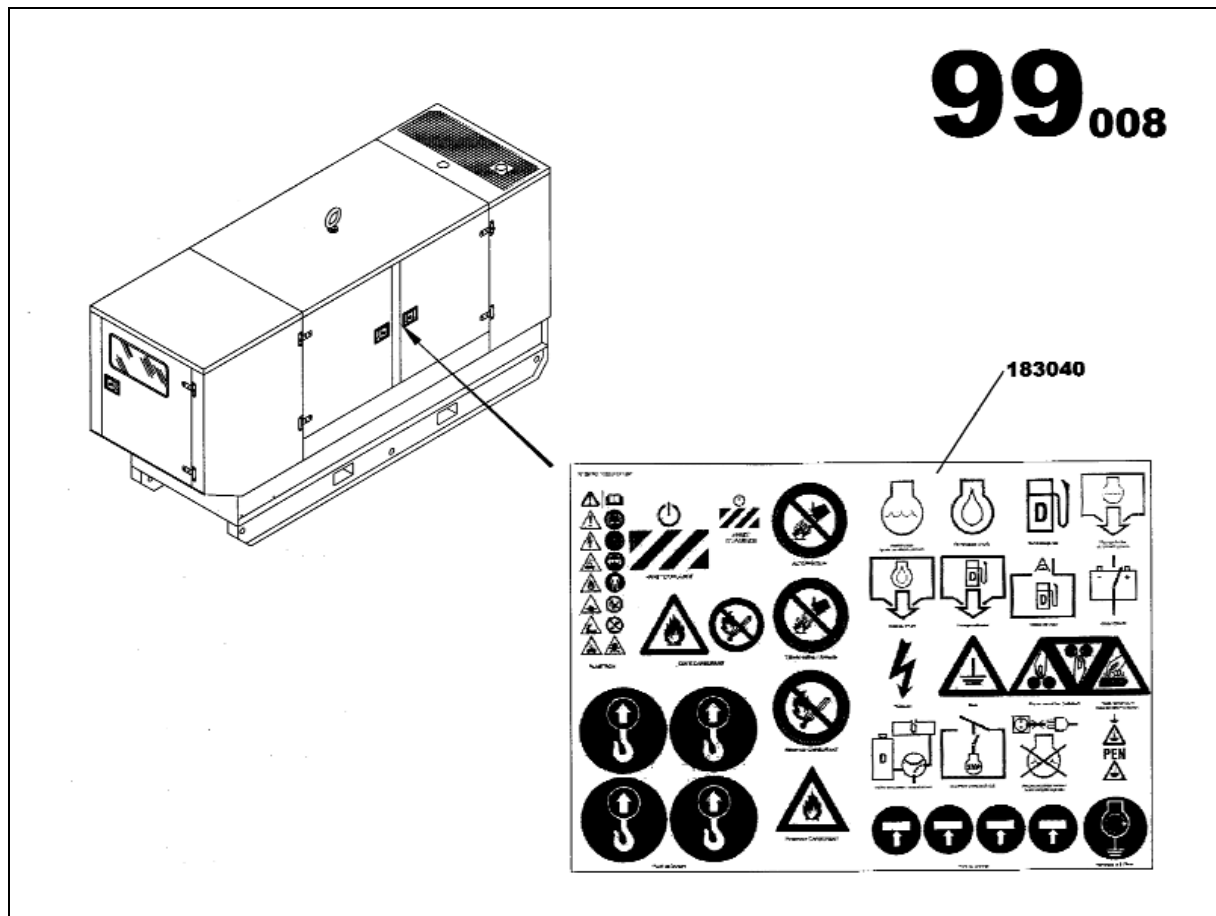
F18035



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
181600	85428019	RECTANGULAR STICKER 450x600	2.0	UN
181900	85500213	ROUND STICKER D385	2.0	UN
182020	85503845	RECTANGULAR STICKER 1100x325	2.0	UN

SAFETY DECALS ASSEMBLY

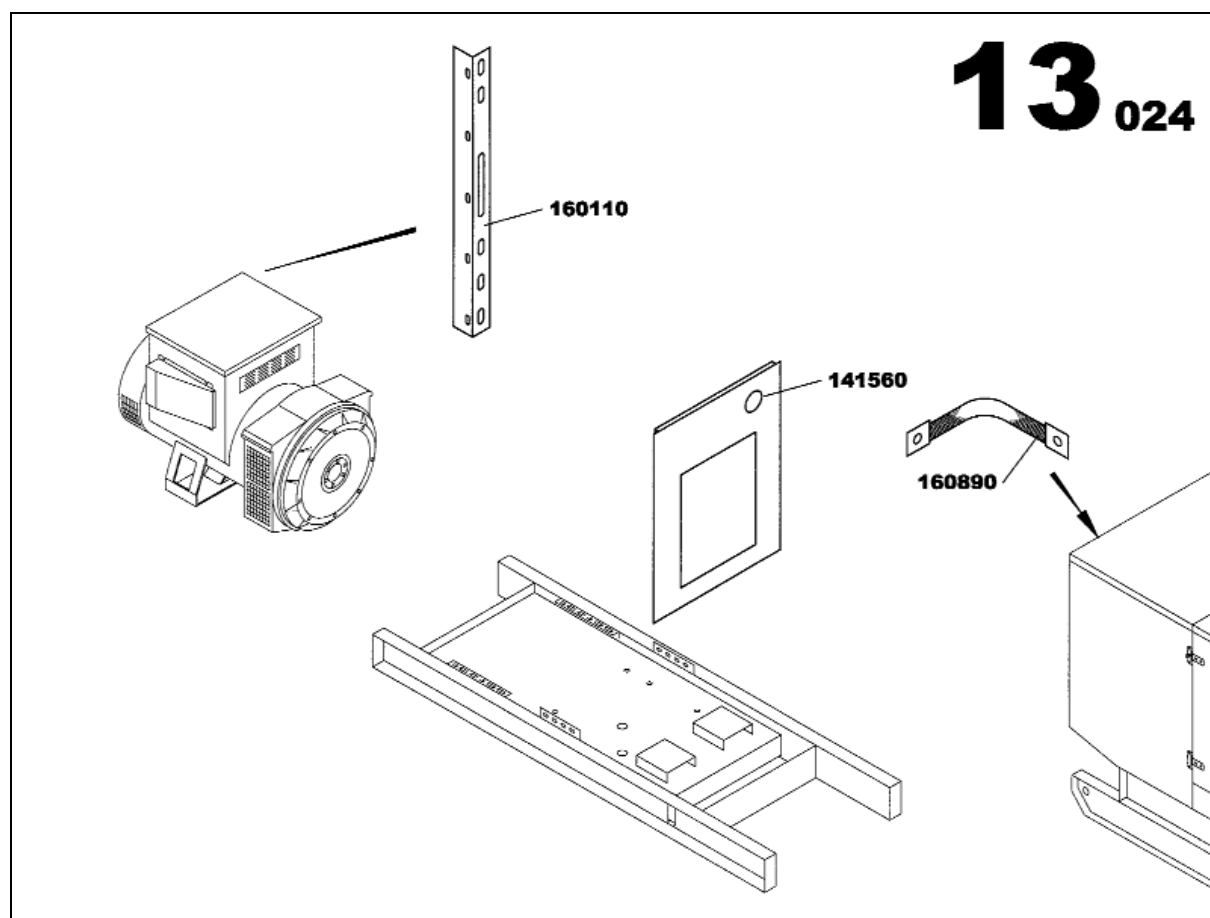
F99008



Item	Part number	Description	Quantity	Units
183040	85506467	SAFETY DECAL	1.0	UN

MISCELLANEOUS CANOPY ASSEMBLY

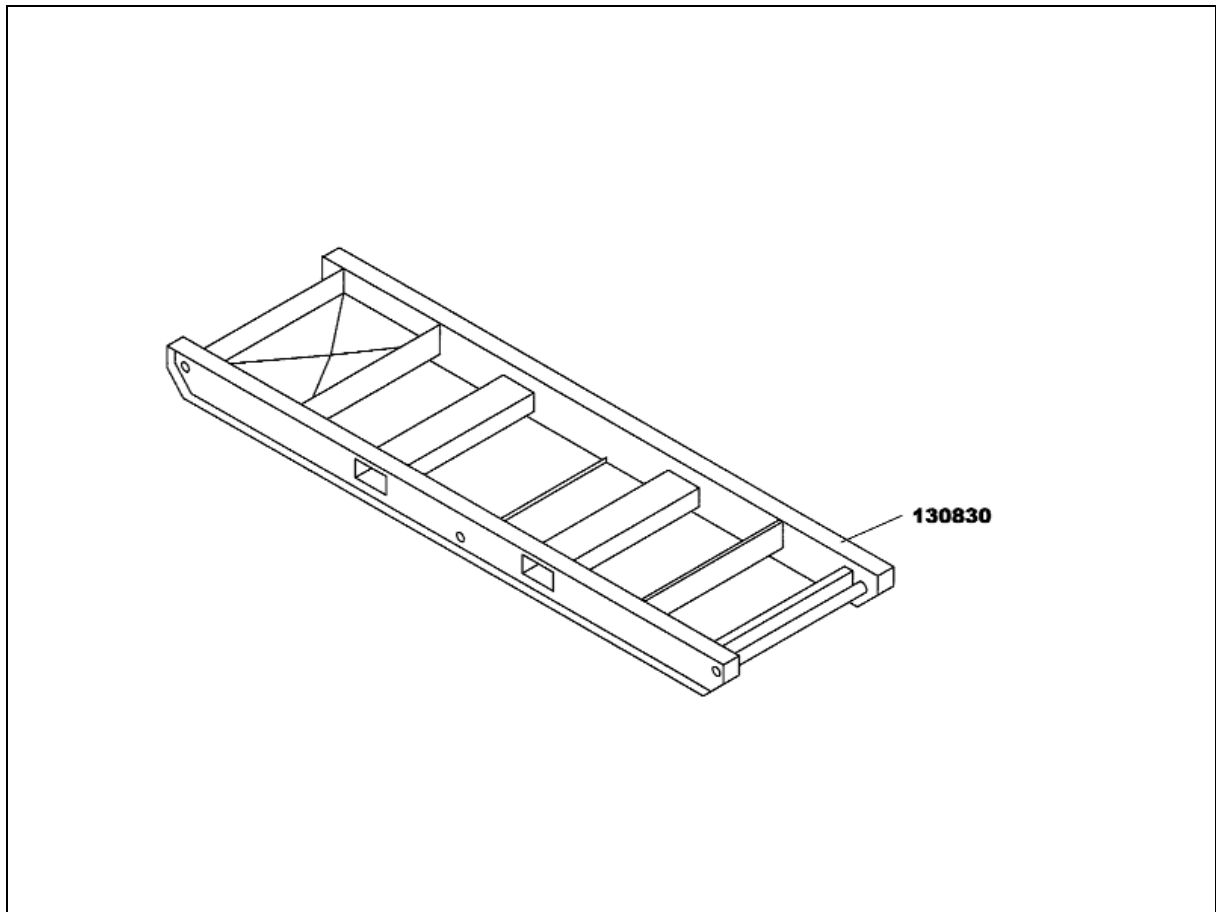
F13024



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
141560	85424588	RADIATOR PANEL M413B VOLVO TWD7L	1.0	UN
160110	85406940	WIRING BRACKET	2.0	UN
160890	85406460	GROUND WIRES 16mm2	4.0	UN

RETENTION BUND M413 BESIL

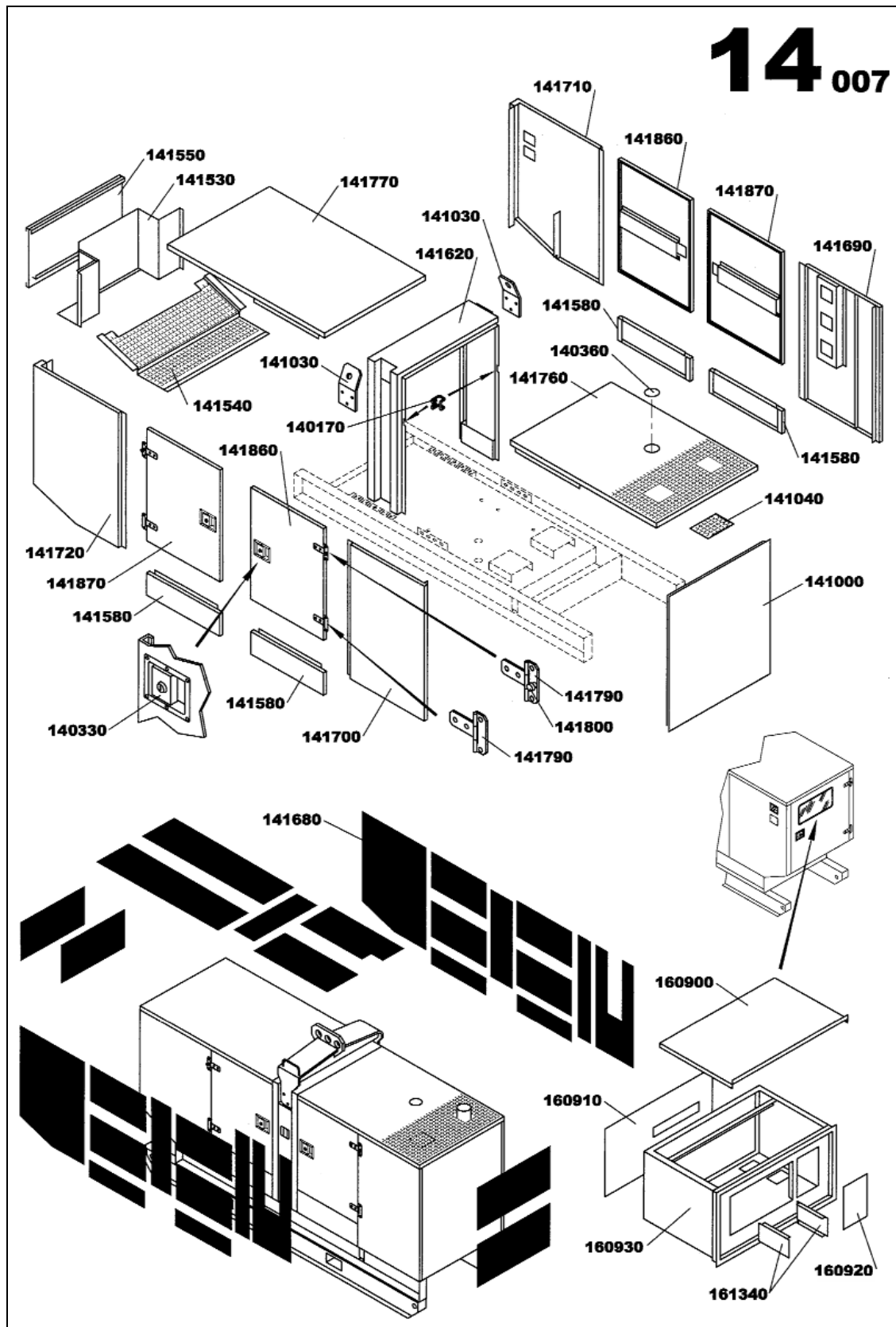
F99006



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
130830	85416808	HIRETECH RETENTION BUND M413 BESIL	1.0	UN

M413BESIL CANOPY ASSEMBLY

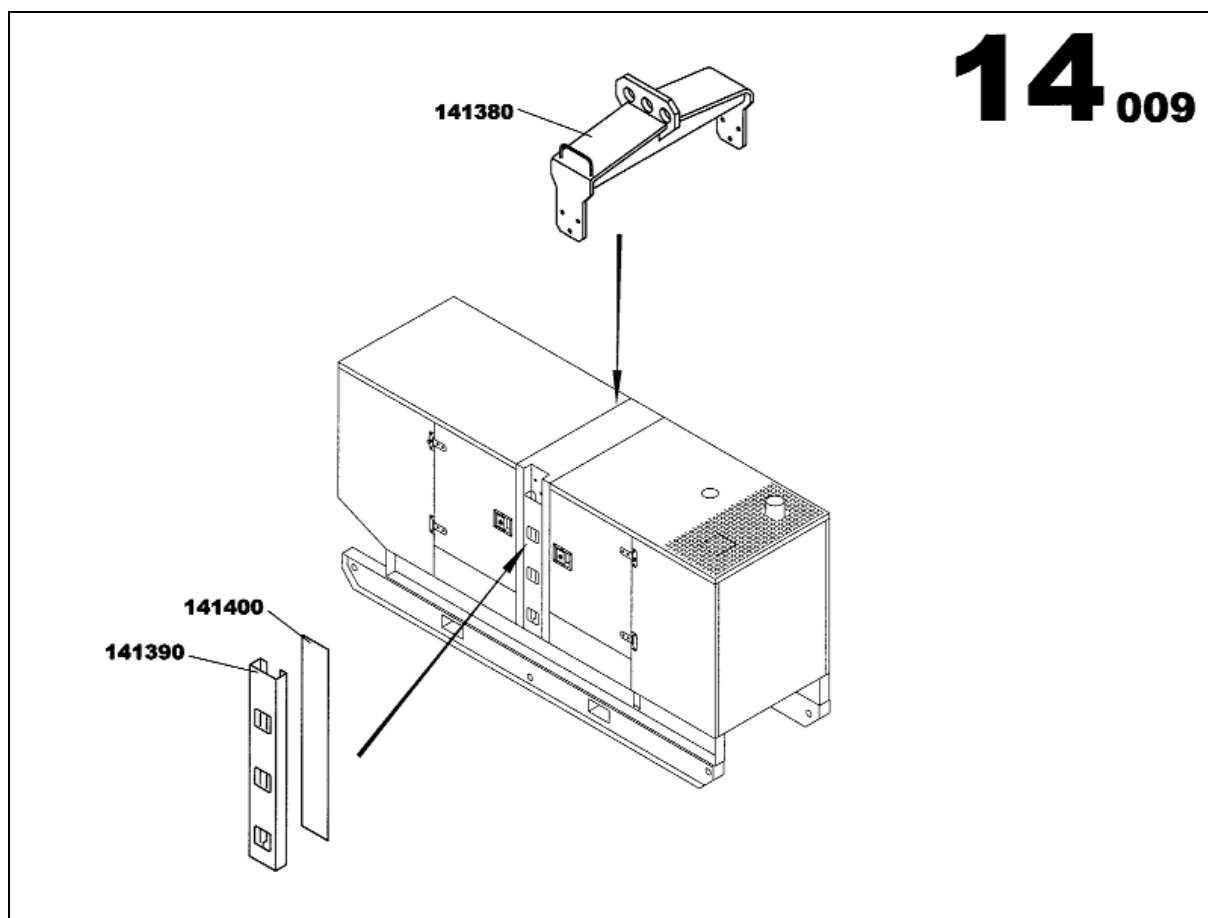
F14007



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
141000	85424430	FRONT HOOD CLOSURE PANEL	1.0	UN
141030	85422483	LIFTING BRACKET M400	2.0	UN
141040	85421584	EXHAUST AIR GRILL	1.0	UN
141530	85417863	AIR DEFLECTOR M413B REAR	1.0	UN
141540	85421550	AIR INLET LOUVER M413B/SSI	1.0	UN
141550	85417871	AIR DEFLECTOR M413BSSI REAR	1.0	UN
141580	85422376	CANOPY SIDE PANEL M413BESI	4.0	UN
141620	85416782	CENTRAL SUPPORT BAIL M413 ESIL	1.0	UN
141680	85421949	SOUNDPROOF PANELS BATCH M413ESI	1.0	UN
141690	85422301	RIGHT FORWARD PLENUM PANEL M413BESI	1.0	UN
141700	85422327	LEFT FORWARD PLENUM PANEL M413BESI	1.0	UN
141710	85422343	RIGHT REAR PLENUM PANEL M413BESIL	1.0	UN
141720	85422350	LEFT REAR PLENUM PANEL M413BESIL	1.0	UN
141760	85424372	FRONT CANOPY TOP M413BESI	1.0	UN
141770	85424364	REAR CANOPY TOP M413BESI	1.0	UN
140330	85406148	CANOPY DOOR LOCK KEY LOCK	4.0	UN
141790	85417558	DOOR HINGE	8.0	UN
141800	85422582	ANTI-VIBRATION MOUNT 140daN 15mm	4.0	UN
140360	85406205	PLUG D100	1.0	UN
140170	85492460	STRIKER PLATE M223/216 CANOPY DOOR	4.0	UN
141860	85422699	CANOPY DOOR M413BESI HINGE ON RIGHT	2.0	UN
141870	85422707	CANOPY DOOR M413BESI HINGE ON LEFT	2.0	UN
160900	85406437	CONTROL PANEL HOUSING	1.0	UN
160910	85406445	REAR PLATE M403 CONTROL PANEL HOUSING	1.0	UN
161340	85423952	SLIDE BRACKET T9000/M216B/214B	2.0	UN
160920	85407138	RACK CLOSURE PANEL	1.0	UN
160930	85407369	CONTROL PANEL HOUSING R3000	1.0	UN

CENTRAL LIFTING BAIL ASSEMBLY

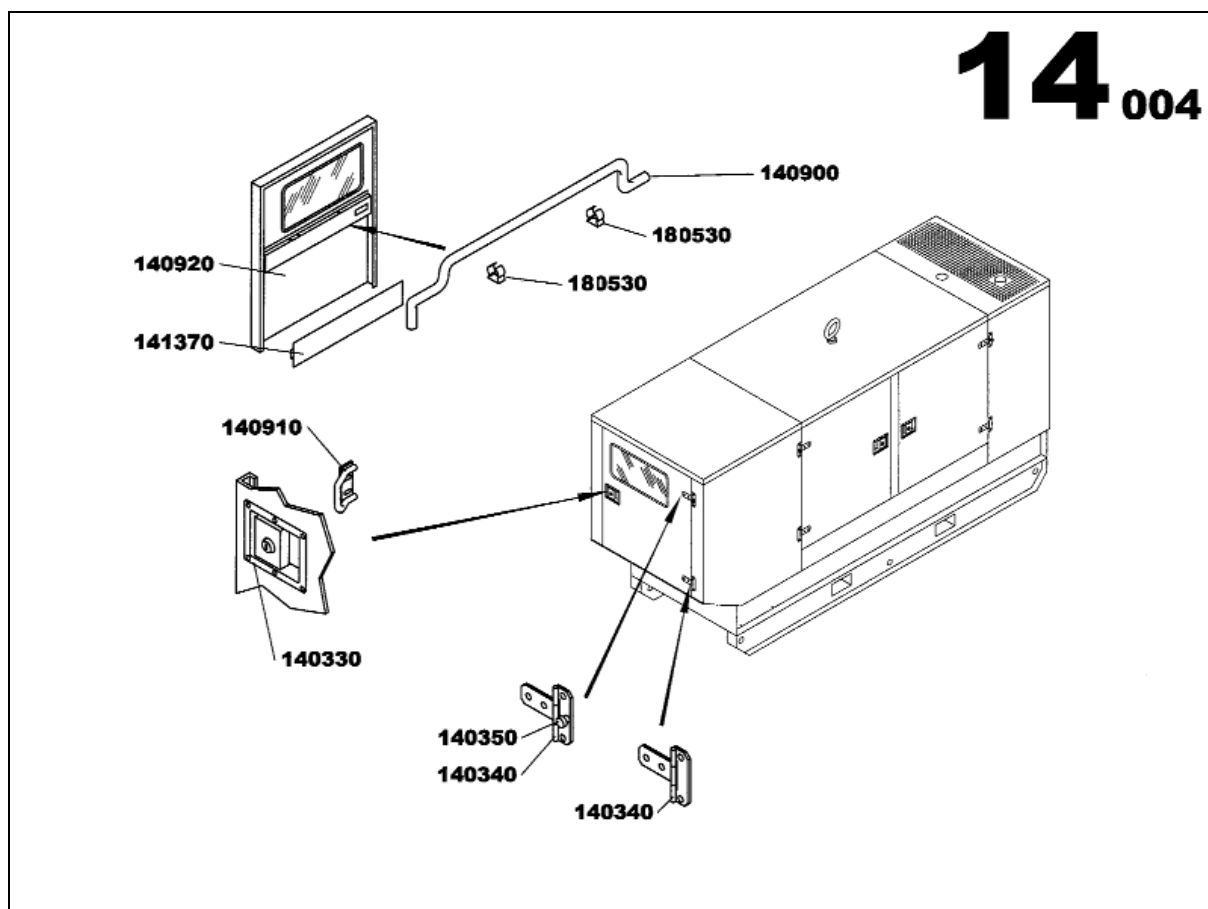
F14009



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
141380	85422228	LIFTING FRAME 3500daN M403BL/M413BL CANOPY	1.0	UN
141390	85417988	LADDER M403BL	1.0	UN
141400	85422541	LADDER PROTECTION PANEL M403BL	1.0	UN

CONTROL PANEL DOOR M216/413ESIL ASSEMBLY

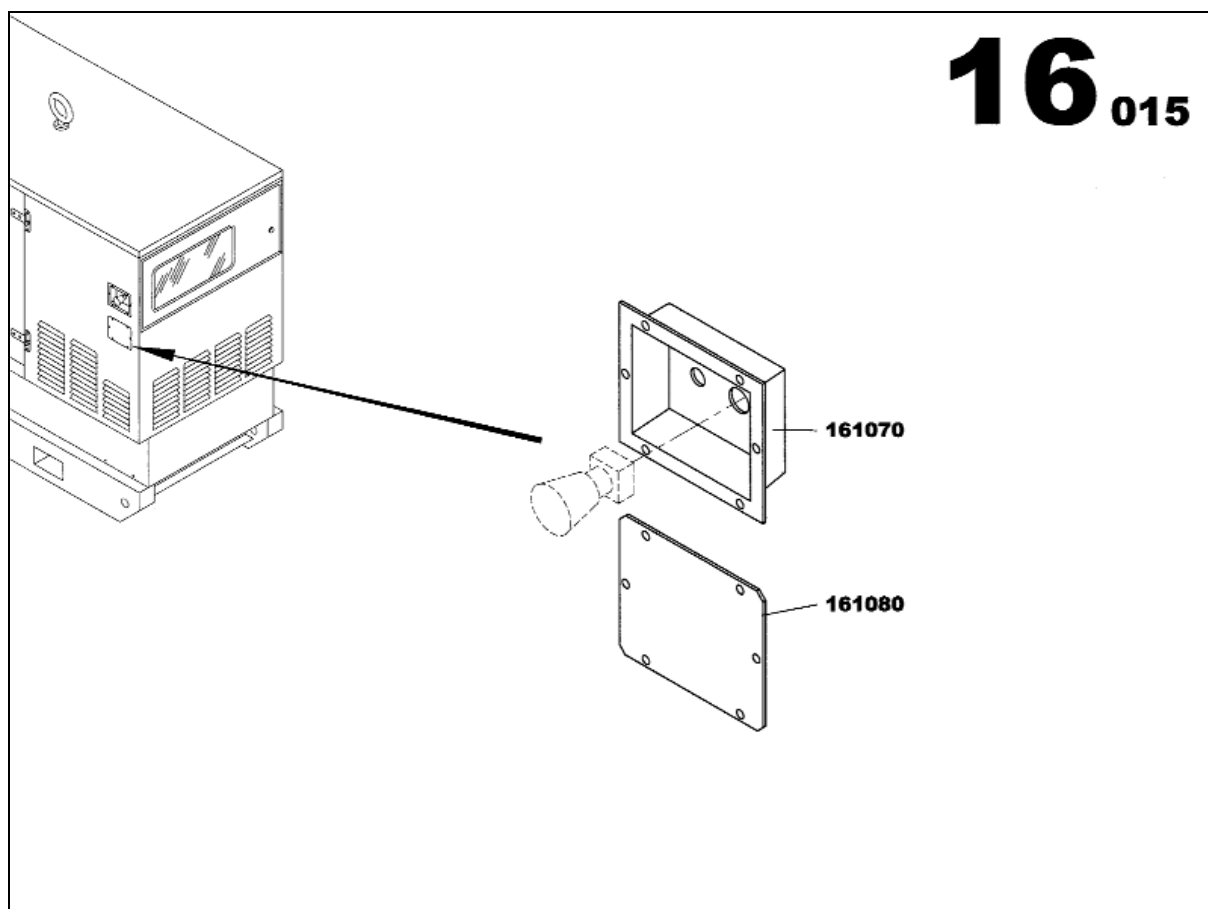
F14004



Item	Part number	Description	Quantity	Units
141370	85405454	DOCUMENT FILE M403BSIL	1.0	UN
140900	85405462	DOOR STOP M400B	1.0	UN
140330	85406148	CANOPY DOOR LOCK KEY LOCK	1.0	UN
140340	85406155	DOOR HINGE h100XL125	2.0	UN
140350	85406189	ANTI-VIBRATION MOUNT 140daN 15mm	1.0	UN
140910	85406262	STRIKER PLATE M216/413BL CANOPY MCPS DOOR	1.0	UN
140920	85406296	CONTROL PANEL DOOR M216SIL	1.0	UN
180530	85409498	CLIP-ON BRACKET	2.0	UN
180540	85409506	CLIP-ON BRACKET	1.0	UN

EMERGENCY STOP PANEL ASSEMBLY

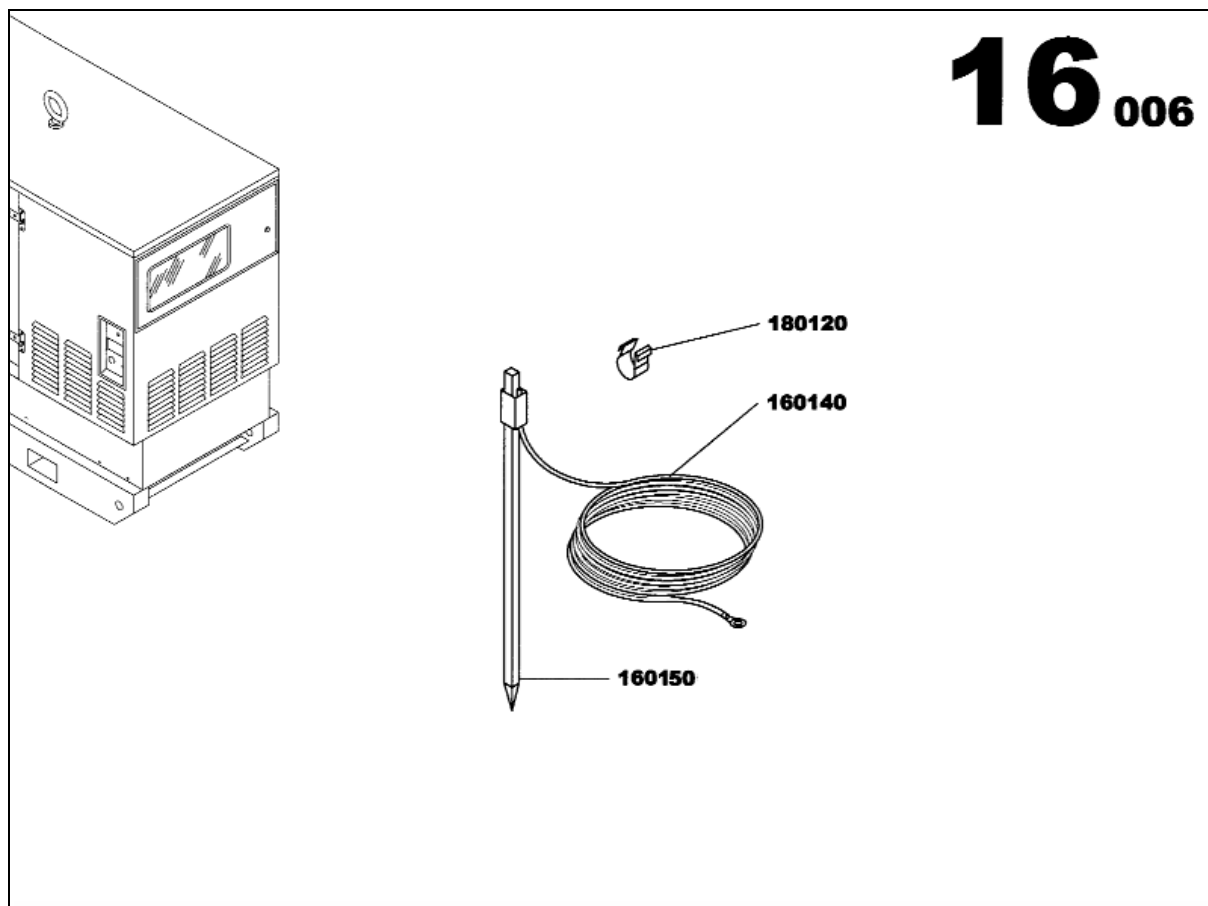
F16015



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
161080	85406726	BRACKET CLOSURE PANEL	1.0	UN
161070	85407294	EMERGENCY STOP PANEL	1.0	UN

EARTH ROD WITH CABLE M100/200 CANOPY ASSEMBLY

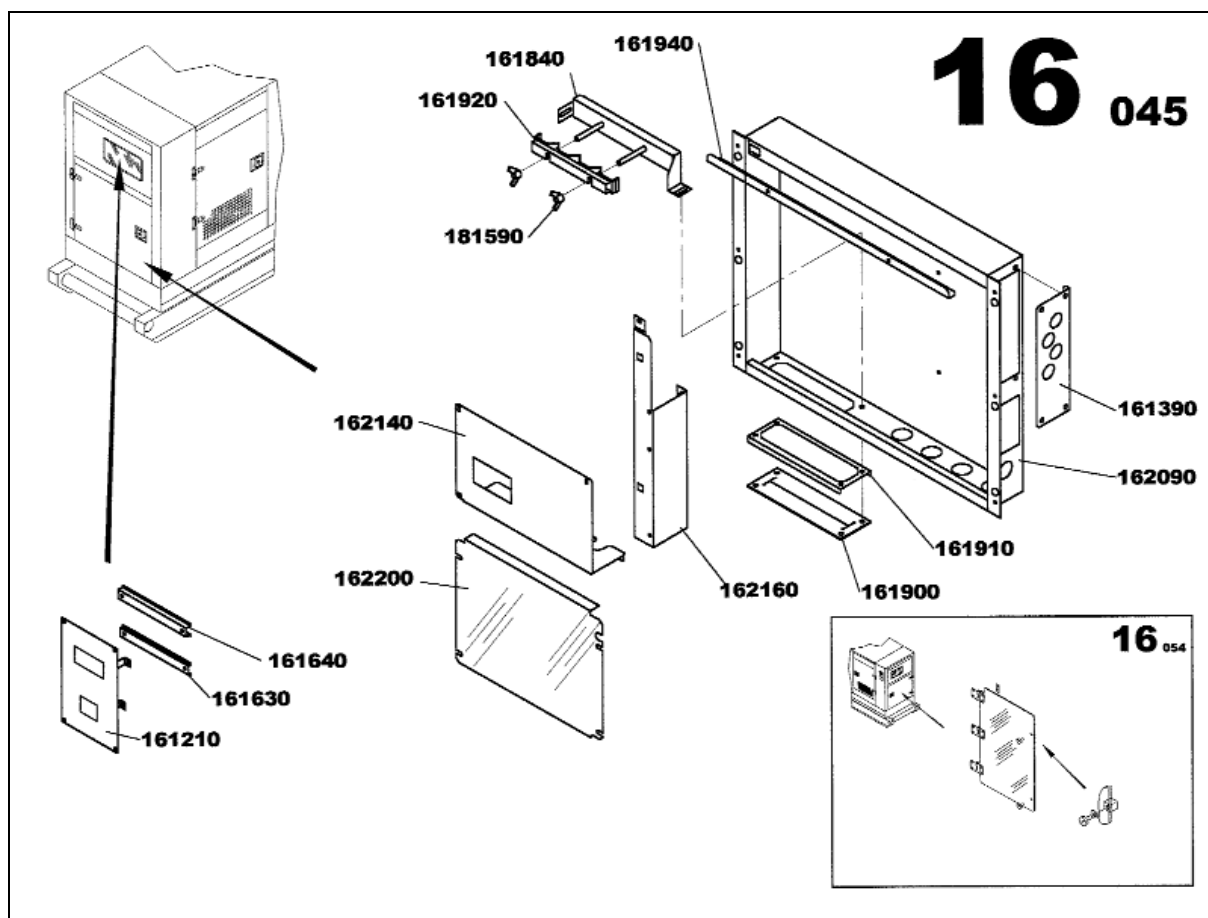
F16006



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
160140	85408227	NEUTRAL/EARTH SYSTEM CABLE 25mm2 L10000 Gr/Ye	1.0	UN
160150	85408334	EARTH ROD L1000	1.0	UN
180120	85409191	CLIP-ON BRACKET	2.0	UN

TERMINAL BLOCK HOUSING 250<I<=480A ASSEMBLY

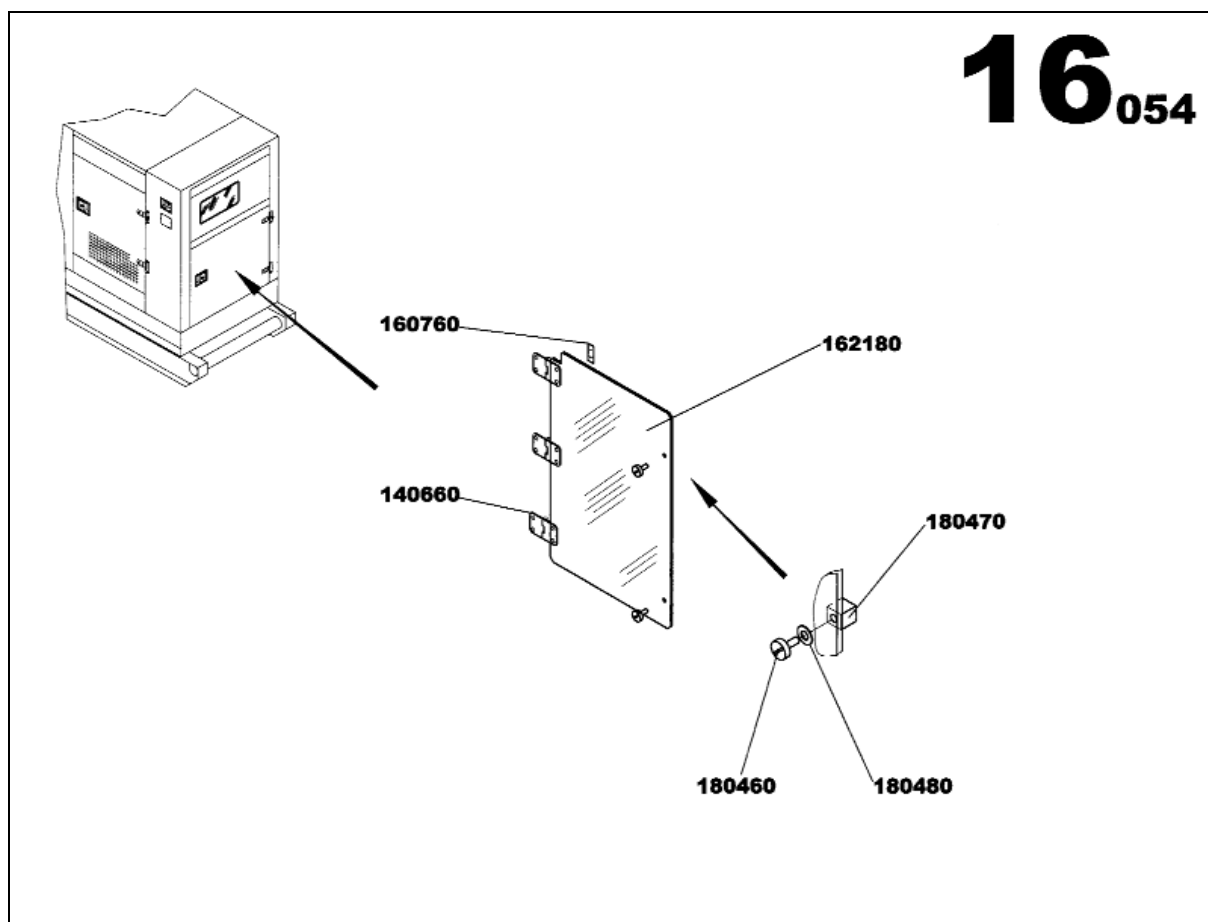
F16045



Item	Part number	Description	Quantity	Units
161390	85424067	GLAND NUT PLATE M204BL/205BL	1.0	UN
161900	85417111	CABLE OUTPUT RUBBER SCREEN	1.0	UN
161910	85423739	WIRE BIB OUTPUT BRACKET M403BL	1.0	UN
161940	85417822	PANEL ANGLE BAR M403BL	1.0	UN
161630	85423341	ELECTRIC DIN RAIL 35x7.5	1.0	UN
161640	85423358	ELECTRIC DIN RAIL 35x7.5	1.0	UN
161210	85423812	DIFFERENTIAL CIRCUIT BREAKER BRACKET	1.0	UN
162090	85423796	CIRCUIT BREAKER BRACKET M403BL	1.0	UN
162140	85424414	CIRCUIT BREAKER PROTECTION PANEL	1.0	UN
162160	85424612	ISOLATION PANEL MCPS 250A	1.0	UN
161840	85423937	CABLE FIXING BRACKET MCPS M403BL	1.0	UN
161920	85423945	CABLE FIXING BRACKET MCPS M403BL	1.0	UN
181590	85418085	WING NUT	2.0	UN
162200	85418051	CIRCUIT BREAKER PROTECTION PLATE	1.0	UN

PANEL DOOR M403BL ASSEMBLY

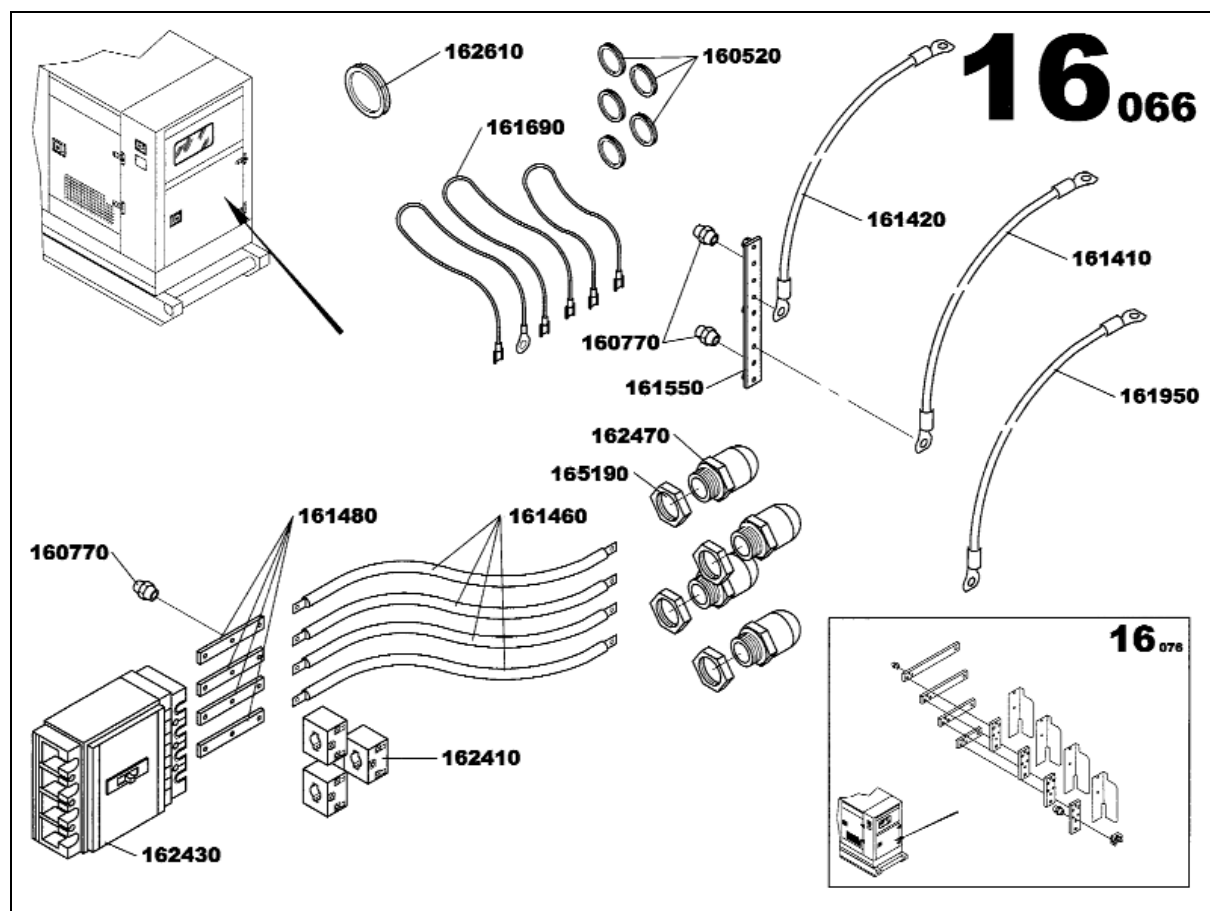
F16054



Item	Part number	Description	Quantity	Units
140660	85406130	DOOR HINGE h50XL50	3.0	UN
162180	85422756	TERMINAL CONNECTION DOOR M403BL CANOPY	1.0	UN
160760	85407708	HINGE FIXING PLATE M214BL	3.0	UN
180460	85409225	1/4 TURN SCREW D9	2.0	UN
180470	85409233	CAPTIVE NUT FOR 1/4 TURN BOLT	2.0	UN
180480	85409241	WASHER FOR 1/4 TURN FASTENER	2.0	UN

POWER TERMINAL CONNECTIONS 360A ASSEMBLY

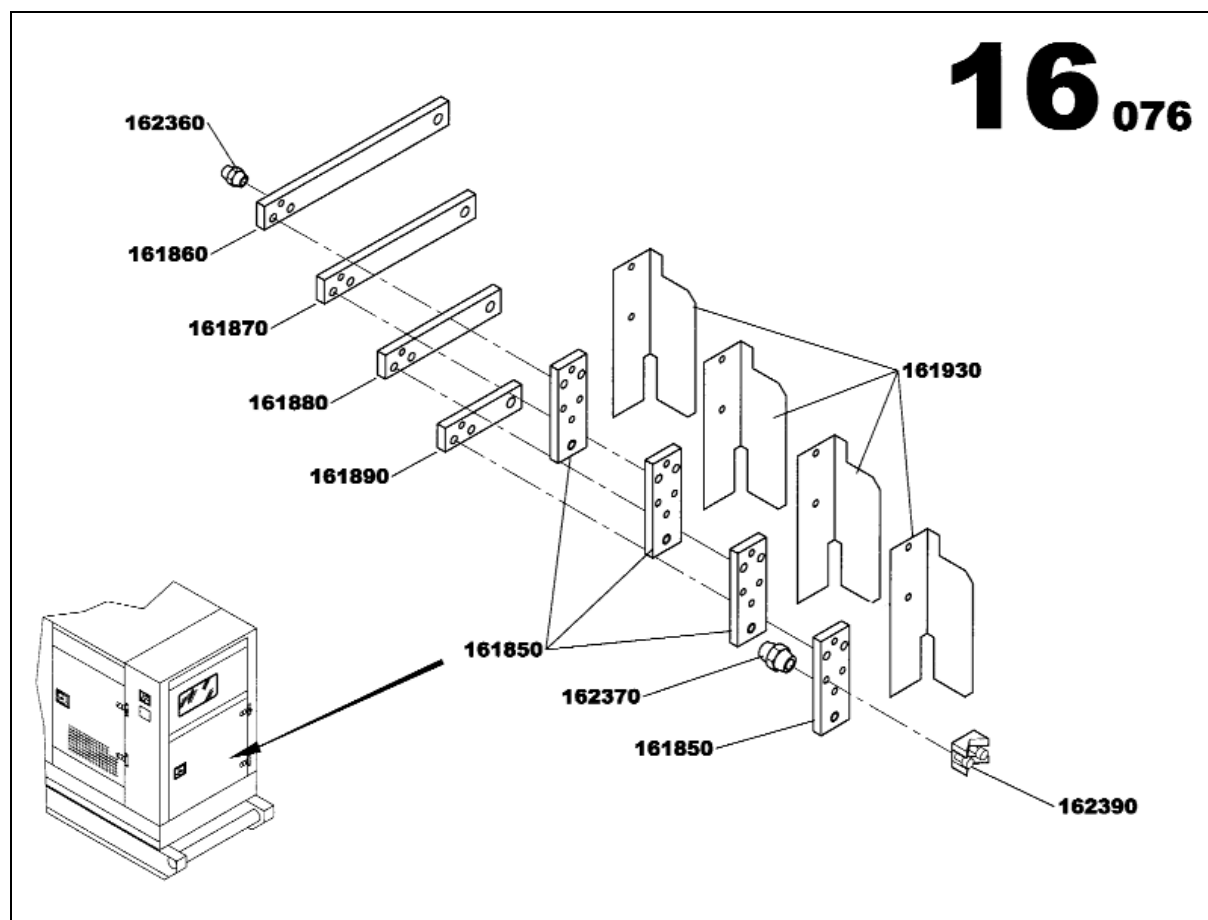
F16066



Item	Part number	Description	Quantity	Units
161410	85417319	EARTHING CABLE D8xD10 25mm2 L2500 Gr/Ye	1.0	UN
161420	85406601	EARTHING CABLE D8xD10 25mm2 L1800 Gr/Ye	1.0	UN
161460	85417335	POWER CABLE SINGLE CORE 100mm2 L1800	4.0	UN
161480	85416915	COPPER BAR 10x30 L125	4.0	UN
161550	85416899	COPPER BAR 5x25 L220 MCPS M400BL	1.0	UN
161690	85406981	CURRENT TRANSFORMER WIRING 2.5mm2 L350 Gr/Ye	1.0	UN
161950	85417368	NEUTRAL/EARTH SYSTEM CABLE 25mm2 L800 Gr/Ye	1.0	UN
160770	85408342	INSULATION PIN	3.0	UN
160520	85408391	RUBBER GROMMET D47	5.0	UN
162410	85424679	CURRENT TRANSFORMER 400/5	3.0	UN
162430	85417905	COMPACT CIRCUIT BREAKER 4x400A	1.0	UN
162470	85415479	GLAND NUT PG29	4.0	UN
165190	85413284	GLAND NUT PG29	4.0	UN
162610	85422442	RUBBER GROMMET D79	1.0	UN

TERMINAL CONNECTION BLOCK ASSEMBLY

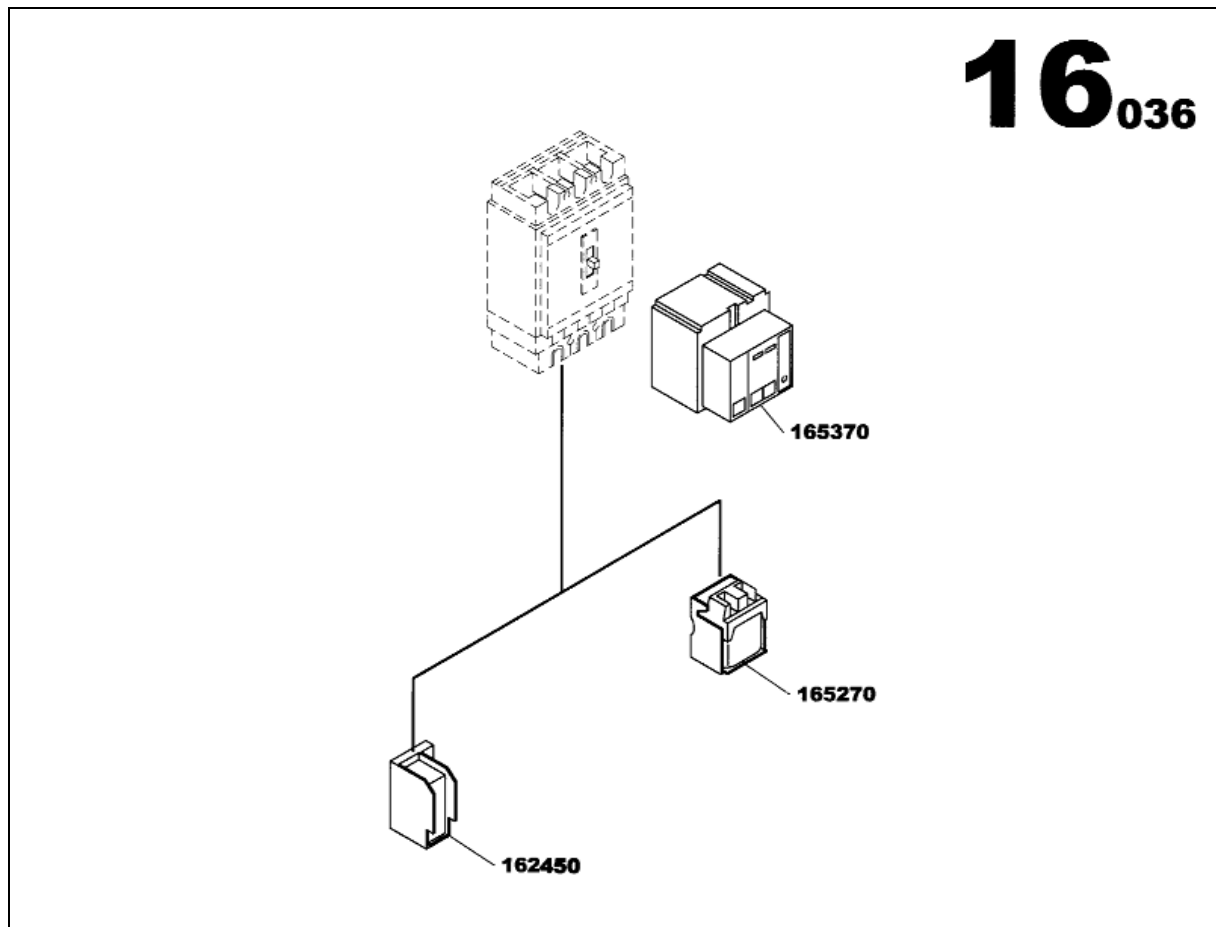
F16076



Item	Part number	Description	Quantity	Units
161850	85417061	COPPER BAR 10x50 L145 MCPS M403BL	4.0	UN
161860	85416972	COPPER BAR 10x30 MCPS M403BL	1.0	UN
161870	85416980	COPPER BAR 10x30 MCPS M403BL	1.0	UN
161880	85416998	COPPER BAR 10x30 MCPS M403BL	1.0	UN
161890	85417004	COPPER BAR 10x30 MCPS M403BL	1.0	UN
161930	85418077	PHASE ISOLATOR M403BL	4.0	UN
162360	85413706	INSULATION PIN	4.0	UN
162370	85421675	INSULATION PIN	4.0	UN
162390	85423598	CABLE CLAMP 120/240mm2	4.0	UN

CIRCUIT BREAKER ACCESSORIES

F16036

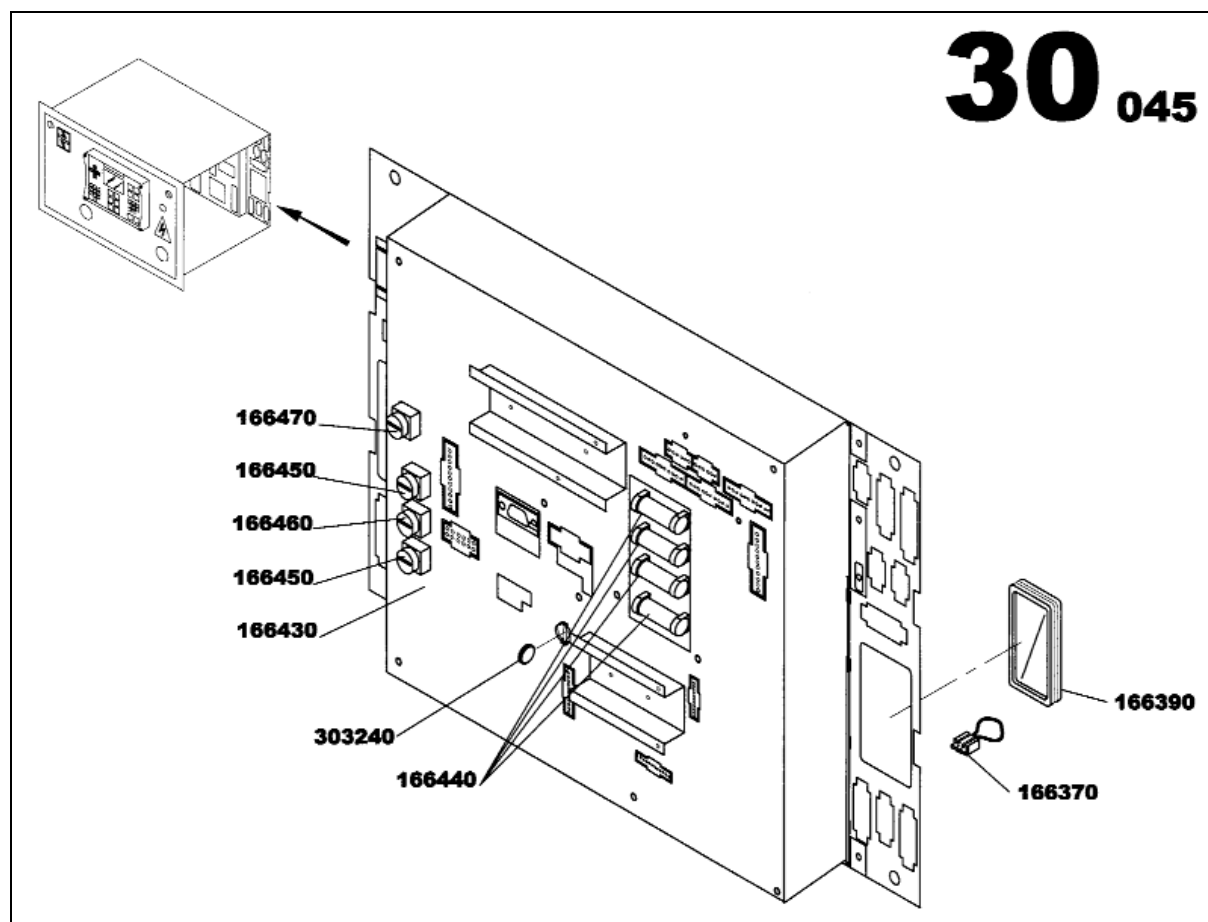


<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
162450	85408573	CIRCUIT BREAKER SHUNT RELEASE COIL 200/280VAC	1.0	UN

Part number listed is the only part used in this model.

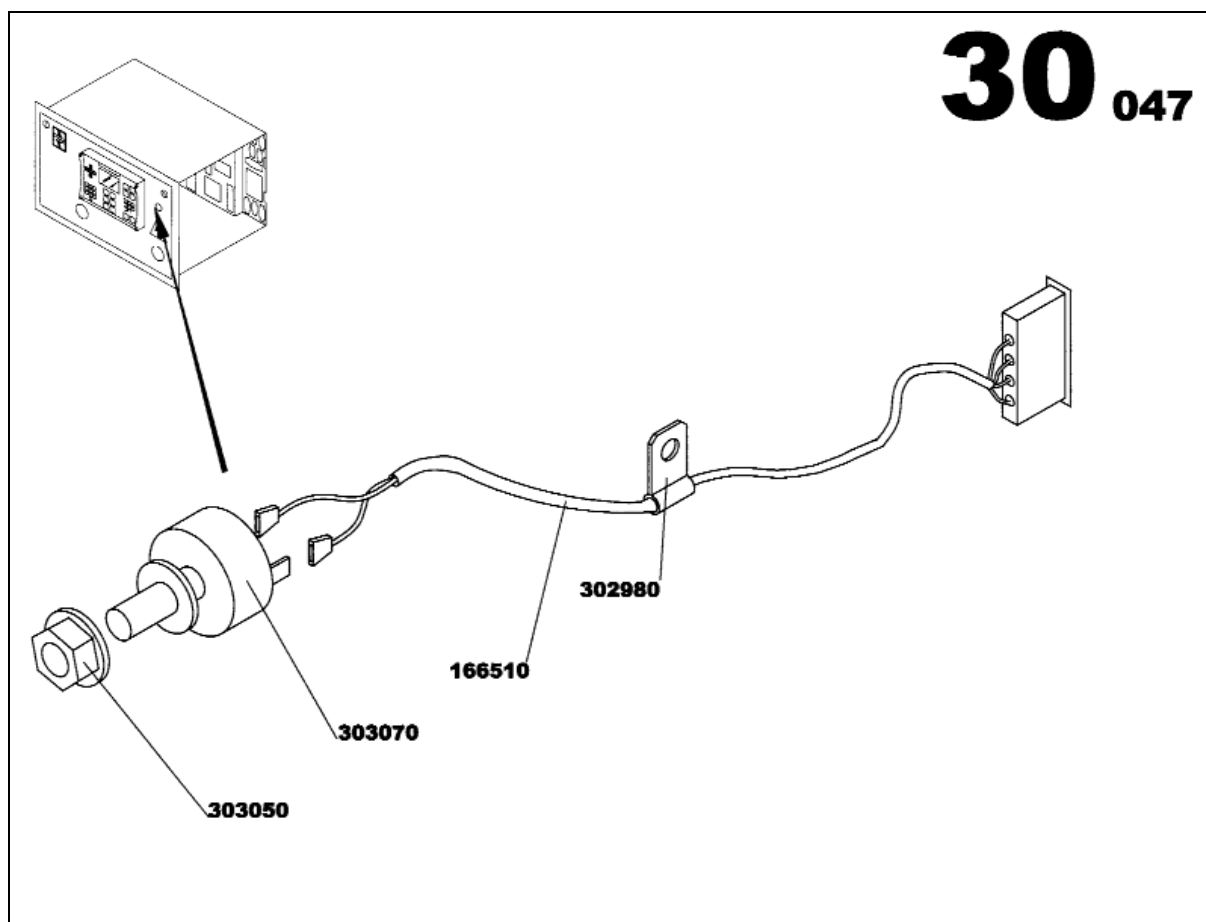
INTELLISYS™ OPTION CB12 CARD

F30045



Item	Part number	Description	Quantity	Units
166390	85504058	RUBBER GROMMET	1.0	UN
166430	85402592	INTELLISYS™ CB12 CARD	1.0	UN
166370	85504033	INTELLISYS™ WIRING LOOM C35S	1.0	UN
166440	85426112	FUSE CYLINDRICAL 12A	4.0	UN
166470	85426120	FUSE CYLINDRICAL 10A	1.0	UN
166450	85426138	FUSE CYLINDRICAL 1A	2.0	UN
166460	85426146	FUSE CYLINDRICAL 2,5A	1.0	UN
303240	85505154	CR2032 CELL	1.0	UN

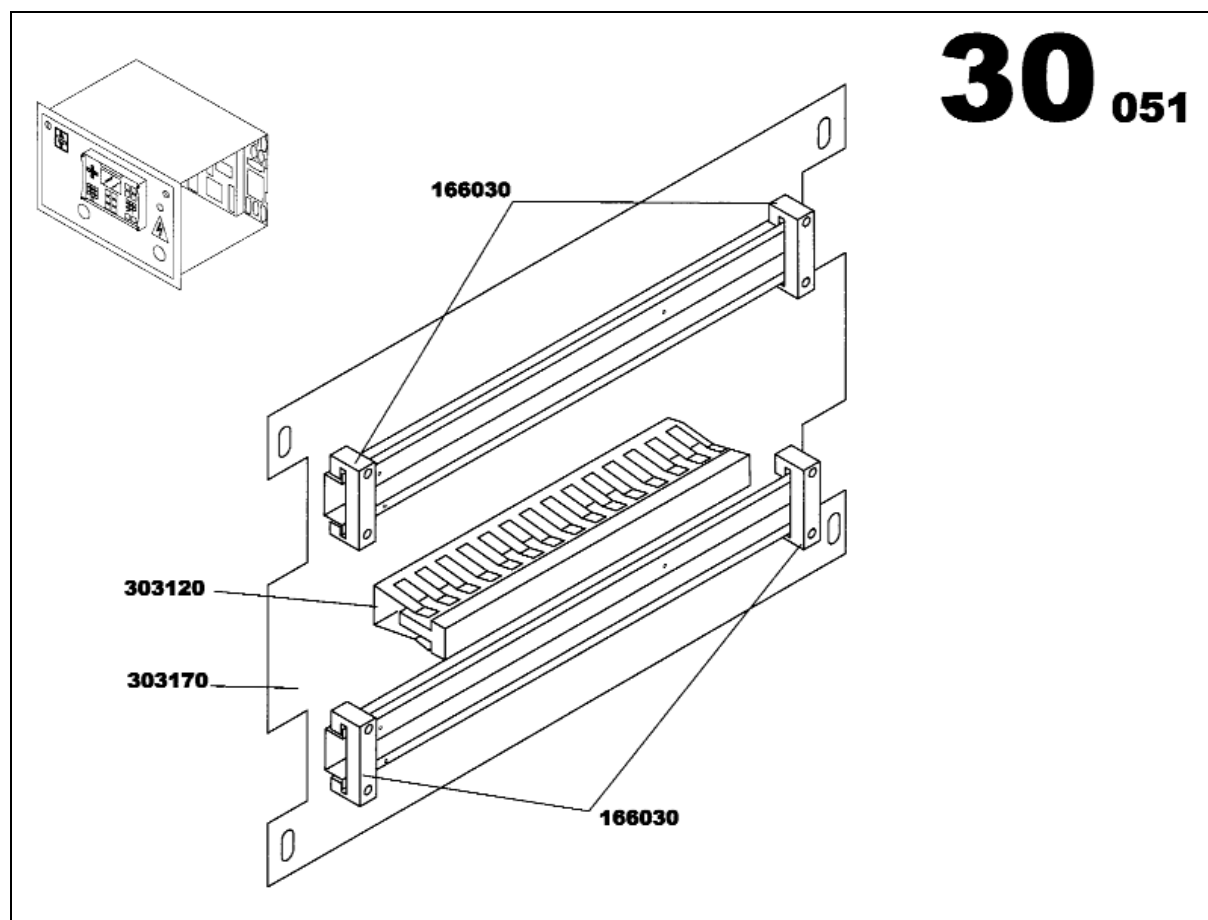
INTELLISYS™ OPTION SPEED POTENTIOMETER
F30047



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
302980	85504207	CLAMP D4.7	1.0	UN
303050	85504215	LOCK AXE SYSTEM	1.0	UN
166510	85503993	INTELLISYS™ WIRING LOOM C105 L540	1.0	UN
303070	85504223	POTENTIOMETER 4.7kOHMS	1.0	UN

INTELLISYS™ OPTION USING PLATEN

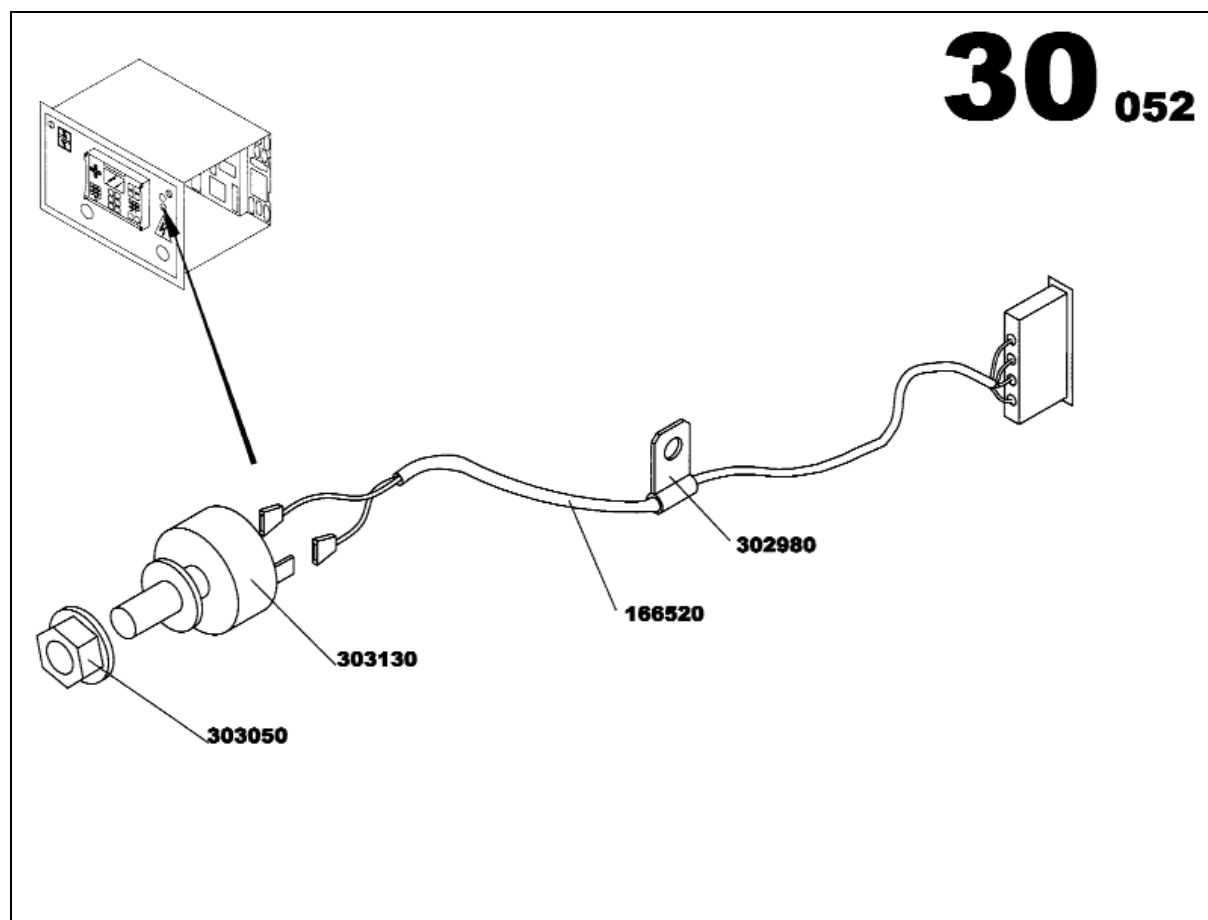
F30051



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
166030	85408854	STOP	4.0	UN
303120	85504256	WIRING LOOM SUPPORT L40XW80	0.21	UN
303170	85504306	USING TERMINAL	1.0	UN

INTELLISYS™ OPTION TENSION POTENTIOMETER

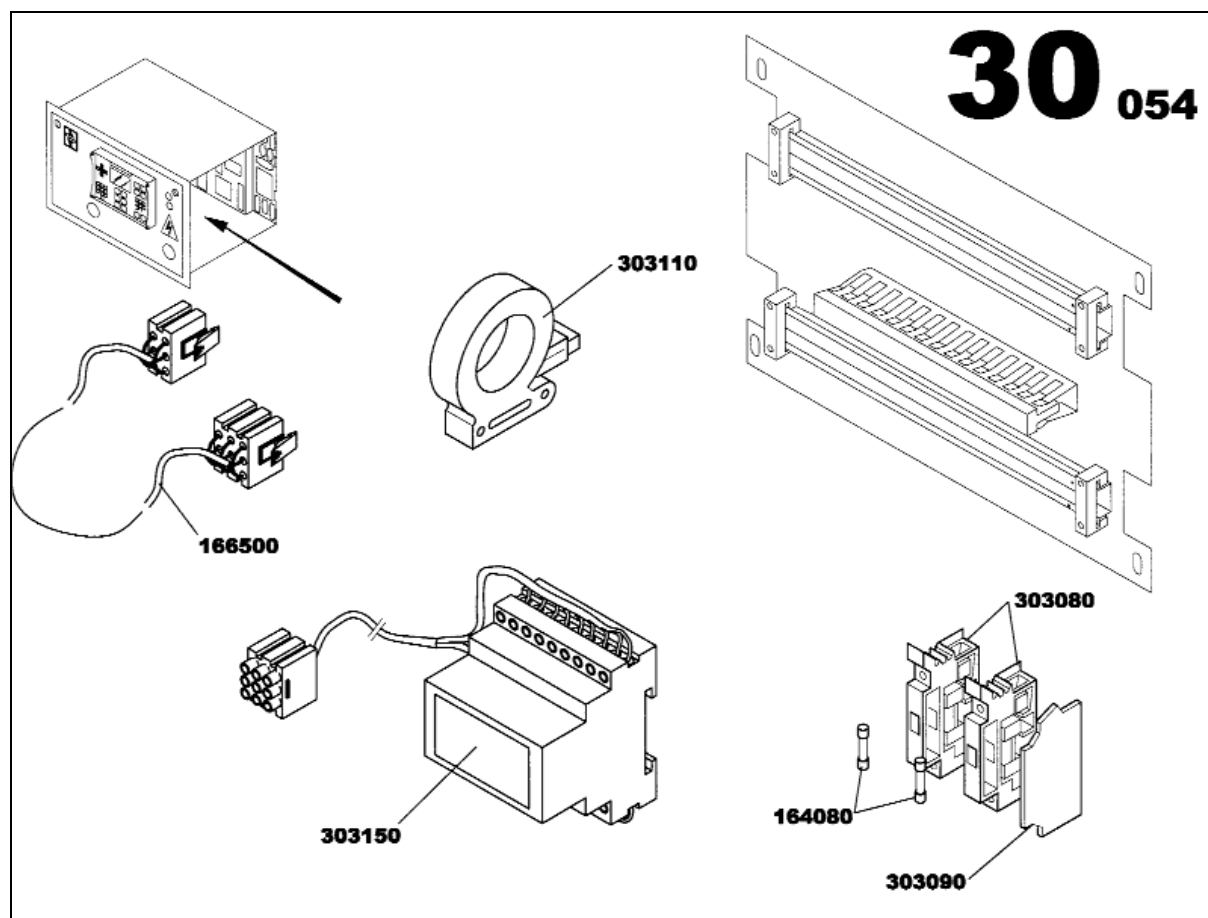
F30052



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
302980	85504207	CLAMP D4.7	1.0	UN
303050	85504215	LOCK AXE SYSTEM	1.0	UN
166520	85504009	INTELLISYS™ WIRING LOOM C106 L560	1.0	UN
303130	85504264	POTENTIOMETER 1KOHMS	1.0	UN

INTELLISYS™ OPTION EARTH LEAKAGE RELAY

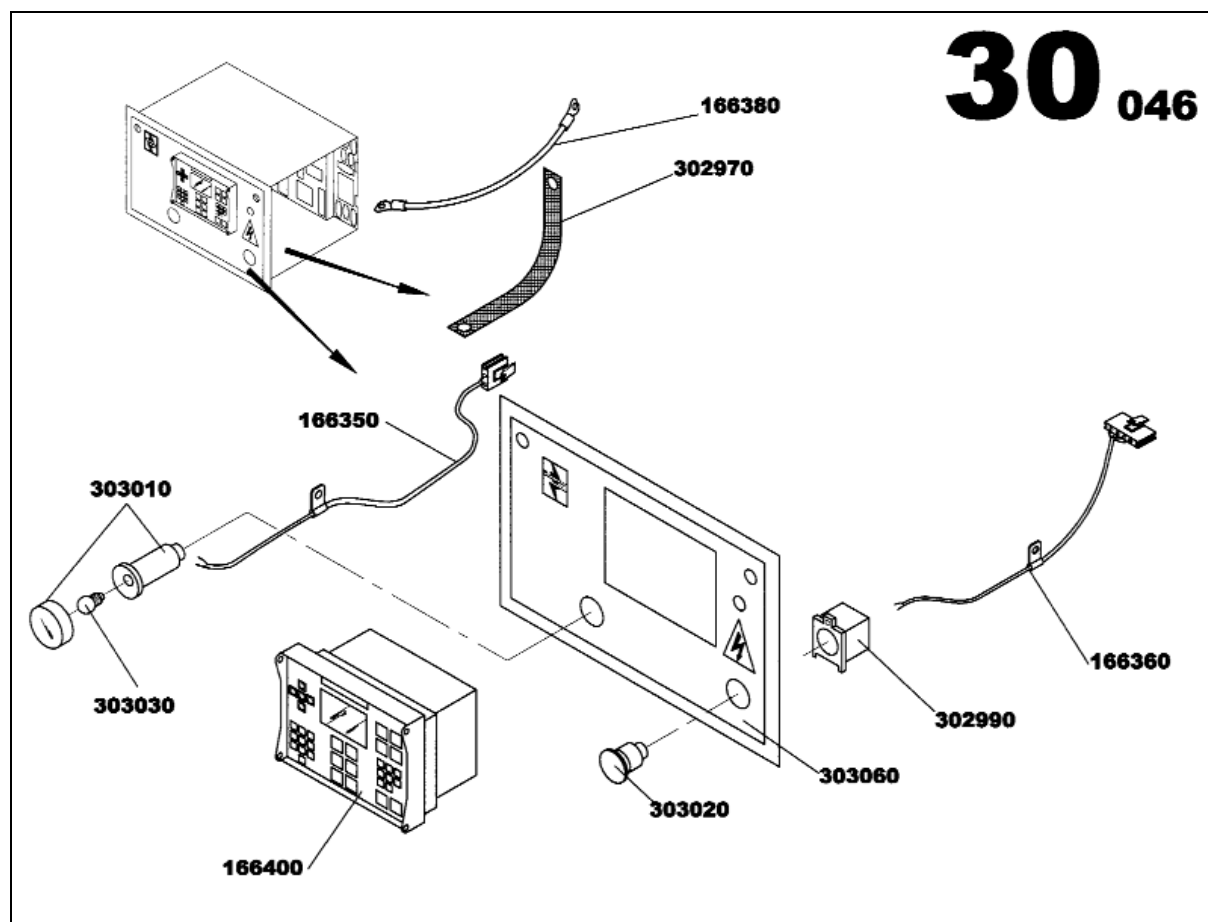
F30054



Item	Part number	Description	Quantity	Units
303090	85504249	FLASK	1.0	UN
164080	85413482	CYLINDRICAL FUSE 5A	2.0	UN
166500	85503985	INTELLISYS™ WIRING LOOM C39 L2000	1.0	UN
303150	85504280	EARTH LEAKAGE RELAY 24V	1.0	UN
303110	85423473	TORE MG 50437	1.0	UN
303080	85504231	FUSE HOUSING	2.0	UN

INTELLISYS™ PANEL 24VDC ASSEMBLY

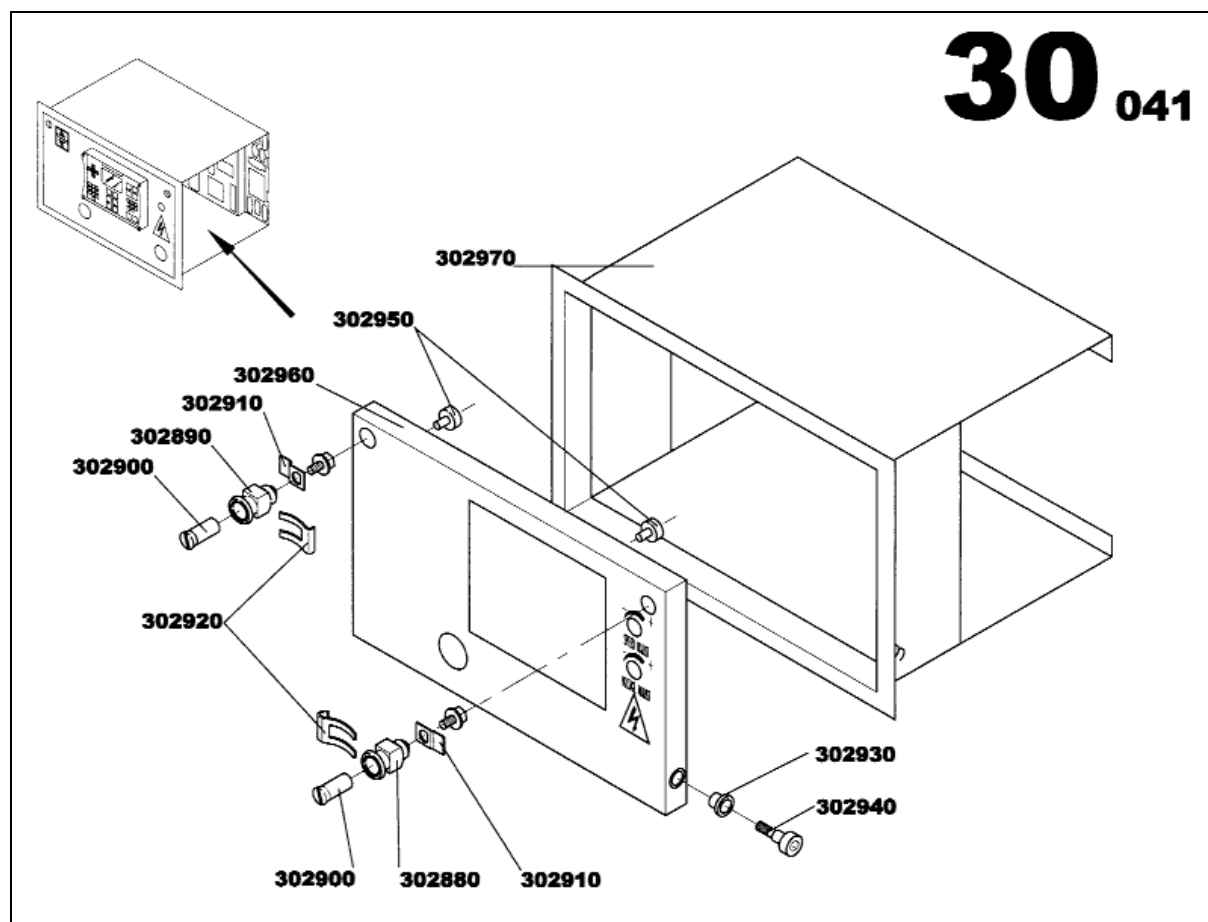
F30046



Item	Part number	Description	Quantity	Units
303010	85503522	WARNING LIGHT CYLINDRIC D22	1.0	UN
302970	85504199	GROUND WIRES 10mm2	1.0	UN
166350	85504017	INTELLISYS™ WIRING LOOM C3 L810	1.0	UN
166360	85504025	INTELLISYS™ WIRING LOOM C11 L460	1.0	UN
166380	85504041	EARTHING INTELLISYS™ WIRING LOOM	1.0	UN
166400	85412021	INTELLISYS™ DISPLAY LEXAN IR	1.0	UN
303060	85504983	INTELLISYS™ PLASTIC PLATE	1.0	UN
303030	85504090	LAMP	1.0	UN
302990	85426781	EMERGENCY STOP SWITCH	1.0	UN
303020	85426773	EMERGENCY STOP BUTTON	1.0	UN

INTELLISYS™ PANEL SHEET METAL ASSEMBLY

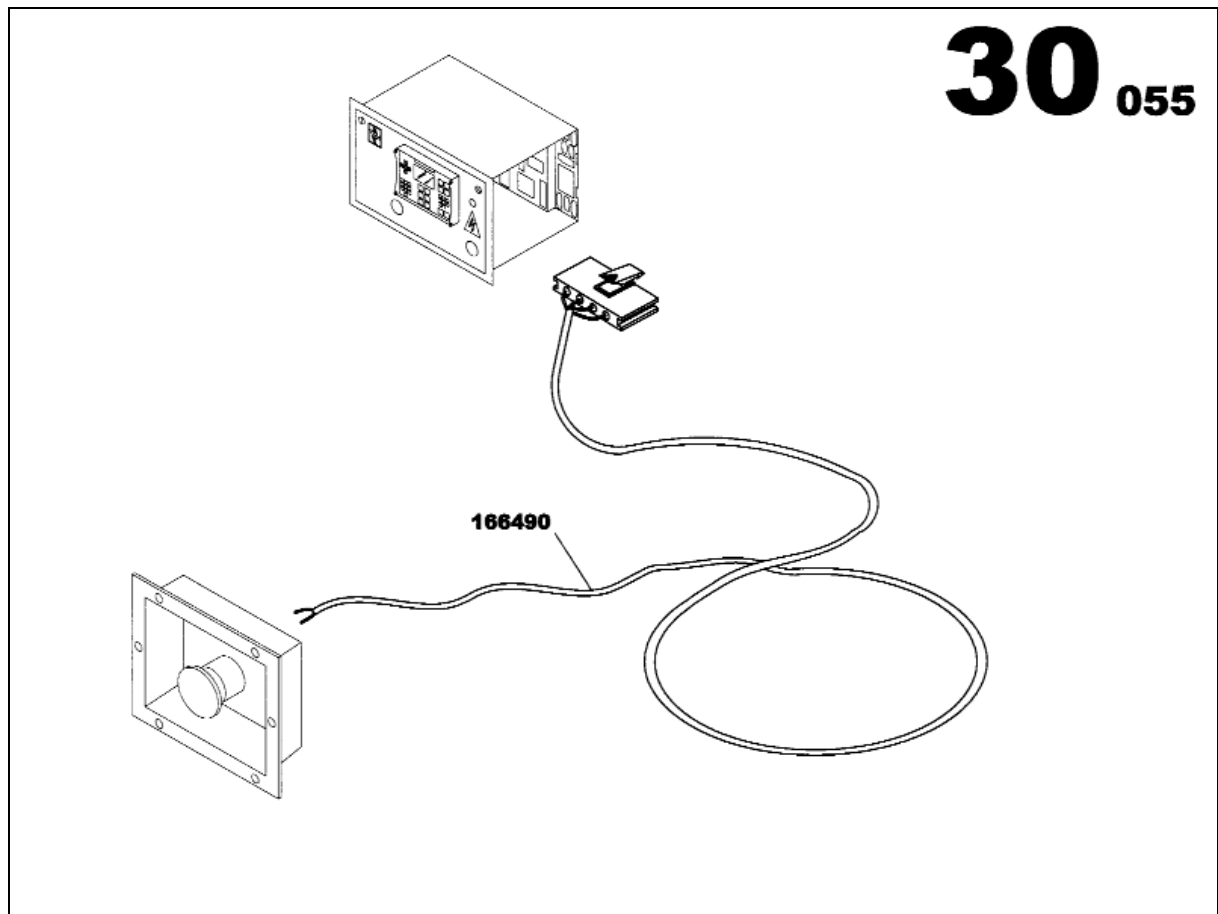
F30041



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
302880	85504108	RIGHT HOUSING	1.0	UN
302890	85504116	LEFT HOUSING	1.0	UN
302900	85504124	ROTOR	2.0	UN
302910	85504132	SLAM SHUT DOOR LATCH	2.0	UN
302920	85504140	LOCK PLATE	2.0	UN
302930	85504157	RING	2.0	UN
302940	85504165	SCREW M6X16	2.0	UN
302950	85504173	STOP	2.0	UN
302960	85504181	DOOR	1.0	UN
302970	85504199	GROUND WIRES 10mm2	1.0	UN

INTELLISYS™ OPTION EMERGENCY STOP

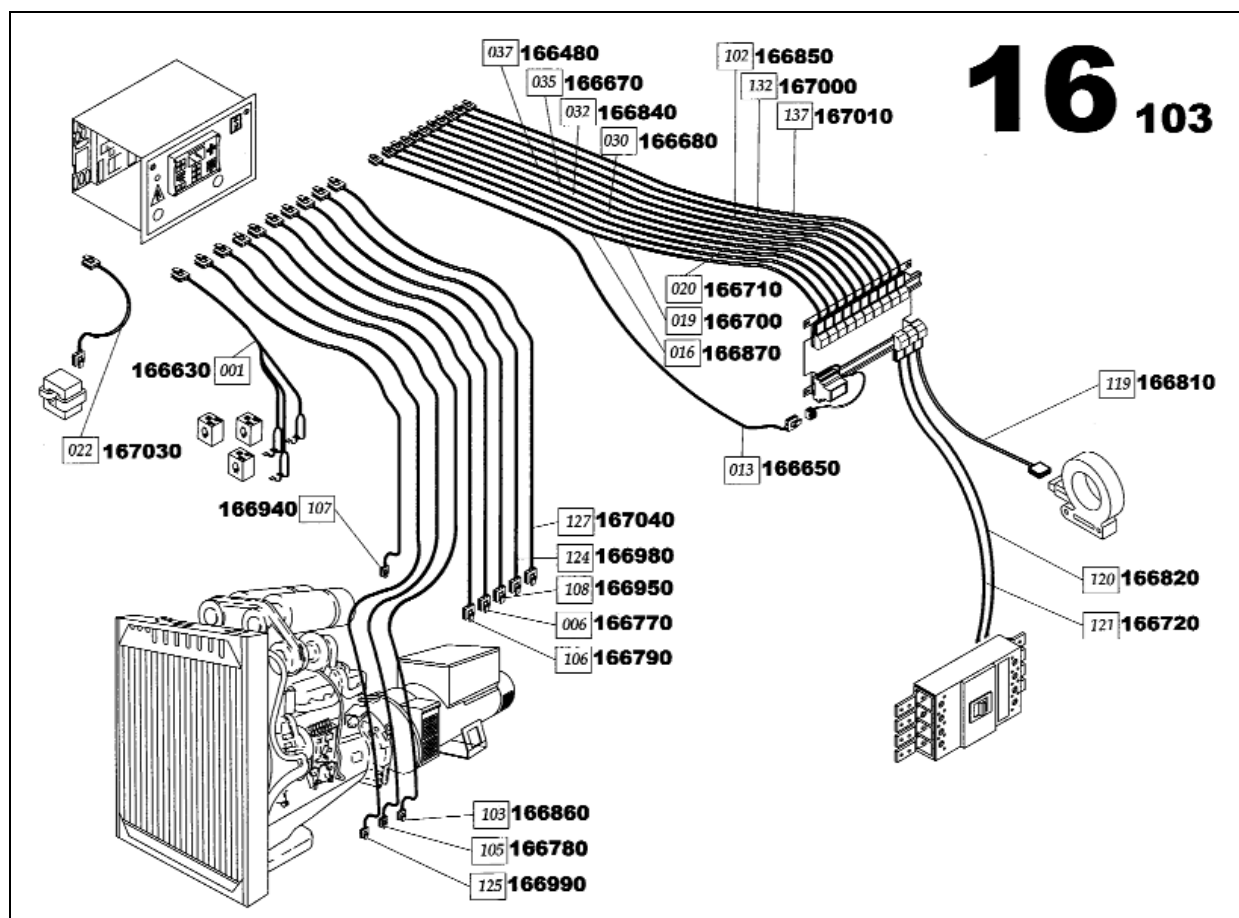
F30055



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
166490	85503977	INTELLISYS™ WIRING LOOM C11 L2000	1.0	UN

INTELLISYS™ WIRING LOOM

F16103

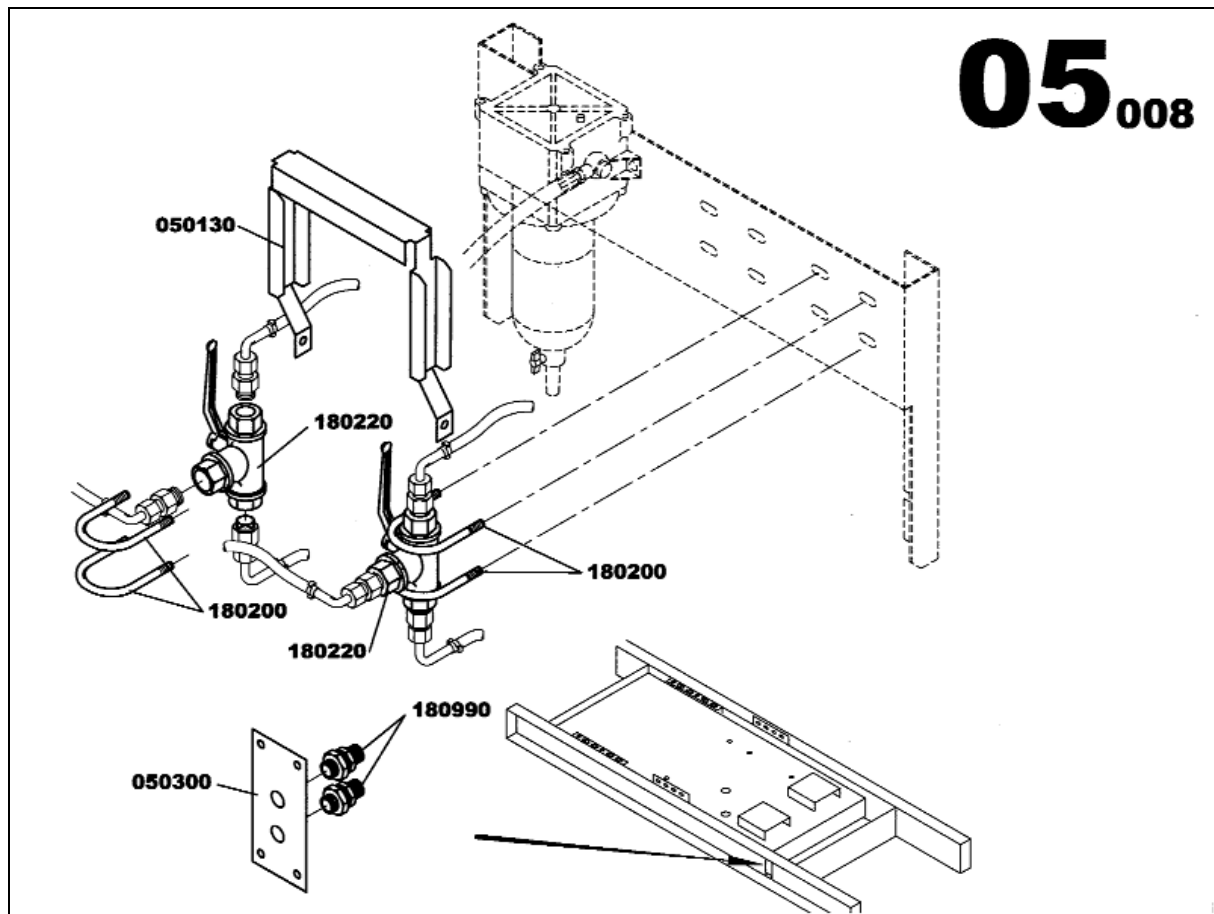


<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
166480	85411221	INTELLISYS™ WIRING LOOM 037/041	1.0	UN
166630	85410546	INTELLISYS™ WIRING LOOM 001	1.0	UN
166780	85411395	INTELLISYS™ WIRING LOOM 105	1.0	UN
166790	85427979	INTELLISYS™ WIRING LOOM 106	1.0	UN
166800	85410520	INTELLISYS™ WIRING LOOM 006	1.0	UN
166810	85417129	INTELLISYS™ WIRING LOOM 119	1.0	UN
166820	85411460	INTELLISYS™ WIRING LOOM 120	1.0	UN

Part numbers listed are the only parts used in this model.

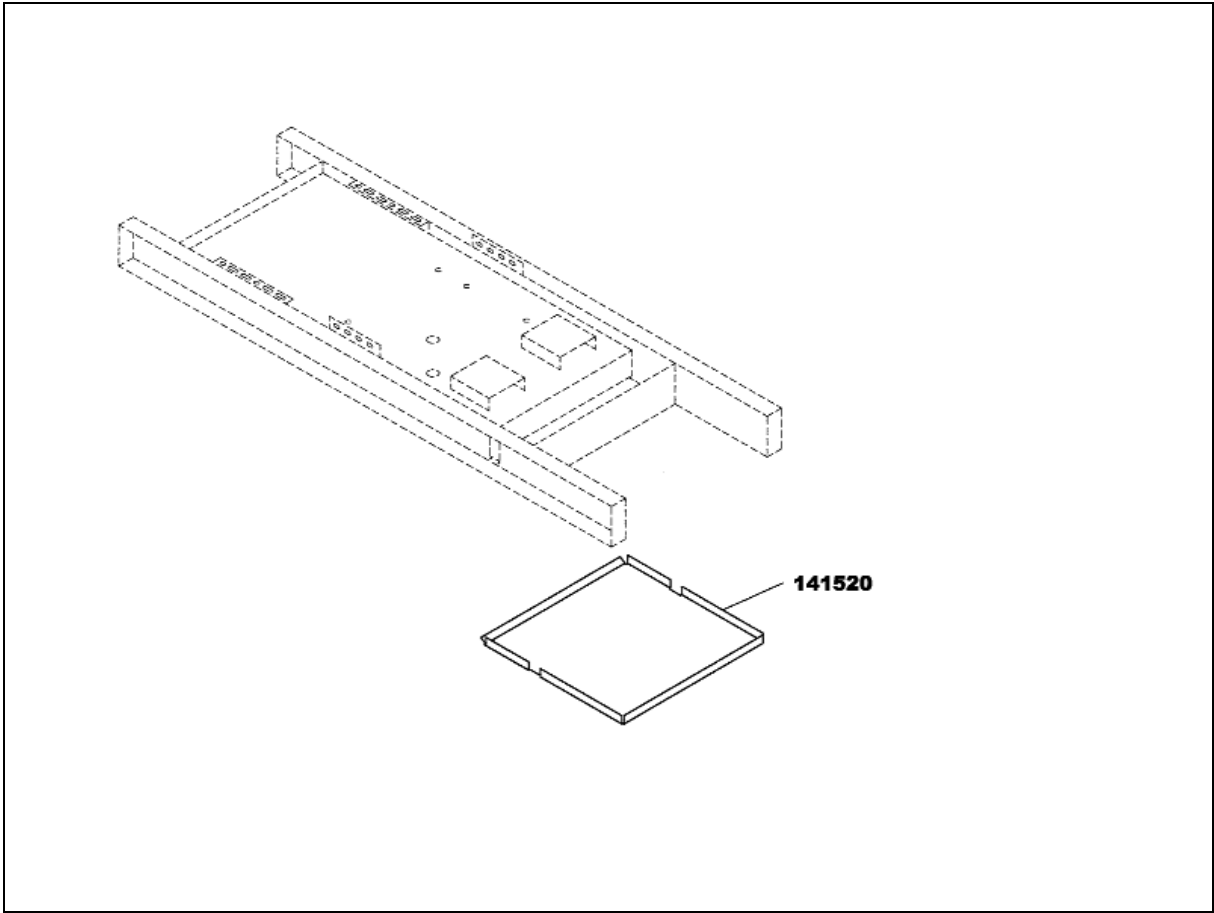
3 WAY FUEL VALVE OPTION

F05008



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
050300	85424174	EXTERIOR FILLING CONNECTION BRACKET	1.0	UN
050130	85403491	3 WAY FUEL VALVE LEVER 3/8G	1.0	UN
180990	85423283	PIPE UNION FEM/FEM D10	2.0	UN
180200	85409464	HOSE CLAMP D36	4.0	UN
180220	85409530	3 WAY FUEL VALVE	2.0	UN

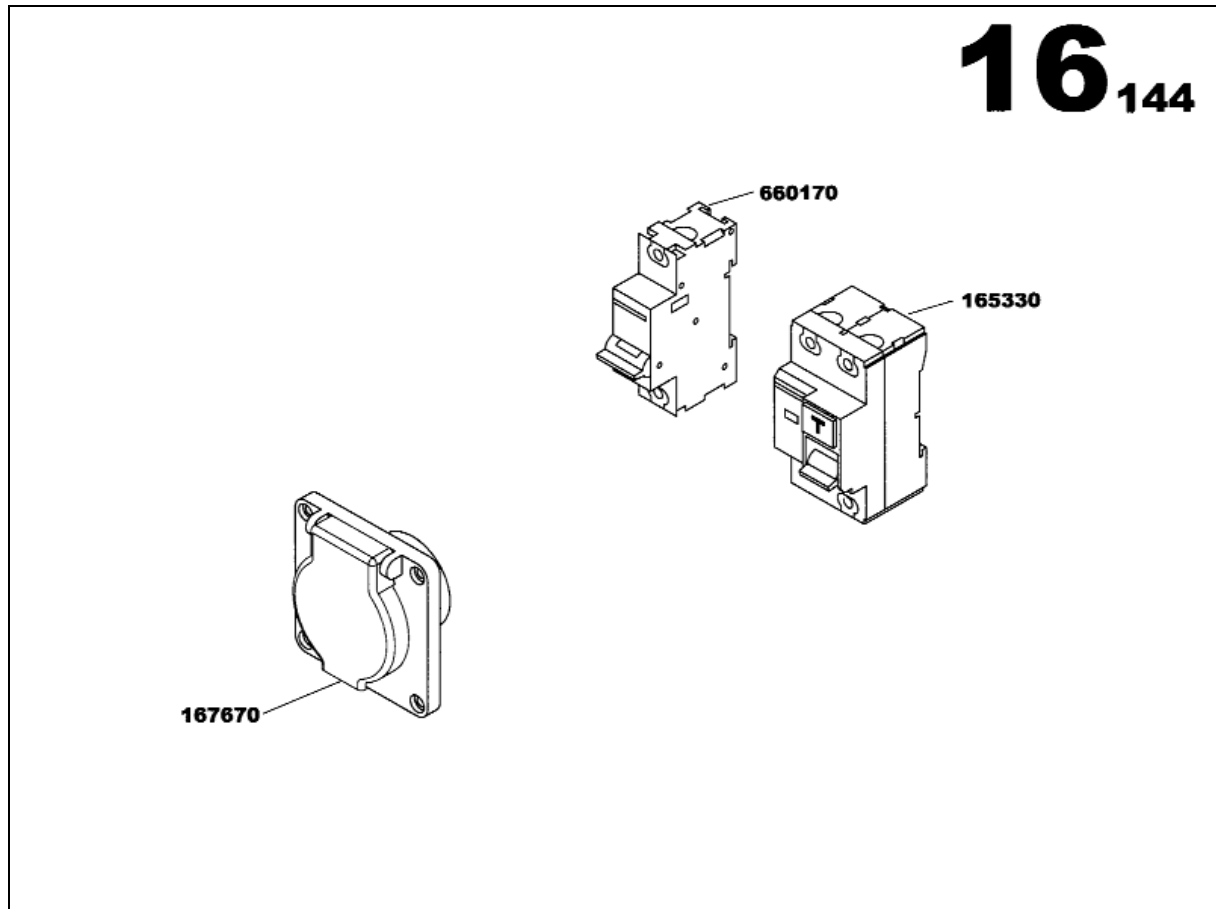
SINGLE BASE PLATE OPTION
F99005



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
141520	85424497	HOOD UNDERSHEETING M413B	1.0	UN

SOCKET TYPE 3 OPTION

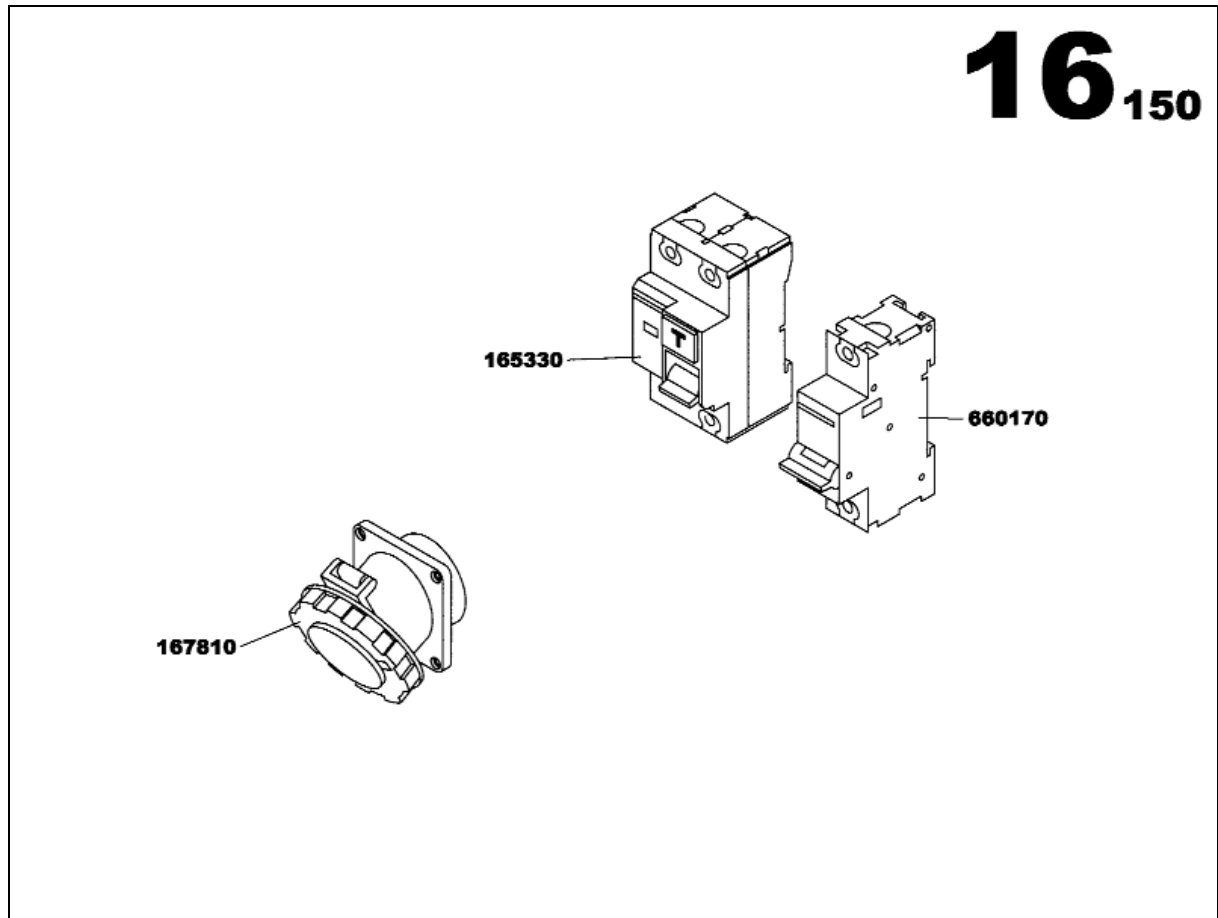
F16144



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
167670	85408300	SOCKET GERMAN 230V 16A 2S+G	1.0	UN
165330	85506087	DIFFERENTIAL SWITCH 2POLE 25A 30mA	1.0	UN
660170	85506459	MOULDED CASE CIRCUIT BREAKER 2x16A	1.0	UN

SOCKET TYPE 7 OPTION

F16150

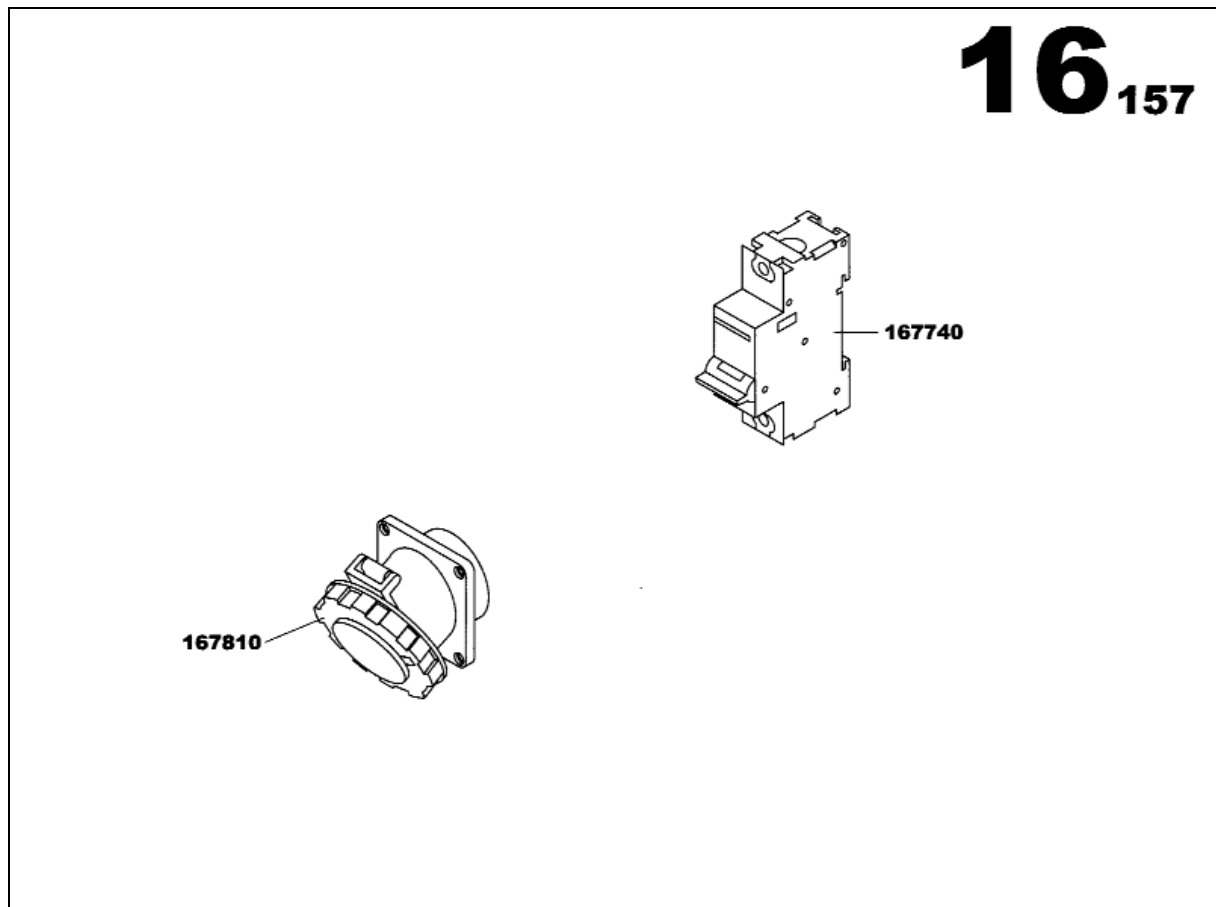


<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
165330	85506087	DIFFERENTIAL SWITCH 2POLE 25A 30mA	1.0	UN
167810	85506111	SOCKET EC 110V 16A 2S+G	1.0	UN
660170	85506459	MOULDED CASE CIRCUIT BREAKER 2x16A	1.0	UN

SOCKET TYPE 10 OPTION

F16157

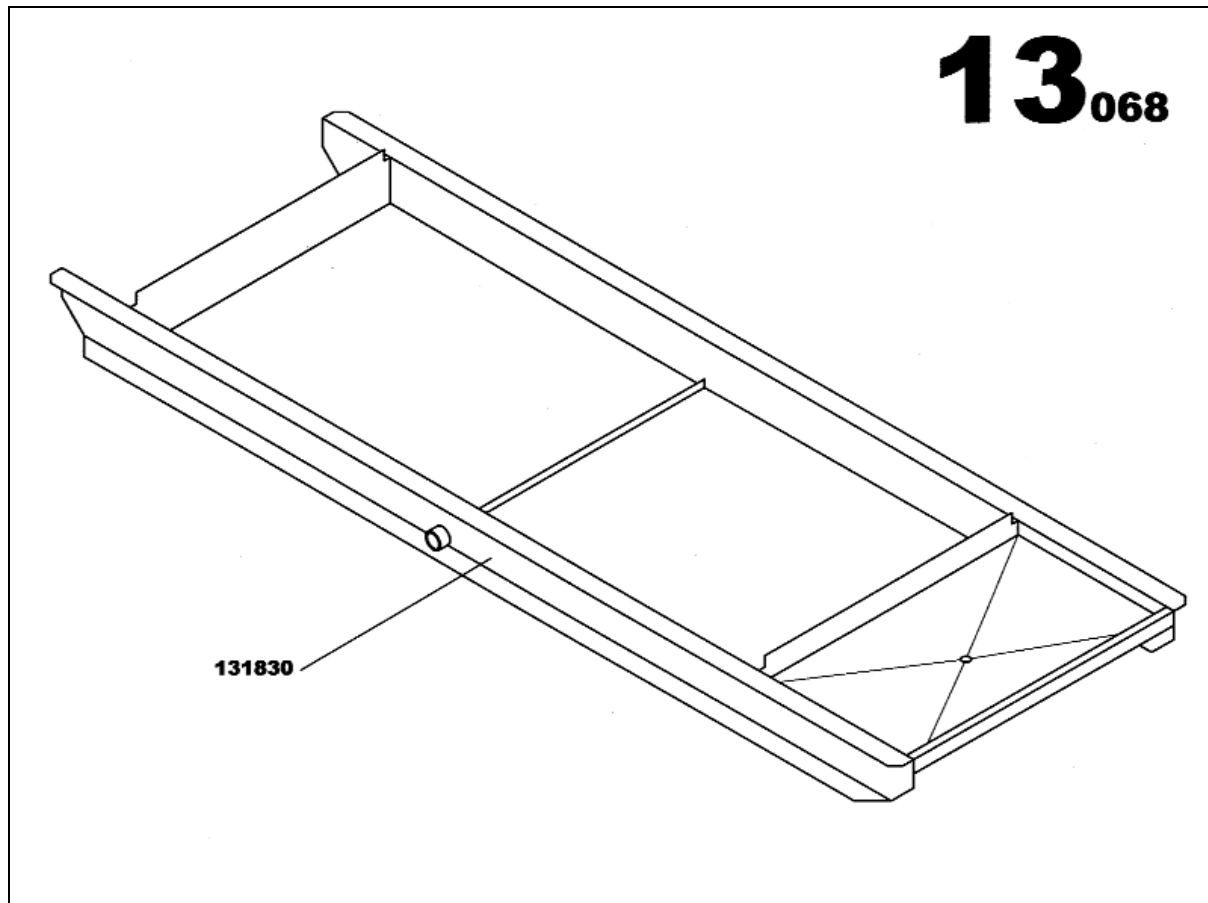
16₁₅₇



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
167740	85506079	MOULDED CASE CIRCUIT BREAKER 2x10A	1.0	UN
167810	85506111	SOCKET EC 110V 16A 2S+G	1.0	UN

SIMPLIFIED RETENTION TANK AND BASE PLATE OPTION

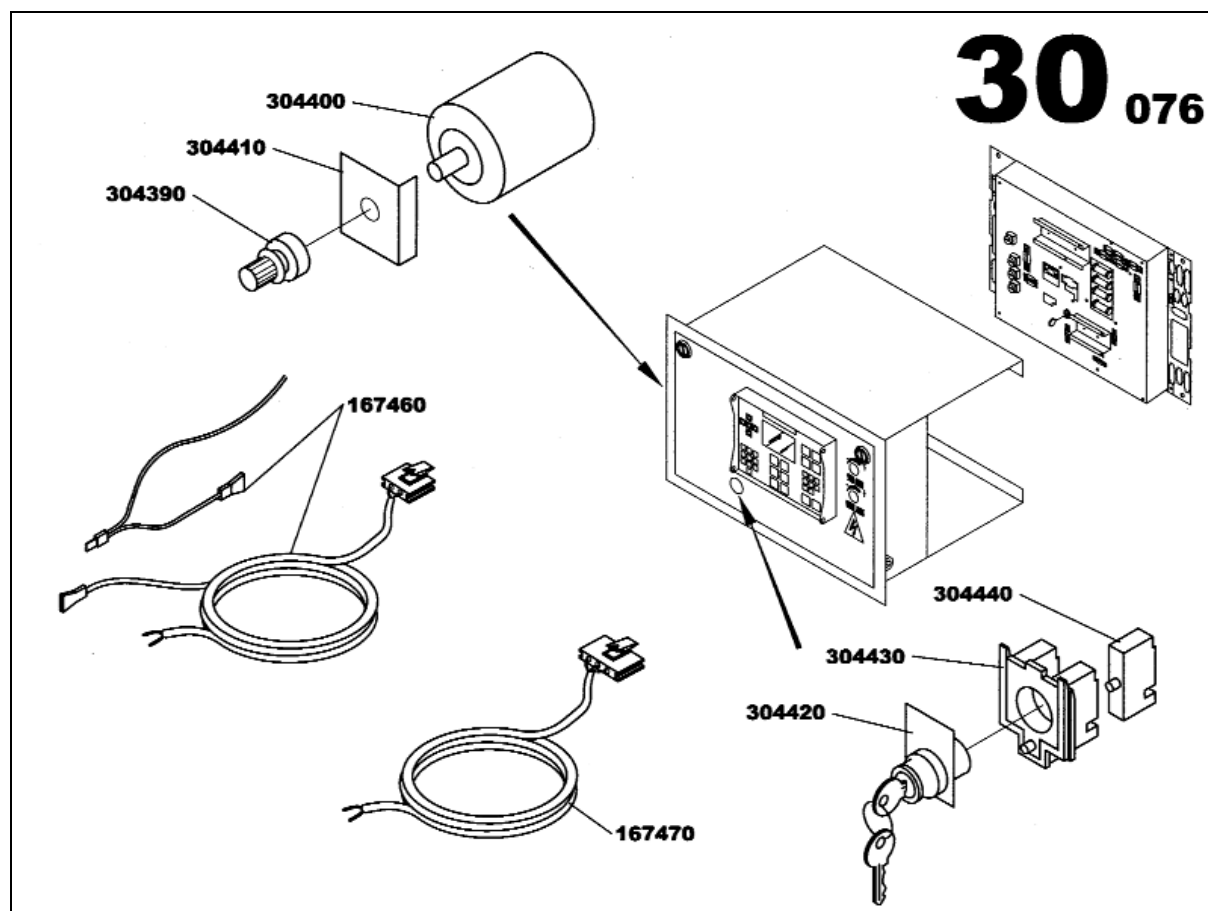
F13068



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
131830	85507572	RETENTION BUND M413	1.0	UN

INTELLISYS™ OPTION DUAL FREQUENCY

F30076

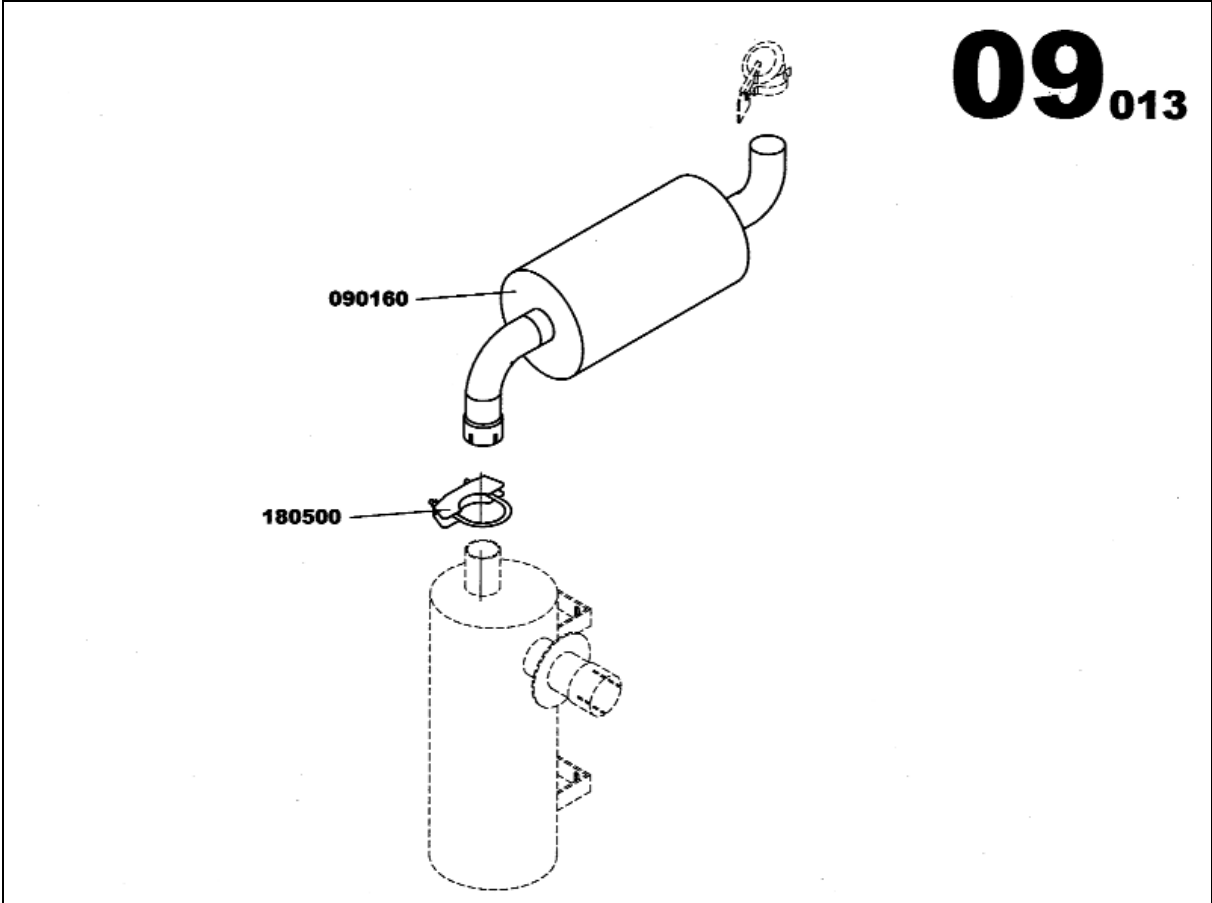


<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
304390	85506673	BUTTON	1.0	UN
304400	85506681	POTENTIOMETER 200kOHMS	1.0	UN
167460	85506566	INTELLISYS™ WIRING LOOM 124	1.0	UN
167470	85506574	INTELLISYS™ WIRING LOOM 125	1.0	UN
304410	85506699	POTENTIOMETER SUPPORT	1.0	UN
304420	85506707	KEY BUTTON	1.0	UN
304430	85506582	EMERGENCY STOP SWITCH	1.0	UN
304440	85506715	SWITCH	1.0	UN

EXPLOSIVE ATMOSPHERE KIT OPTION

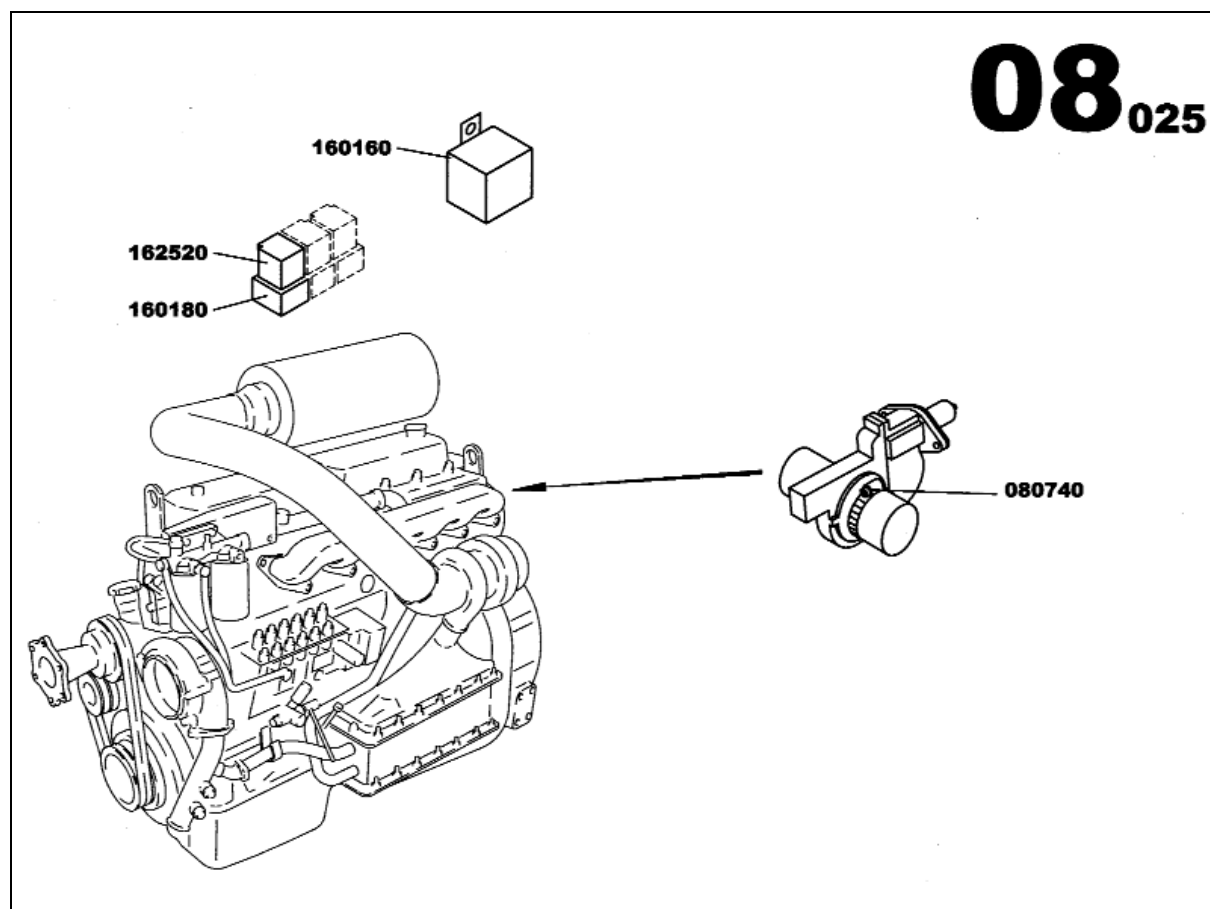
SPARK ARRESTER INERIS DN100 ASSEMBLY

F09013



<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
090160	85404325	INERIS SPARK ARRESTER DN100	1.0	UN
180500	85409381	HOSE CLAMP D120	1.0	UN

AIR SHUT OFF VALVE VO TWD740 ASSEMBLY F08025

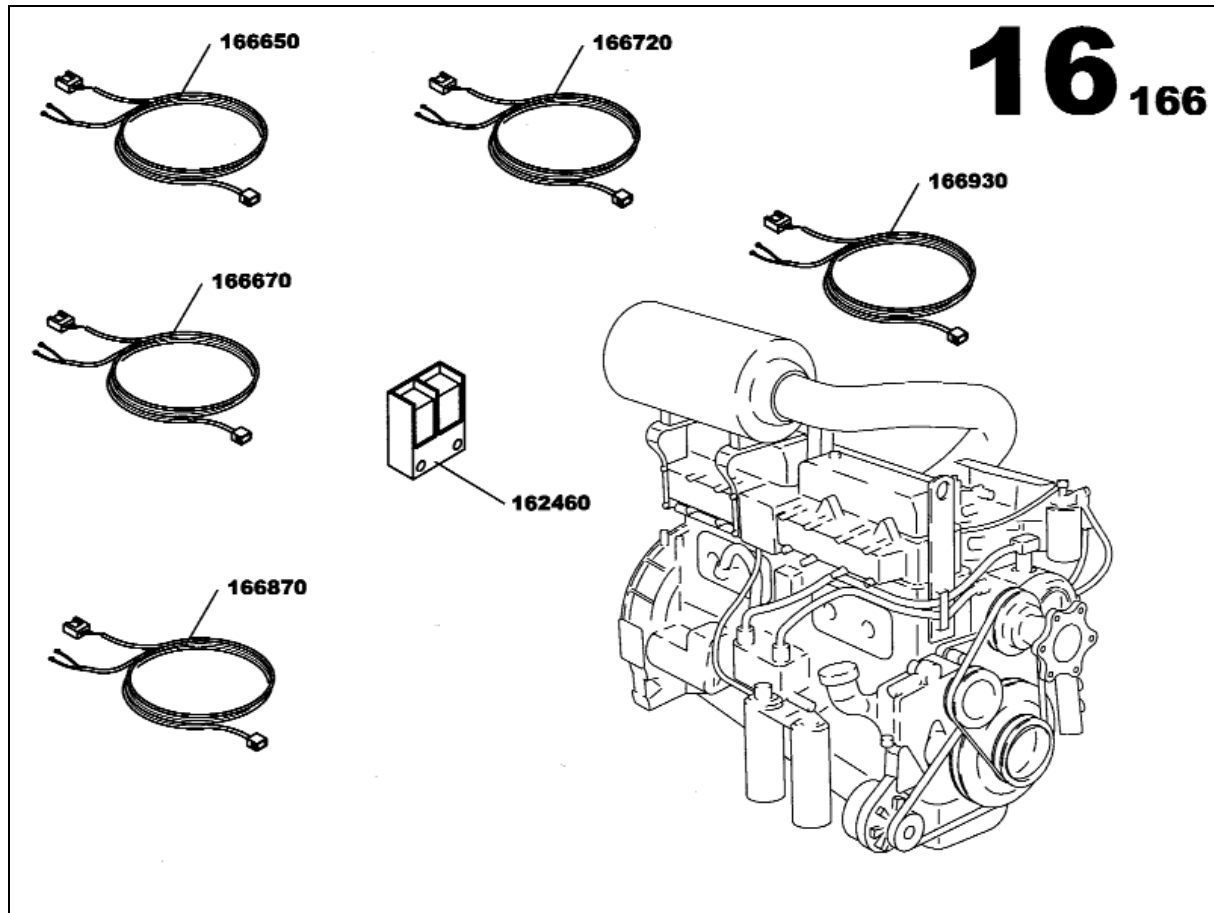


<i>Item</i>	<i>Part number</i>	<i>Description</i>	<i>Quantity</i>	<i>Units</i>
080740	85425064	AIR SHUT OFF VALVE D51	1.0	UN
160160	85408367	RELAY 12V/24V 75A	1.0	UN
162520	85423366	RELAY 24V 10/20A	1.0	UN
160180	85408912	AUTOMOBILE RELAY BASE	1.0	UN

AUTO START OPTION

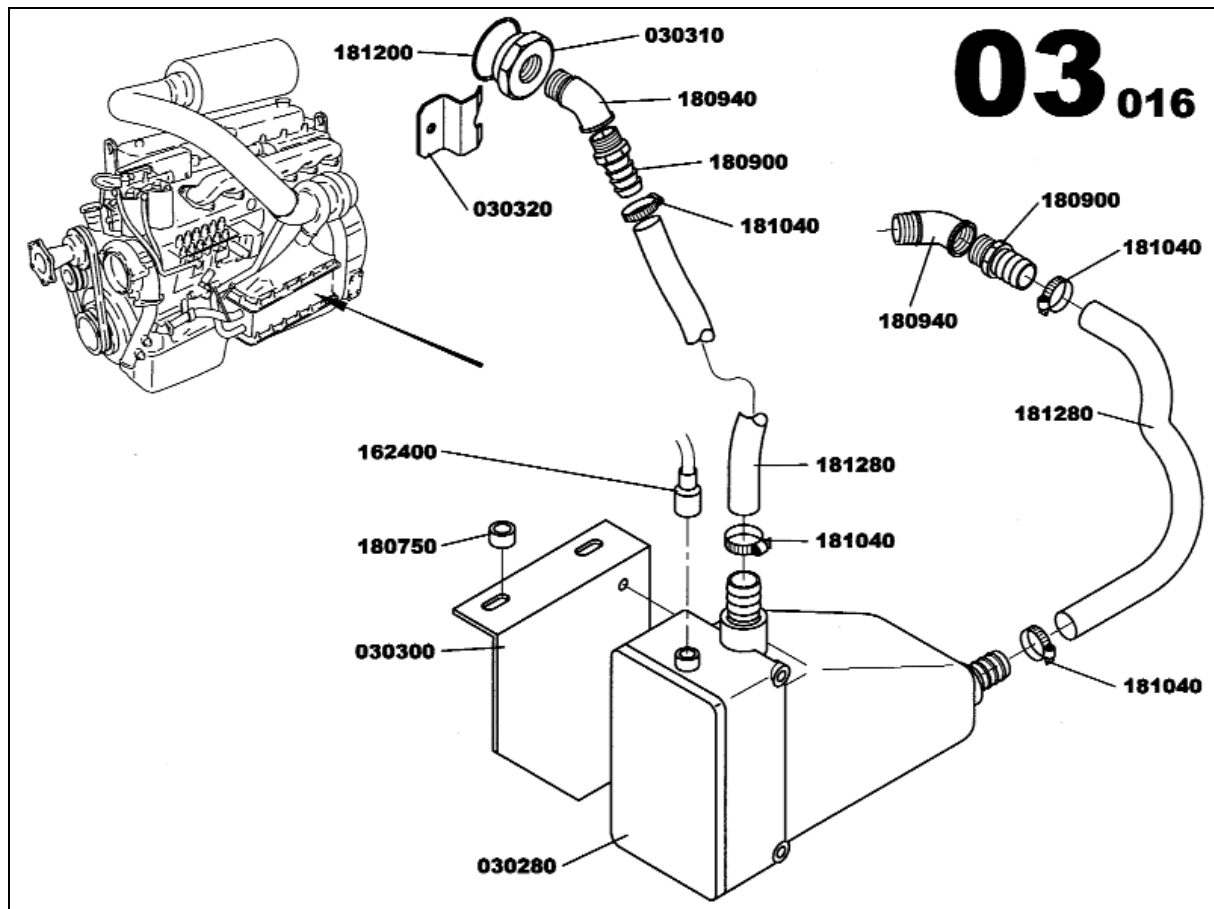
AUTO START ASSEMBLY

F16166



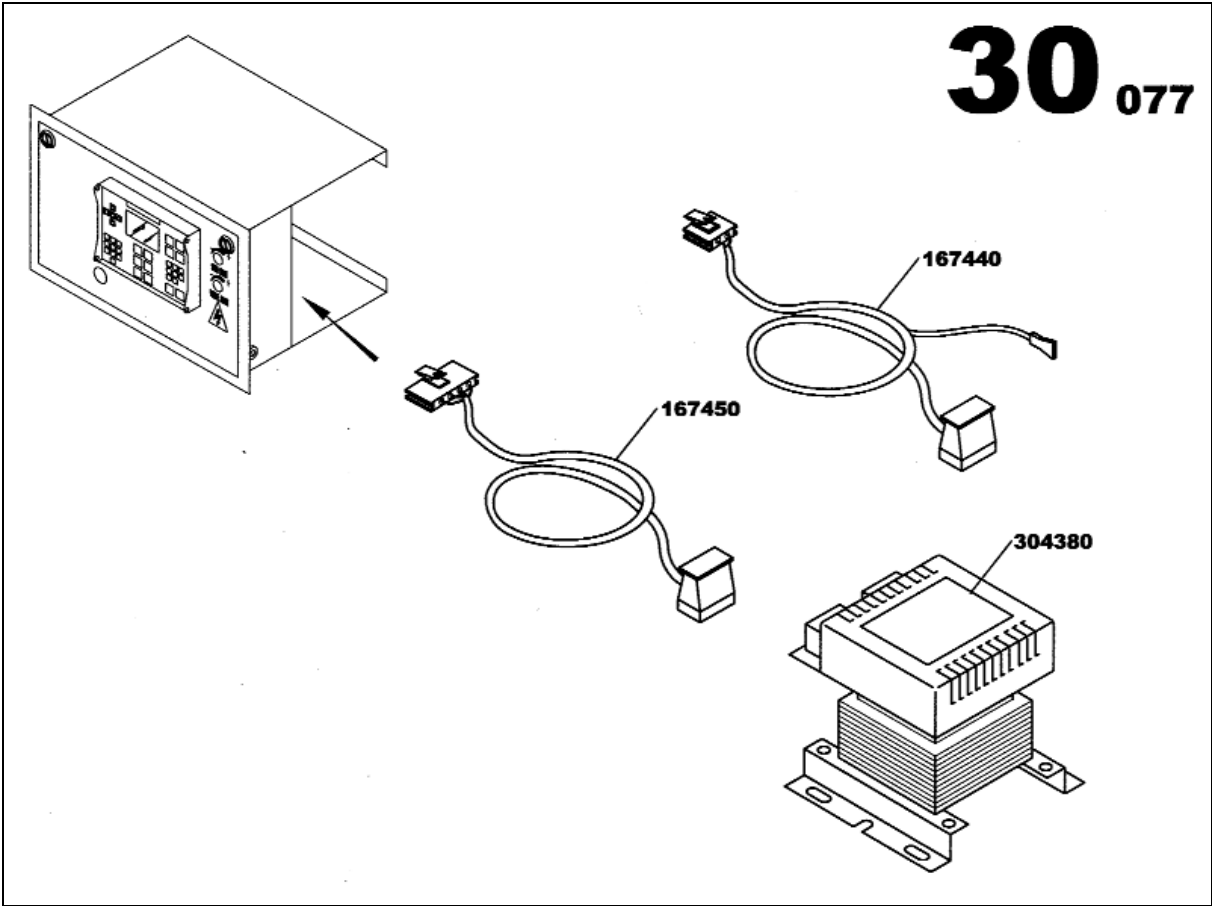
Item	Part number	Description	Quantity	Units
166930	85507614	INTELLISYS™ WIRING LOOM 100	1.0	UN
162460	85408581	AUXILARY CONTACT	1.0	UN
166670	85411163	INTELLISYS™ WIRING LOOM 035	1.0	UN
166650	85410835	INTELLISYS™ WIRING LOOM 013	1.0	UN
166870	85426948	INTELLISYS™ WIRING LOOM 016	1.0	UN
166720	85411486	INTELLISYS™ WIRING LOOM 121	1.0	UN

COOLANT HEATER 700W VOLVO 7L ASSEMBLY F03016



Item	Part number	Description	Quantity	Units
030280	85401982	RESISTANCE HOUSING 700W	1.0	UN
030300	85423655	PREHEATER HOUSING BRACKET VOLVO 7/10L	1.0	UN
030310	85423291	COOLANT PREHEAT CONNECTION VO TAD/TWD740G	1.0	UN
030320	85421287	WATER HEATING CONNECTION STANDING HANGER	1.0	UN
162400	85417491	RIGHT COWL D14x6 L26	1.0	UN
180750	85421204	SPACER Th10 D15 d9	1.0	UN
180900	85423267	PIPE UNION REDUCER MALE/MALE 1/2" GAS	1.0	UN
180940	85423051	PIPE UNION ELBOW 45° MALE/FEMALE 1/2" GAS	1.0	UN
181040	85417756	HOSE CLIP D16/27	4.0	UN
181200	85421766	O RING D40x2.5	1.0	UN
181280	85424844	FLEXIBLE HOSE D16x26	1.0	ML

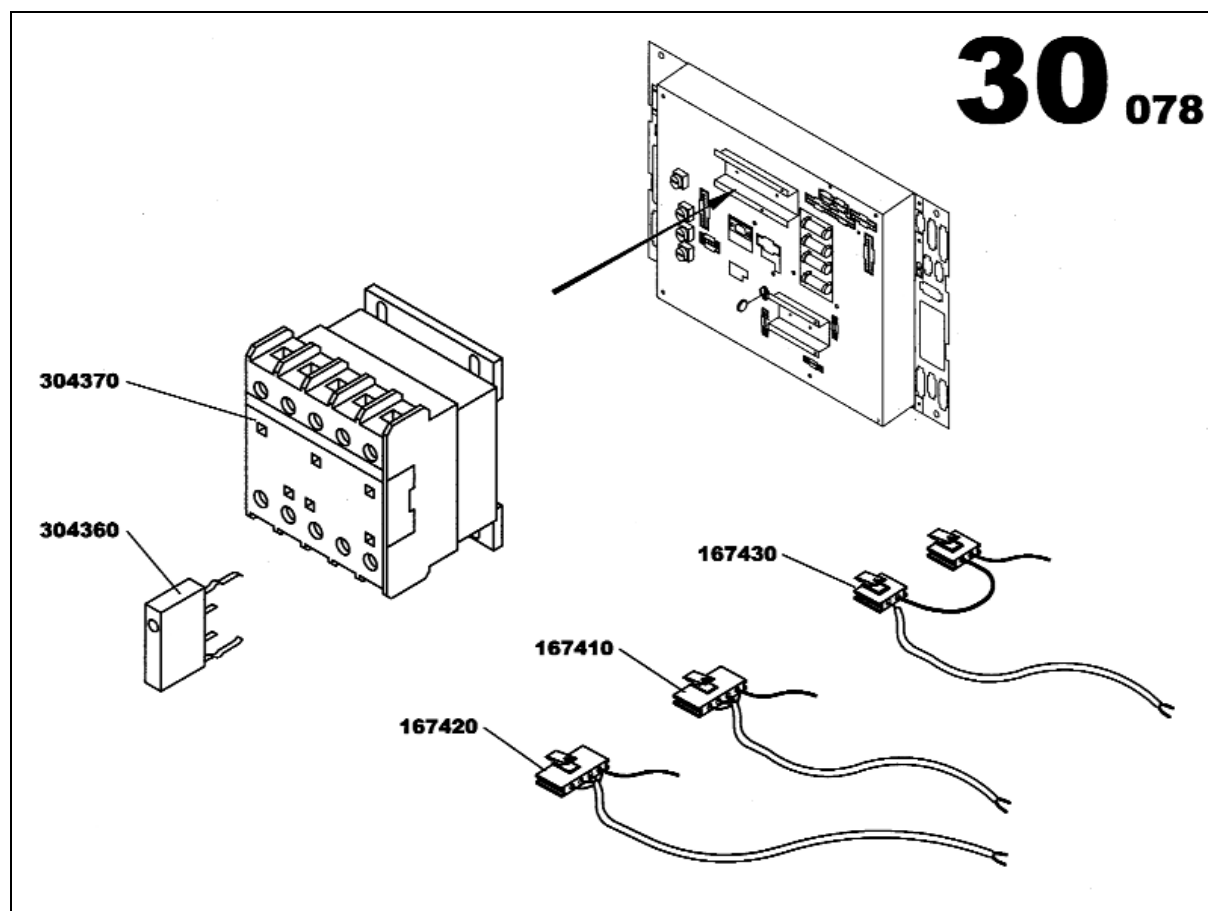
INTELLISYS™ OPTION BATTERY CHARGER 24V/3A
F30077



Item	Part number	Description	Quantity	Units
304380	85507606	CHARGER	1.0	UN
167440	85506541	INTELLISYS™ WIRING LOOM 022/024	1.0	UN
167450	85506558	INTELLISYS™ WIRING LOOM 009	1.0	UN

INTELLISYS™ OPTION WATER PREHEATING

F30078



Item	Part number	Description	Quantity	Units
167410	85506517	INTELLISYS™ WIRING LOOM 031/33/34	1.0	UN
167420	85506525	INTELLISYS™ WIRING LOOM 100	1.0	UN
167430	85506533	INTELLISYS™ WIRING LOOM 027	1.0	UN
304360	85506640	SURGE SUPPRESSOR BLOCK	1.0	UN
304370	85507598	RELAY	1.0	UN

Users guide and maintenance manual

Leroy Somer Alternators LSA 46.2 / 47.1

Réf. constructeur : 2981 GB - 4.33/a
- 04.00

Réf. GPAO : 33522035901

LSA 46.2 / 47.1 ALTERNATORS

This manual concerns the alternator which you have just purchased.

The latest addition to a whole new generation of alternators, this range benefits from the experience of the world's leading manufacturer, using advanced technology and incorporating strict quality control.

SAFETY MEASURES

Before using your machine for the first time, it is important to read the whole of this installation and maintenance manual.

All necessary operations and work on this machine must be performed by a qualified technician.

Our technical support service will be pleased to provide any additional information you may require.

The various operations described in this manual are accompanied by recommendations or symbols to alert the user to potential risks of accidents. It is vital that you understand and take notice of the following warning symbols.

WARNING

Warning symbol for an operation which may damage or destroy the machine or surrounding equipment.



Warning symbol for general danger to personnel.



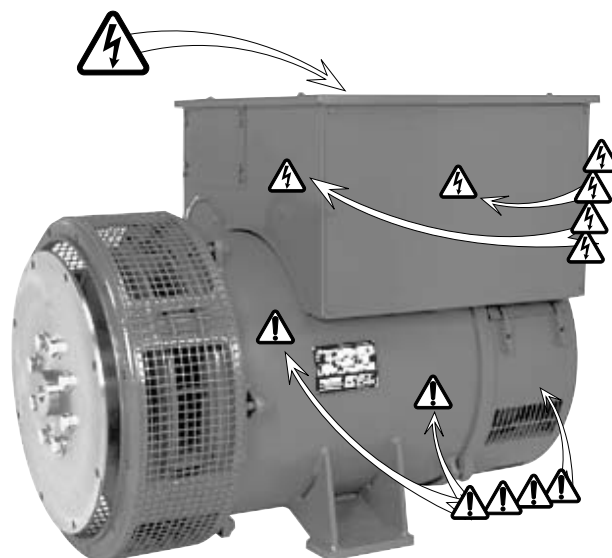
Warning symbol for electrical danger to personnel.

Note : LEROY-SOMER reserves the right to modify the characteristics of its products at any time in order to incorporate the latest technological developments. The information contained in this document may therefore be changed without notice.

We wish to draw your attention to the contents of this maintenance manual. By following certain important points during installation, use and servicing of your alternator, you can look forward to many years of trouble-free operation.

WARNING SYMBOLS

A set of self-adhesive stickers depicting the various warning symbols is included with this maintenance manual. They should be positioned as shown in the drawing below once the machine has been fully installed.



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LSA 46.2 / 47.1 ALTERNATORS

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LSA 46.2 / 47.1**ALTERNATORS****RECEIPT****1 - RECEIPT****1.1 - Standards and safety measures**

Our alternators comply with most international standards and are compatible with :

- the recommendations of the

International Electrotechnical Commission

IEC 34-1, (EN 60034).

- the recommendations of the

International Standards Organisation ISO 8528.

- the European Community directive 89/336/EEC on Electromagnetic Compatibility (EMC).

- the European Community directives

73/23/EEC and 93/68/EEC (Low Voltage Directive).

They are CE marked with regard to the LVD (Low Voltage Directive) in their role as a machine component. A declaration of incorporation can be supplied on request.

Before using your generator for the first time, read carefully the contents of this installation and maintenance manual, supplied with the machine. All operations performed on the generator should be undertaken by qualified personnel with specialist training in the commissioning, servicing and maintenance of electrical and mechanical machinery. This maintenance manual should be retained for the whole of the machine's life and be handed over with the contractual file. The various operations described in this manual are accompanied by recommendations or symbols to alert the user to potential risks of accidents. It is vital that you understand and take notice of the different warning symbols.

1.2 - Inspection

On receipt of your alternator, check that it has not suffered any damage in transit. If there are obvious signs of damage, contact the carrier (you may be able to claim on their insurance) and after a visual check, turn the machine by hand to detect any malfunction.

1.3 - Identification

The alternator is identified by means of a nameplate fixed on the frame (see drawing).

Make sure that the nameplate on the machine conforms to your order.

The machine name is defined according to various criteria, for example : LSA 46.2 M6 C6/4 -

• LSA : name used in the PARTNER range

M : Marine

C : Cogeneration

T : Telecommunications.

• 46.2 : machine type

• M5 : model

• C : excitation system

(C : AREP / J : SHUNT or PMG / E : COMPOUND)

• 6/4 : winding number / number of poles.

1.3.1 - Nameplate



So that you can identify your machine quickly and accurately, we suggest you fill in its specifications on the nameplate below.

1.4 - Storage

Prior to commissioning, machines should be stored :

- Away from humidity : in conditions of relative humidity of more than 90%, the machine insulation can drop very rapidly, to just above zero at around 100%; monitor the state of the anti-rust protection on unpainted parts. For storage over an extended period, the machine can be placed in a sealed enclosure (heatshrink plastic for example) with dehydrating sachets inside, away from significant and frequent variations in temperature to avoid the risk of condensation during storage.

- If the area is affected by vibration, try to reduce the effect of these vibrations by placing the generator on a damper support (rubber disc or similar) and turn the rotor a fraction of a turn once a fortnight to avoid marking the bearing rings.

LEROY-SOMER		ALTERNATEURS PARTNER ALTERNATORS																																		
LSA	<input type="text"/>	Date	<input type="text"/>																																	
N	<input type="text"/>	Hz	<input type="text"/>																																	
Min-1/R.P.M.	<input type="text"/>	Protection	<input type="text"/>																																	
Cos Ø / P.F.	<input type="text"/>	Cl. ther. / Th.class	<input type="text"/>																																	
Régulateur/A.V.R.	<input type="text"/>																																			
Altitude	<input type="text"/>	Masse / Weight	<input type="text"/>																																	
Rlt AV/D.E bearing	<input type="text"/>																																			
Rlt AR/N.D.E bearing	<input type="text"/>																																			
Graisse / Grease	<input type="text"/>																																			
Valeurs excit / Excit. values	<input type="text"/>																																			
en charge / full load	<input type="text"/>																																			
à vide / at no load	<input type="text"/>																																			
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Made by Leroy Somer - 1 024 647 Y

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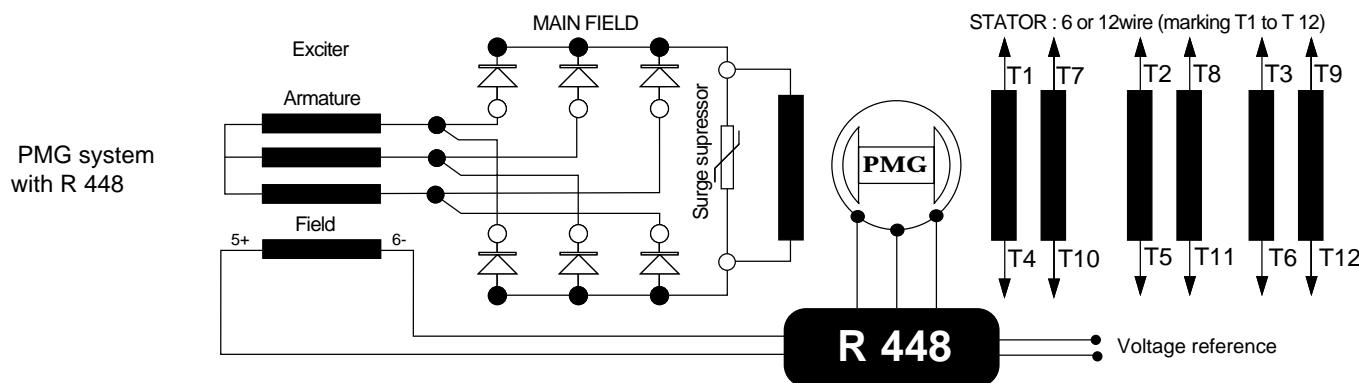
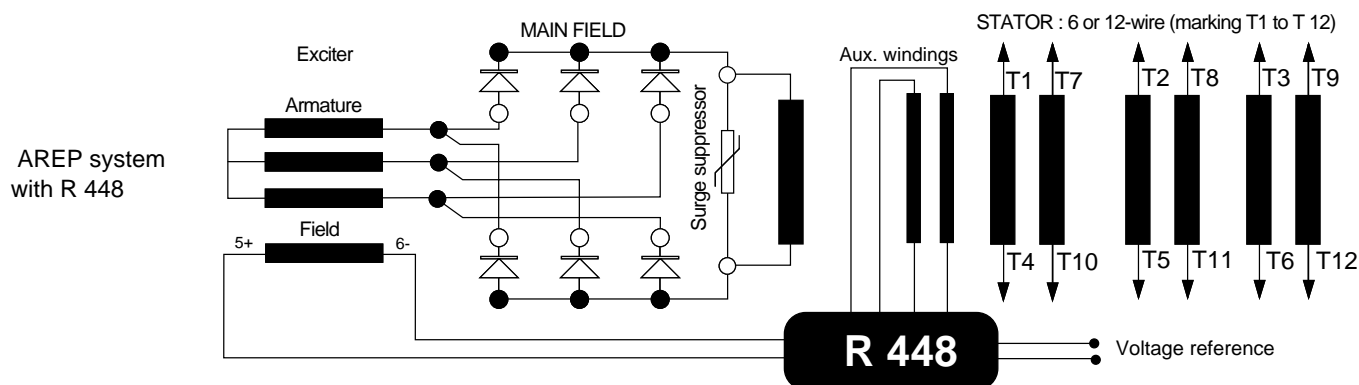
ALTERNATORS

TECHNICAL CHARACTERISTICS

2 - TECHNICAL CHARACTERISTICS

2.1 - Electrical characteristics

LSA 46.2/47.1 alternators are machines without sliprings or revolving field brushes, wound as « 2/3 pitch»; 6 or 12-wire, with class H insulation and a field excitation system available in either AREP or "PMG" version (see diagrams).



Interference suppression conforms to standard EN 55011, group 1, class B.

2.1.1 - Options

- Stator temperature detection probes
- Space heaters

2.2 - Mechanical characteristics

- Steel frame
- Cast iron end shields
- Ball bearings greased for life
- Mounting arrangement

MD 35 :
single bearing with standard feet and SAE flanges/coupling discs.

B 34 :

- two-bearing with SAE flange and standard cylindrical shaft extension.
- Drip-proof machine, self-cooled
- Degree of protection : IP 21

2.2.1 - Options

- IP 23,
- Air inlet filter,
- Greasable ball bearings,
- IP 44,
- Bearing probes,
- PT 100 stators.

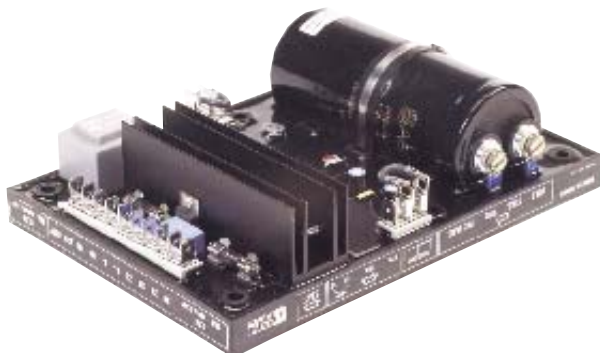
LSA 46.2 / 47.1

ALTERNATORS

TECHNICAL CHARACTERISTICS

2.3 - Excitation system

For both the AREP & PMG excitation systems, the alternator voltage regulator is the R 448.



With **AREP** excitation, the electronic AVR is powered by two auxiliary windings which are independent of the voltage detection circuit. The first winding (X1, X2) has a voltage proportional to that of the alternator (Shunt characteristic), the second (Z1, Z2) has a voltage in proportion with the stator current (compound characteristic : Booster effect). The power supply voltage is rectified and filtered before being used by the AVR monitoring transistor. As a result the machine has a short-circuit current capacity of 3 IN for 10 s, and good immunity to distortions generated by the load.

With **PMG** excitation, a permanent magnet generator (PMG) is added to the alternator. This is fitted at the rear of the machine and connected to the AVR. The PMG supplies the AVR with voltage which is independent of the main alternator winding. As a result the machine has a short-circuit current capacity of 3 IN for 10 s, and good immunity to distortions generated by the load.

The AVR monitors and corrects the alternator output voltage by adjusting the excitation current.

2.3.1 - R448 AVR characteristics

- shunt power supply : max 140V - 50/60 Hz
- rated overload current : 10A - 10s
- electronic protection (overload, voltage detection opening short-circuit): excitation overload current for 10 s then return to approximately 1A

The alternator must be stopped (or the power switched off, see section 3.5.3.) in order to reset the protection.

- Fuse :

- F1 on X1,X2.

- voltage detection : 5 VA isolated via transformer

0-110 V terminals = 95 to 140 V

0-220 V terminals = 170 to 260 V

0-380 V terminals = 340 to 520 V

- voltage regulation $\pm 0.5\%$

- normal or rapid response time via strap ST2

- voltage adjustment via potentiometer P2

other voltages via adapter transformer

- current detection : (parallel operation) :

C.T. 2.5 VA cl1, secondary 1A (Option)

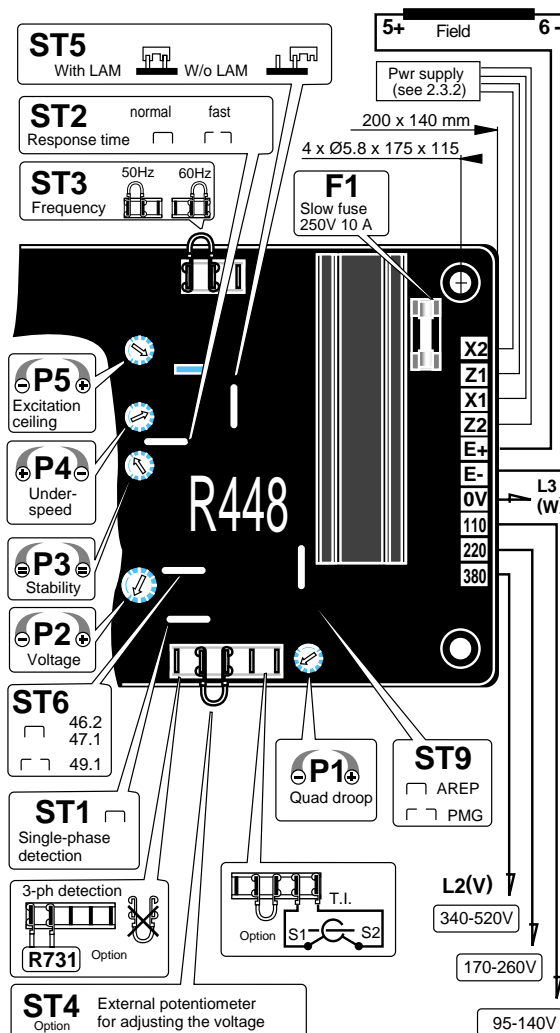
- quadrature droop adjustment via potentiometer P1

- underspeed protection (U/f) and LAM : frequency threshold

adjustable via potentiometer P4

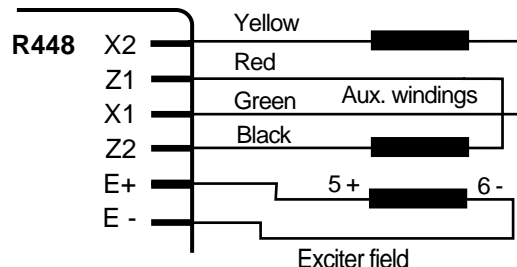
- max. excitation current adjustment via P5 : 4 to 10A

- 50/60 Hz selection via strap ST3.



2.3.2 - R 448 power supply connection

AREP excitation

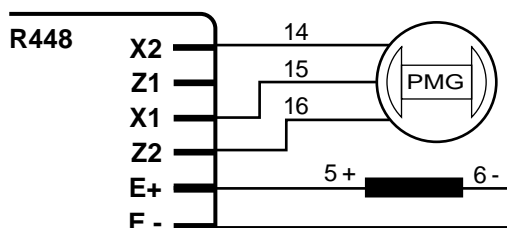


LSA 46.2 / 47.1

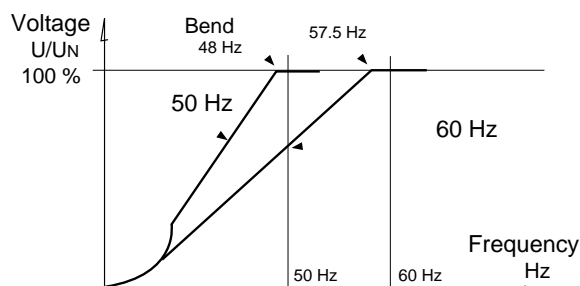
ALTERNATORS

TECHNICAL CHARACTERISTICS

PMG excitation



2.3.3 - Frequency compared with voltage (without LAM)



2.3.4 - LAM characteristics

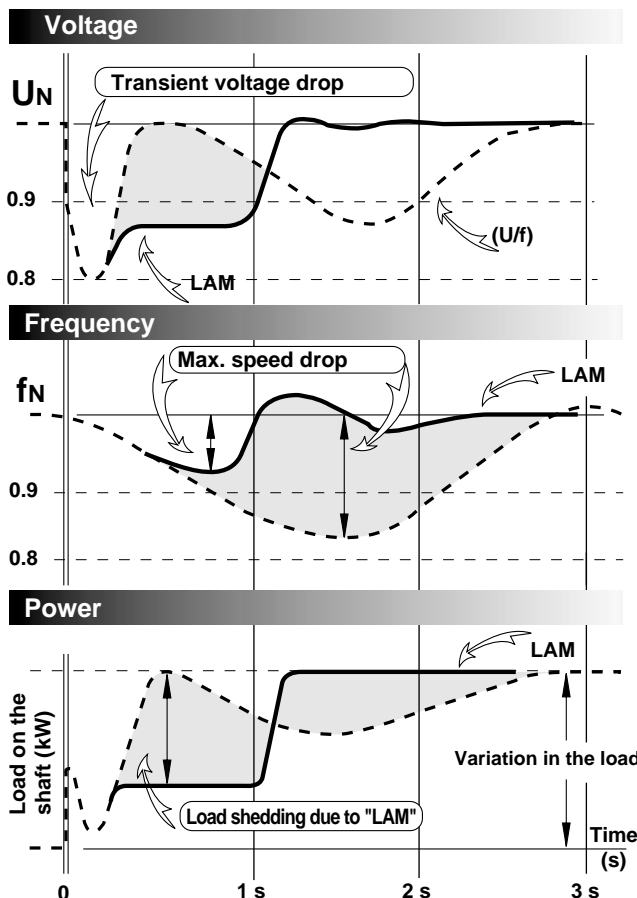
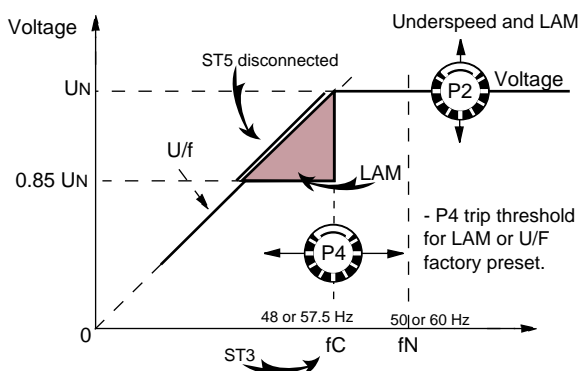
The LAM system is integrated in the regulator, as standard it is active (ST5 with bridge). It can be deactivated by removing the ST5 bridge.

- Role of the "LAM" (Load Adjustment Module) :

On application of a load, the rotation speed of the generator set decreases. When it passes below the preset frequency threshold, the LAM causes the voltage to drop by approximately 15% and consequently the amount of active load applied is reduced by approximately 25%, until the speed reaches its rated value again.

Hence the LAM can be used either to reduce the speed variation (frequency) and its duration for a given applied load, or to increase the applied load possible for one speed variation (turbo-charged engine).

To avoid voltage oscillations, the trip threshold for the LAM function should be set approximately 2 Hz below the lowest frequency in steady state.



Typical effects of the "LAM" with a diesel engine -

— with LAM ···· without LAM (U/F only)

2.3.5 - R 448 AVR options

- Current transformer for parallel operation

of...../1 A -2.5 VA CL 1 (See the diagram included with this manual).

- Remote voltage adjustment potentiometer :

470 Ω , 3 W min. : adjustment range $\pm 5\%$ (range limited by internal voltage potentiometer P2). Remove ST4 to connect the potentiometer. (A 1 k Ω potentiometer can also be used to extend the adjustment range by $\pm 10\%$)

- **R 731 module** : detection of 3-phase voltage 200 to 500V, compatible with parallel operation. Cut ST1 to connect the module; set the voltage via the module potentiometer.

- **R 726 module** : regulation system changed to "4-function" (See the maintenance manual and connection diagram).

- PF regulation (2F)

- equalization of voltages before paralleling (3 F).

- possibility of coupling alternators, already running in parallel, to the mains (4F).

R 726 module connected in place of ST4.

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ALTERNATORS

INSTALLATION

3 - INSTALLATION

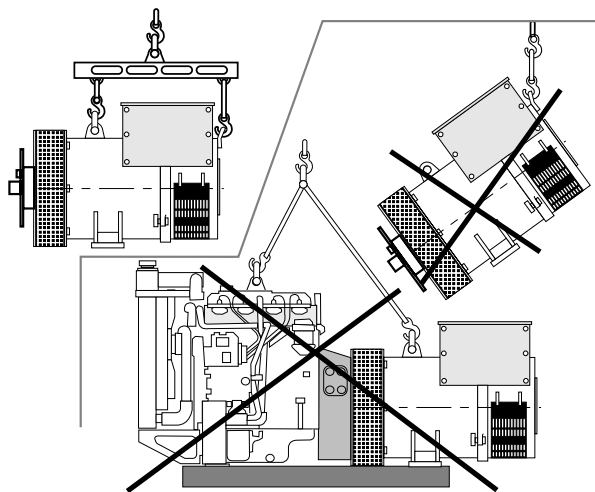
3.1 - Assembly



All mechanical handling operations must be undertaken using approved equipment.
Whilst being handled, the machine should remain horizontal.

3.1.1 - Handling

The generously-sized lifting rings are for handling the alternator alone. They must not be used to lift the genset. Use a lifting system which respects the positioning of the rings.



3.1.2 - Coupling

3.1.2.1 - single bearing alternator

Before coupling the two machines, check that both are compatible by :

- undertaking a torsional analysis of the transmission
- checking the dimensions of the flywheel and its housing, the flange, coupling discs and the offset of the alternator

WARNING

When coupling the alternator to the prime mover, the holes of the coupling discs should be aligned with the flywheel holes by rotating the primary pulley on the thermal engine.

Do not use the alternator fan to turn the rotor.

Tighten the coupling disc screws to the recommended torque (see section 4.6.2.) and check that there is lateral play on the crankshaft.

3.1.2.2 - two-bearing alternator

- Semi-flexible coupling

Careful alignment of the machines is recommended, checking that the concentricity and parallelism of both parts of the coupling does not exceed 0.1 mm.

WARNING

This alternator has been balanced with a 1/2 key.

3.1.3 - Location

Ensure that the ambient temperature in the room where the alternator is placed cannot exceed 40°C for standard power ratings (for temperatures > 40°C, apply a derating coefficient). Fresh air, free from damp and dust, must be able to circulate freely around the air intake grilles on the opposite side from the coupling. It is essential to prevent not only the recycling of hot air from the machine or engine, but also exhaust fumes.

3.2 - Inspection prior to first use

3.2.1 - Electrical checks



Under no circumstances should an alternator, new or otherwise, be operated if the isolation is less than 1 megohm for the stator and 100,000 ohms for the other windings.

There are three possible methods for restoring these minimum values.

- a) Dry out the machine for 24 hours in a drying oven at a temperature of 110 °C (without the AVR)
- b) Blow hot air into the air intake, having made sure that the machine is rotating with the exciter field disconnected.
- c) Run in short-circuit mode (disconnect the AVR) :
 - Short-circuit the three output power terminals using connections capable of supporting the rated current (try not to exceed 6 A/mm²)
 - Insert a clamp ammeter to monitor the current passing through the short-circuit connections.
 - Connect a 24 Volt battery in series with a rheostat of approximately 10 ohms (50 W) to the exciter field terminals, respecting the polarity.
 - Open fully all the alternator openings.
 - run the alternator at its rated speed, and adjust the exciter field current using the rheostat to obtain the rated output current in the short-circuit connections.

Note : Prolonged standstill : In order to avoid these problems, we recommend the use of space heaters, as well as turning over the machine from time to time. Space heaters are only really effective if they are working continuously while the machine is stopped.

3.2.2 - Mechanical checks

Before starting the machine for the first time, check that :

- all fixing bolts and screws are tight
 - cooling air is drawn in freely
 - the protective louvers and housing are correctly positioned
 - the standard direction of rotation is clockwise as seen from the shaft end (phase rotation in order 1 - 2 - 3).
- For anti-clockwise rotation, swap 2 and 3.
- the winding connection corresponds to the site operating voltage (see section 3.3)

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3.3 - Terminal connection diagrams

To modify the connections, change the position of the terminal links or shunts. The winding code is specified on the nameplate.



Any intervention on the alternator terminals during reconnection or checks should be performed with the machine stopped.

3.3.1 - Terminal connection : LSA 46.2/47.1 - 12-wire

The connection accessories are detailed in section 5.3.3.

Connection codes	Voltage L.L			Factory connection
(A) 3-phase 	Winding	50 Hz	60 Hz	LSA 46.2/47.1 - 12-WIRE
	6	190 - 208	190 - 240	
	7	220	-	
	8	-	190 - 208	
R 448 voltage detection : 0 => (T3) / 220 V => (T2)				
(D) 3-phase 	Winding	50 Hz	60 Hz	LSA 46.2/47.1 - 12-WIRE
	6	380 - 415	380 - 480	
	7	440	-	
	8	-	380 - 416	
	R 448 voltage detection : 0 => (T3) / 380 V => (T2)			
	9		600	
Winding 9 : R 448 voltage detection + transformer (See specific diagram)				
(FF) 1 phase 	Winding	50 Hz	60 Hz	LSA 46.2 - 12-WIRE (*)
	6	220 - 240	220 - 240	
	7	240 - 254	-	
	8	-	220 - 240	
R 448 voltage detection : 0 => (T10) / 220 V => (T1)				
(F) 1 phase or 3-phase 	Winding	50 Hz	60 Hz	LSA 46.2/47.1 - 12-WIRE (*)
	6	220 - 240	220 - 240	
	7	240 - 254	-	
	8	-	220 - 240	
R 448 voltage detection : 0 => (T3) / 220 V => (T2) Operating phases L2 (V), L3 (W) single phase				
In case of reconnection, ensure that AVR voltage detection is correct !				

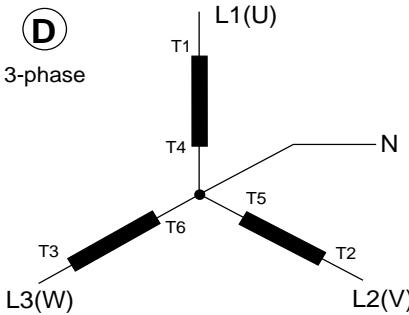
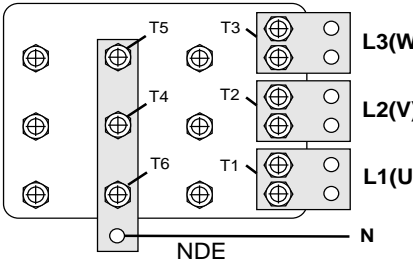

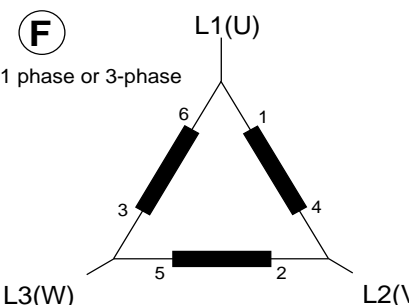
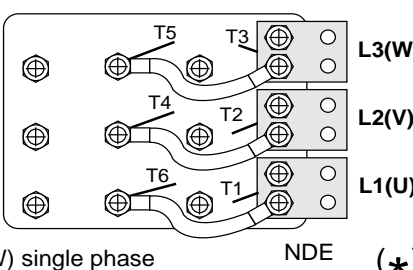

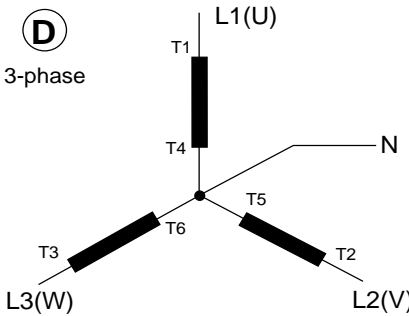
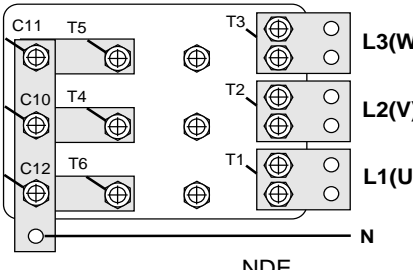

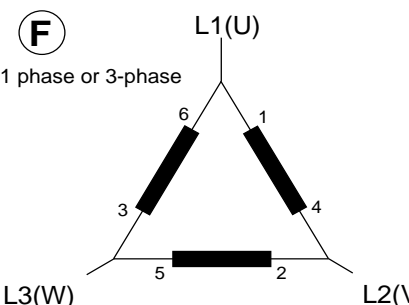
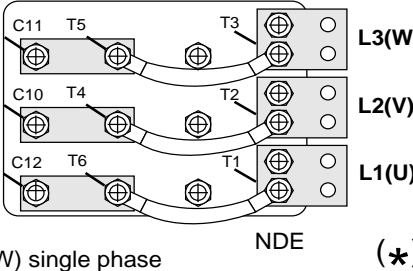


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3.3.2 - Terminal connection :

LSA 46.2/47.1 - 6-wire

Connection codes		Voltage L.L			Factory connection	
(D) 3-phase 	Winding	50 Hz	60 Hz	LSA 46.2 - 6-WIRE 		
	7S	440	-			
	8S	-	380 - 416			
	 R 448 voltage detection : 0 => (T3) / 380 V => (T2)					
	9S		600			
		Winding 9 : R 448 voltage detection + transformer (See specific diagram)				
(F) 1 phase or 3-phase 	Winding	50 Hz	60 Hz	LSA 46.2 - 6-WIRE 		
	7S	240 - 254	-			
	8S	-	220 - 240			
	 R 448 voltage detection : 0 => (T3) / 220 V => (T2) Operating phases : L2 (V), L3 (W) single phase					
					NDE (★)	
Connection codes		Voltage L.L			Factory connection	
(D) 3-phase 	Winding	50 Hz	60 Hz	LSA 47.1 - 6-WIRE 		
	6S	380 - 415	380 - 480			
	7S	440	-			
	8S	-	380 - 416			
	 R 448 voltage detection : 0 => (T3) / 380 V => (T2)					
					NDE	
(F) 1 phase or 3-phase 	Winding	50 Hz	60 Hz	LSA 47.1 - 6-WIRE 		
	6S	220 - 240	220 - 277			
	7S	240 - 254	-			
	8S	-	220 - 240			
	 R 448 voltage detection : 0 => (T3) / 220 V => (T2) Operating phases : L2 (V), L3 (W) single phase					
				NDE (★)		
 In case of reconnection, ensure that the AVR voltage detection is correct !						

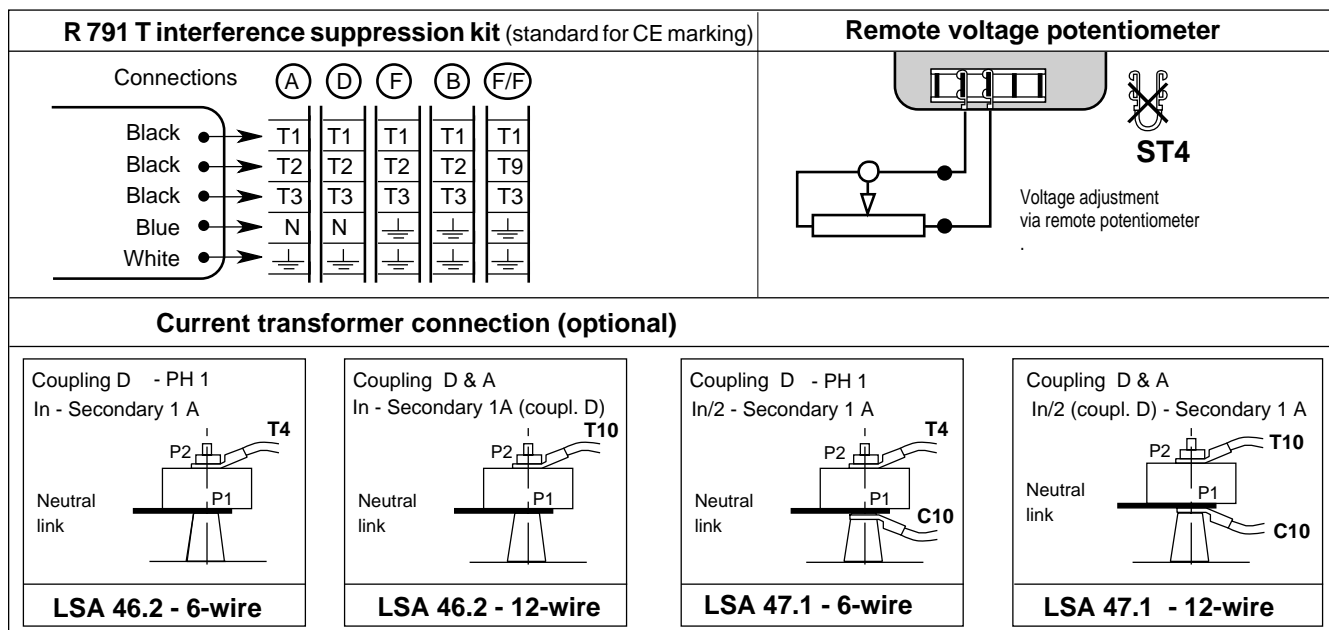
(*) The factory can supply a set of flexible shunts and special connection links as an option for making these connections. The standard alternator is fitted with 3 starting ranges, 6 connection links and one neutral link.

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3.3.3 - Option connection diagram



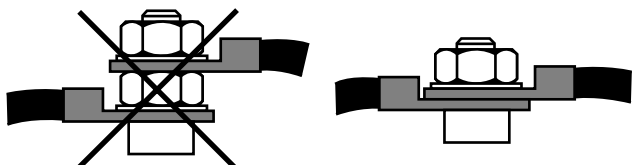
3.3.4 - Connection checks



Electrical installations must comply with the current legislation in the country of use.

Check that :

- the residual circuit-breaker conforms to legislation on protection of personnel, in force in the country of use, and has been correctly installed on the alternator power output as close as possible to the alternator. (In this case, disconnect the wire of the interference suppression module linking the neutral).
- Any protective devices in place have not been tripped.
- If there is an external AVR , the connections between the alternator and the cubicle are made in accordance with the connection diagram.
- There is no short-circuit between phase or phase-neutral between the alternator output terminals and the generator set control cabinet (part of the circuit not protected by circuit-breakers or cubicle relays).
- The machine should be connected with the busbar separating the terminals as shown in the terminal connection diagram.



3.3.5 - Electrical checks on the AVR

- Check that all connections have been made properly as shown in the attached connection diagram.

- Check that the frequency selection strap "ST3" is on the correct frequency setting.
- Check whether strap ST4 or the remote adjustment potentiometer have been connected.
- Optional operating modes
 - Strap ST1 : cut to connect the R 731 3-phase detection module.
 - Strap ST2 : cut for rapid response time
 - Strap ST5 : cut to suppress the LAM function.

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3.4 - Commissioning



The machine can only be started up and used if the installation has been set up in accordance with the regulations and instructions defined in this manual.

The machine is tested and set at the factory. When first used with no load, make sure that the drive speed is correct and stable (see the nameplate). With the greaseable ball bearings option, we recommend greasing the bearings at the time of commissioning (see 4.2.3).

On application of the load, the machine should achieve its rated speed and voltage; however, in the event of abnormal operation, the machine setting can be altered (follow the adjustment procedure in section 3.5). If the machine still operates incorrectly, the cause of the malfunction must be located (see section 4.4).

3.5 - Settings



The various adjustments during tests must be made by a qualified engineer.

WARNING

Take care that the drive speed specified on the nameplate is reached before commencing adjustment

1500 min⁻¹ / 50Hz or 1800 min⁻¹ / 60 Hz.

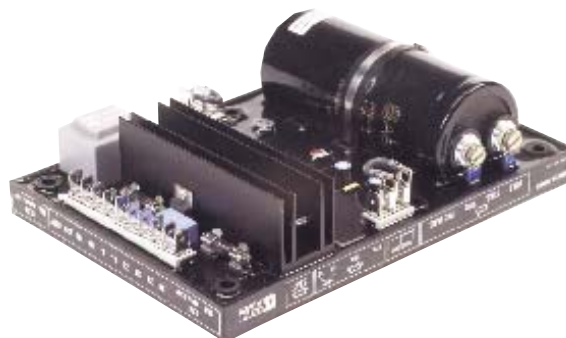
Do not try to set the voltage if the frequency or speed is not correct (risk of irreparable rotor damage).



After operational testing, replace all access panels or covers.

The AVR should be used to make any adjustments to the machine.

3.5.1 - R 448 settings



a) Initial potentiometer settings (see table below)
- Remote voltage adjustment potentiometer : centre (strap ST4 removed).

Action	Factory setting	Pot.
Voltage minimum fully anti-clockwise	400V - 50 Hz (Input 0 - 380 V)	
Stability	Not set (centre position)	
Threshold/LAM or U/F Underspeed protection and "LAM" trip threshold Maximum frequency fully anti-clockwise	If ST3 = 50 Hz (factory) = 48 Hz If ST3 = 60 Hz (factory) = 58 Hz	
Voltage quadrature droop (// operation with C.T.) - 0 quadrature droop fully anti-clockwise.	Not set (fully anti- clockwise)	
Excitation ceiling Limit of excitation and short-circuit current, minimum fully anti-clockwise	10 A maximum	

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Adjustments in standalone operation

b) Install a D.C. analogue voltmeter (needle dial) cal. 100V on terminals E+, E- and an A.C. voltmeter cal 300 - 500 or 1000V on the alternator output terminals.

c) Make sure that strap ST3 is positioned on the desired frequency (50 or 60 Hz).

d) Voltage potentiometer P2 at minimum, fully anti-clockwise.

e) Turn the V/Hz potentiometer P4 fully clockwise.

f) Stability potentiometer P3 to approximately 1/3 anti-clockwise turn.

g) Start the engine and set its speed to a frequency of 48 Hz for 50 Hz, or 58 for 60 Hz.

h) Set the output voltage to the desired value using P2.

- Rated voltage UN for solo operation (eg. 400 V)

- Or UN + 2 to 4% for parallel operation with C.T. (eg. 410 V)
If the voltage oscillates, use P3 to make adjustments (try both directions) observing the voltage between E+ and E- (approx. 10V D.C.). The best response times are obtained at the limit of the instability. If no stable position can be obtained, try cutting or replacing strap ST2 (normal/fast).

i) Check LAM operation : ST5 closed.

j) Turn potentiometer P4 slowly anti-clockwise until there is a significant voltage drop (approximately 15%)

k) Vary the frequency (speed) around 48 or 58 Hz according to the operating frequency, and check the change in voltage from that observed previously (approximately 15%).

l) Readjust the speed of the unit to its rated no-load value.

Adjustments in parallel operation

WARNING

Before any intervention on the alternator, make sure that the speed droop is identical for all engines.

m) Preset for parallel operation (with C.T. connected to S1, S2 on connector J2)

- Potentiometer P1 (quadrature droop) in centre position. Apply the rated load ($\cos \varnothing = 0.8$ inductive).

The voltage should drop by 2 to 3%. If it increases, swap the 2 incoming wires from the C.T. secondary.

n) The no-load voltages should be identical for all the alternators intended to run in parallel.

- Couple the machines in parallel.

- By adjusting the speed, try to obtain 0 KW power exchange.

- By altering the voltage setting P2 or Rhe on one of the

machines, try to cancel (or minimise) the current circulating between the machines.

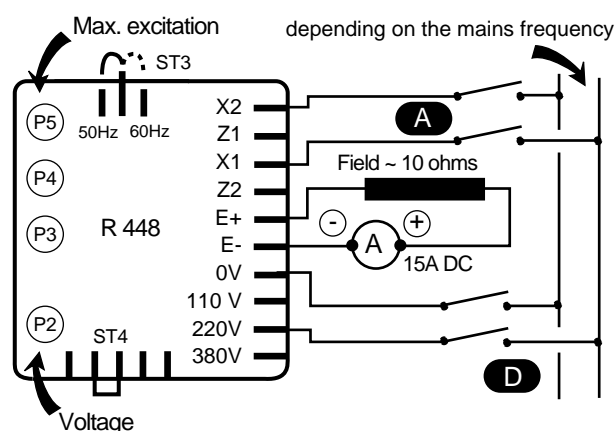
From now on, do not touch the voltage settings.

o) Apply the available load (the setting is only correct if a reactive load is available)

- By altering the speed, equalise the KW (or divide the rated power of the units proportionally)

- By altering the quadrature droop potentiometer P1, equalise or divide the currents.

3.5.2 - Max. excitation setting (excitation ceiling)



Adjustment of the current limit

via potentiometer P5 (fuse rating : 8A-10 seconds).

The maximum factory setting corresponds to that of the excitation current required to obtain a 3-phase short-circuit current of approximately 3 IN at 50 Hz for industrial power, unless otherwise specified(*).

A static method can be used to reduce this value or adapt the Isc to the actual max. operating power (derated machine), which is safer for the alternator and the installation.

Disconnect power supply wires X1,X2 and Z1,Z2 and the voltage reference (0-110V-220V-380V) on the alternator. Connect the mains power supply (200-240V) as indicated (X1,X2). Install a 10A D.C. ammeter in series with the exciter field. Turn P5 fully anti-clockwise and activate the power supply. If there is no output current from the AVR, turn potentiometer P2 (voltage) clockwise until the ammeter indicates a stable current. Switch the power supply off, then on again, turn P5 clockwise until the required max. current is obtained (no more than 10 A).

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Checking the internal protection :

Open switch (D): the excitation current should increase to its preset ceiling, remain at that level for ≥ 10 seconds and then drop to < 1 A.

To reset, switch off the power supply by opening switch (A).

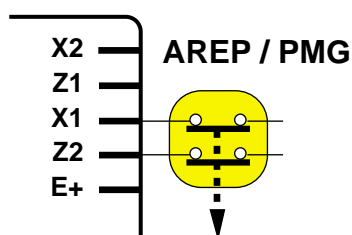
Note : After setting the excitation ceiling as described, adjust the voltage again

(see section 3.5.2.) via P2.

(*) : In some countries it is a legal requirement to have a short-circuit current, so as to offer discriminating protection.

3.5.3 - Special type of use

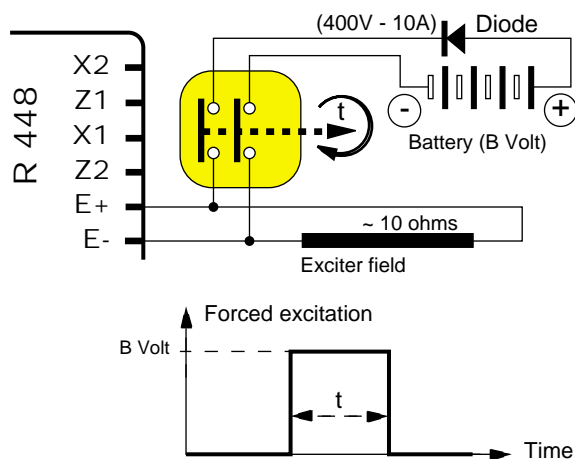
- Field weakening



The exciter is switched off by disconnecting the AVR power supply (1 wire on each auxiliary winding) – contact rating 16 A - 250V A.C.

Connection is identical for resetting the AVR internal protection

- Field forcing



Applications	B volts	Time t
Guaranteed voltage build-up	12 (1A)	1 - 2 s
Parallel operation, de-energized	12 (1A)	1 - 2 s
Parallel operation, at standstill	24 (2A)	5 - 10 s
Frequency starting	48 (4A)	5 - 10 s
Sustained voltage on overload	48 (4A)	5 - 10 s

LSA 46.2 / 47.1**ALTERNATORS****SERVICING - MAINTENANCE****4 - SERVICING - MAINTENANCE****4.1 - Safety measures**

Servicing or troubleshooting must be carried out strictly in accordance with instructions so as to avoid the risk of accidents and to maintain the machine in its original condition.



All such operations performed on the alternator should be undertaken by personnel trained in the commissioning, servicing and maintenance of electrical and mechanical components.

Before any intervention on the machine, ensure that it cannot be started by a manual or automatic system and that you understand how the operating system works.

4.2 - Regular maintenance**4.2.1 - Checks after start-up**

After approximately 20 hours of operation, check that all fixing screws on the machine are still tight, plus the general condition of the machine and the various electrical connections in the installation.

4.2.2 - Cooling circuit

It is advisable to check that circulation of air is not reduced by partial blocking of the air intake and outlet grilles : mud, fibre, grease, etc.

4.2.3 - Bearings

The bearings are greasable (option). It is advisable to lubricate the machine during operation. Time intervals and quantity of grease are given in the table below.

DE bearing - LSA 46.2	6316 C3
Quantity of grease	33 g
Lubrication interval	4000 H

NDE bearing - LSA 46.2/ 47.1	6315 C3
Quantity of grease	30 g
Lubrication interval	4500 H

DE bearing - LSA 47.1	6318 C3
Quantity of grease	41 g
Lubrication interval	3500 H

Lubrication intervals are given for a grease of grade
LITHIUM - standard - NLGI 3.

The factory lubrication is performed with grease :
SHELL - ALVANIA G3.

Before using another grease, check for compatibility with the original one. Monitor the temperature rise in the bearings, which should not exceed 50°C above the ambient temperature. Should this value be exceeded, the machine must be stopped and checks carried out.

4.2.4 - Electrical servicing

Cleaning product for the windings

WARNING

Do not use : trichlorethylene, perchlorethylene, trichloroethane or any alkaline products.

Certain strictly defined pure volatile degreasing products can be used, such as :

- Normal petrol (without additives)
- Toluene (slightly toxic); inflammable
- Benzene (or benzine, toxic); inflammable
- Cyclohexane (non toxic); inflammable

Cleaning of the stator, rotor, exciter and diode bridge

The insulating components and the impregnation system are not at risk of damage from solvents (see the above list of authorised products).

Avoid letting the cleaning product run into the slots. Apply the product with a brush, sponging frequently to avoid accumulation in the housing. Dry the winding with a dry cloth. Let any traces evaporate before reassembling the machine.

4.2.5 - Mechanical servicing**WARNING**

Cleaning the machine using water or a high-pressure washer is strictly prohibited.

Any problems arising from such treatment are not covered by our warranty.

Degreasing : Use a brush and detergent (suitable for paintwork).

Dusting : Use an air gun.

If filters have been added to the machine after manufacture and do not have thermal protection, the service personnel should clean the air filters periodically and systematically, as often as is necessary (every day in very dusty atmospheres). Cleaning can be performed using water for dry dust or in a bath containing soap or detergent in the case of greasy dust. Petrol or chlorethylene can also be used.

After cleaning the alternator, it is essential to check the winding insulation (see sections 3.2. and 4.8.).

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ALTERNATORS

SERVICING - MAINTENANCE

4.3 - Fault detection

If, when commissioned, the alternator does not work normally, the source of the malfunction must be identified.

To do this, check that :

- the protective devices are fitted correctly
- the connections comply with diagrams in the manuals supplied with the machine
- the speed of the unit is correct (see section 1.3).

Repeat the operations defined in section 3.

4.4 - Mechanical defects

Fault		Action
Bearing	Excessive overheating of one or both bearings (bearing temperature 50°C above the ambient temperature) (With or without abnormal bearing noise)	<ul style="list-style-type: none"> - If the bearing has turned blue or if the grease has turned black, change the bearing. - Bearing not fully locked (abnormal play in the bearing cage). - End shields incorrectly aligned.
Abnormal temperature	Excessive overheating of alternator frame (more than 40° C above the ambient temperature)	<ul style="list-style-type: none"> - Airflow (inlet-outlet) partially clogged or hot air is being recycled from the alternator or engine - Alternator operating at too high a voltage (> 105% of Un on load) - Alternator overloaded
Vibrations	Too much vibration	<ul style="list-style-type: none"> - Misalignment (coupling) - Defective mounting or play in coupling - Rotor balancing fault (Engine - Alternator)
	Excessive vibration and humming noise coming from the machine	<ul style="list-style-type: none"> - Phase imbalance - Stator short-circuit
Abnormal noise	Alternator damaged by a significant impact, followed by humming and vibration	<ul style="list-style-type: none"> - System short-circuit - Mis-paralleling <p>Possible consequences</p> <ul style="list-style-type: none"> - Broken or damaged coupling - Broken or bent shaft end. - Shifting and short-circuit of main field - Fan fractured or coming loose on shaft - Irreparable damage to rotating diodes or AVR.

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SERVICING - MAINTENANCE

4.5 - Electrical faults

Fault	Action	Effect	Check/Cause
No voltage at no load on start-up	Connect a new battery of 4 to 12 volts to terminals E- and E+, respecting the polarity, for 2 to 3 seconds	The alternator builds up and its voltage is still correct when the battery is removed.	- Lack of residual magnetism
		The alternator builds up but its voltage does not reach the rated value when the battery is removed.	- Check the connection of the voltage reference to the AVR - Faulty diode - Armature short-circuit
		The alternator builds up but its voltage disappears when the battery is removed	- Faulty AVR - Field windings open circuit (check winding) - Main field winding open circuit (check the resistance)
Voltage too low	Check the drive speed	Correct speed	Check the AVR connections (possible AVR failure) - Field windings short-circuited - Rotating diodes burnt out - Main field winding short-circuited - Check the resistance
		Speed too low	Increase the drive speed. (Do not touch the AVR voltage pot. (P2) before running at the correct speed.)
Voltage too high	Adjust AVR voltage potentiometer	Adjustment ineffective	Faulty AVR
Voltage oscillations	Adjust AVR stability potentiometer	If no effect : try normal / fast recovery modes (ST2)	- Check the speed : possibility of cyclic irregularity - Loose connections - Faulty AVR - Speed too low when on load (or LAM set too high)
Voltage correct at no load and too low when on load	Run at no load and check the voltage between E+ et E- on the AVR	Voltage between E+ and E- (DC) AREP / PMG < 10V	- Check the speed (or LAM set too high)
		Voltage between E+ and E- AREP / PMG > 15V	- Faulty rotating diodes - Short-circuit in the main field. Check the resistance- Faulty exciter armature. Check the resistance.
Voltage disappears during operation	Check the AVR, the surge suppressor, the rotating diodes, and replace any defective components	The voltage does not return to the rated value.	- Exciter winding open circuit - Faulty exciter armature - Faulty AVR - Main field open circuit or short-circuited

4.5.1 - Checking the winding

You can check the winding insulation by performing a high voltage test. In this case, you must disconnect all AVR wires.

WARNING

Damage caused to the AVR in such conditions is not covered by our warranty.

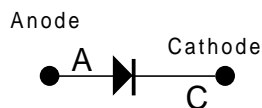
LSA 46.2 / 47.1

ALTERNATORS

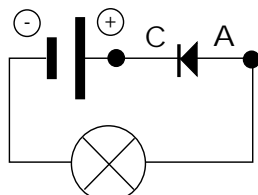
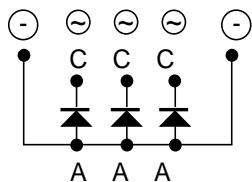
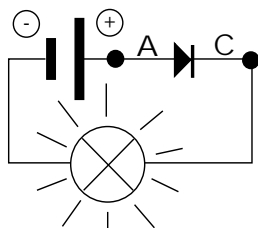
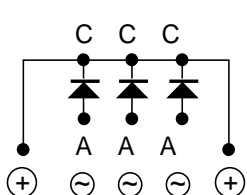
SERVICING - MAINTENANCE

4.5.2 - Checking the diode bridge

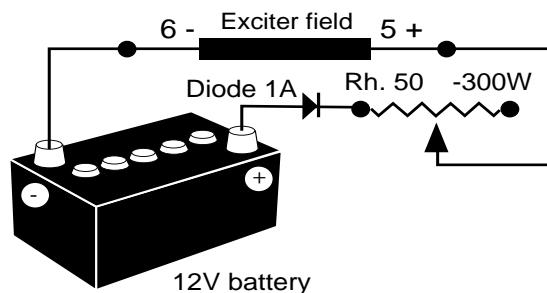
DIODE BRIDGE



A diode in good working order must allow the current to flow from the anode to the cathode only.



ASSEMBLY A



Assembly B : Connect a "Variat" variable power supply and a diode bridge on both exciter field wires (5+) and (6-).

Both these systems should have characteristics which are compatible with the machine field excitation power (see the nameplate).

3) Run the unit at its rated speed.

4) Gradually increase the exciter field current by adjusting the rheostat or the variac and measure the output voltages on L1 - L2 - L3, checking the excitation voltage and current at no load and on load (see the machine nameplate or ask for the factory test report).

When the output voltage is at its rated value and balanced within < 1 % for the rated excitation level, the machine is in good working order. The fault therefore comes from the AVR or its associated wiring (ie. sensing, auxiliary windings).

4.5.3 - Checking the windings and rotating diodes using separate excitation

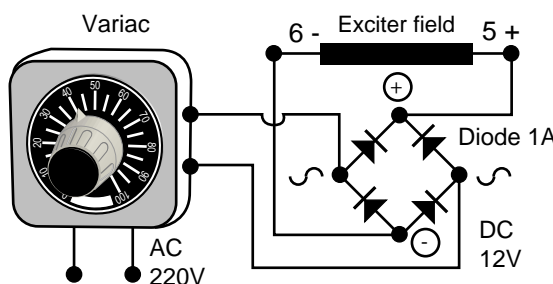


During this procedure, make sure that the alternator is disconnected from any external load and inspect the terminal box to check that the connections are fully tightened.

- 1) Stop the unit, disconnect and isolate the AVR wires.
- 2) There are two ways of creating an assembly with separate excitation.

Assembly A : Connect a 12 V battery in series with a rheostat of approximately 50 ohms - 300 W and a diode on both exciter field wires (5+) and (6-).

ASSEMBLY B



LSA 46.2 / 47.1

ALTERNATORS

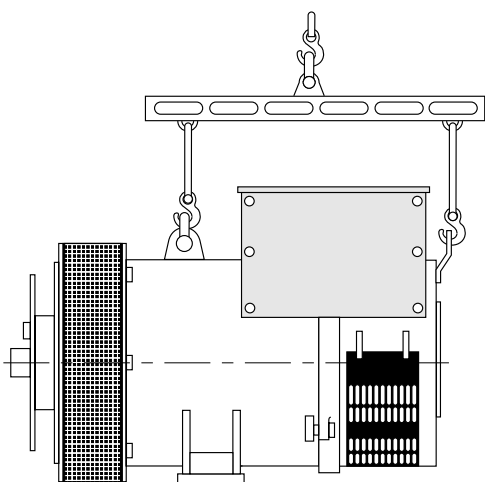
SERVICING - MAINTENANCE

4.6 - Dismantling, reassembly (see sections 5.4.1. & 5.4.2.)

WARNING

During the warranty period, this operation should only be carried out in an approved LEROY-SOMER workshop or in our factory, otherwise the warranty may be invalidated.

Whilst being handled, the machine should remain horizontal (rotor not locked when moved).



4.6.1 - Tools required

To fully dismantle the machine, we recommend using the tools listed below :

- 1 ratchet spanner + extension,
- 1 torque wrench,
- 1 set of flat spanners : 8 mm, 10 mm, 18 mm,
- 1 socket set : 8, 10, 13, 16, 18, 21, 24, 30 mm
- 1 socket with male ferrule : 5 mm,
- 1 puller.

4.6.2 - Screw tightening torque

IDENTIFICATION	Screw Ø	Torque N.m
Exciter screw	M 6	10
Star diode bridge	M 6	10
Diode nut	M 6	4
Flange / Frame screw (46.2 S, M)	M 14	80
Flange / Frame screw (46.2 L, VL)	M 14	190
Flange / Frame screw (47.1)	M 16	190
NDE bracket / frame screw	M 12	50
Discs / Sleeve screw	M 16	230
Earth screw	M 10	20
Grille screws	M 6	5
Cover screws	M 6	5
Terminal block nut	M 12	35

4.6.3 - Access to diodes

- Open the air inlet louvre (51)
- Disconnect the diodes.
- Check the diodes using an ohmmeter or a battery lamp (see section 4-5)

If the diodes are faulty

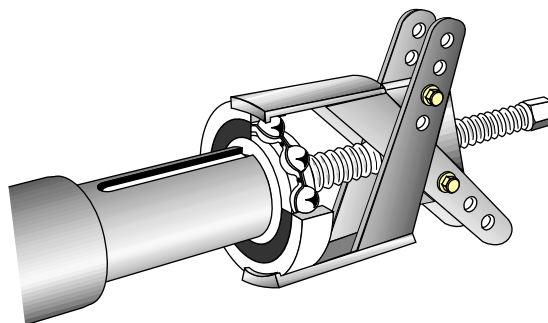
- Remove the surge suppressor (347).
- Remove the 6 "H" mounting nuts for the diode bridges on the support.
- Change the crescents, respecting the polarity.

4.6.4 - Access to connections and the regulation system

Access directly by removing the box lid (48) or the AVR access door (466).

4.6.5 - Replacing the NDE bearing on single bearing machines

- Remove the box lid (48) and the NDE panel (365) and remove the 2 screws from the part (122).
- Disconnect the stator outputs (T1 to T12).
- Disconnect the auxiliary winding wires with AREP (X1,X2,Z1,Z2).
- Disconnect the exciter wires (5+,6-).
- Remove the air inlet louvre (51)
- Remove the 2 bearing thrust screws (78).
- Remove all 4 screws (37).
- Remove the bearing (36).
- Remove the ball bearing (70) using a puller with a central screw (see drawing below).



- Check the condition of the "O" ring seal (349) and, if necessary, change it.
- Fit the new bearing, after heating it by induction to approximately 80°C.

WARNING

When dismantling the machine, always change the bearings.

LSA 46.2 / 47.1

ALTERNATORS

SERVICING - MAINTENANCE

4.6.6 - Replacing the DE bearing on two-bearing machines

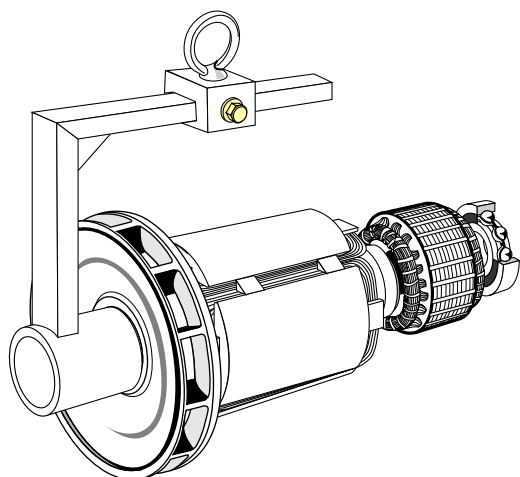
- Remove the screws (31) and (62).
- Remove the shield (30).
- Remove the circlips (284).
- Remove the ball bearing (60) using a puller with a central screw.
- Fit the new bearing, after heating it by induction to approximately 80°C.

WARNING

When dismantling the machine, always change the bearings.

4.6.7 - Complete dismantling

- Remove the DE shield (30) as described in section 4.6.6.
- Support the DE rotor (4) with a strap or a support constructed as shown in the drawing below.



- Remove the NDE shield bearing cover.
- Tap the shaft end lightly on the opposite side from the coupling using a small mallet.
- Pull the strap in order to move the rotor and ensure its weight is evenly supported.
- Remove the NDE shield following the instructions in section 4.6.5.

4.6.8 - Reassembling the end shields

- Place the "O" ring seal (349) and the preloading wavy washer (79) in the bearing seat (36).
- Position shields (30) and (36) on the stator (1).
- Tighten screws (31) and (37).
- Reconnect all the exciter wires, auxiliary windings, stator, etc.
- Fit the 2 support screws (122).
- Fit the air inlet louvre (51)
- Replace the cover.

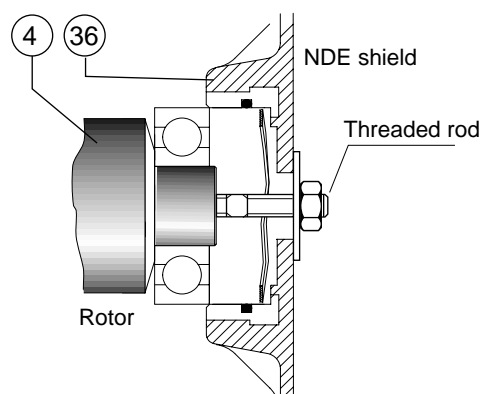
4.6.9 - Reassembling the rotor

On single bearing machines :

- Mount the rotor (4) in the stator (1) (see drawing below)
- Check that the machine is correctly assembled and that all screws are tightened.

On two-bearing machines :

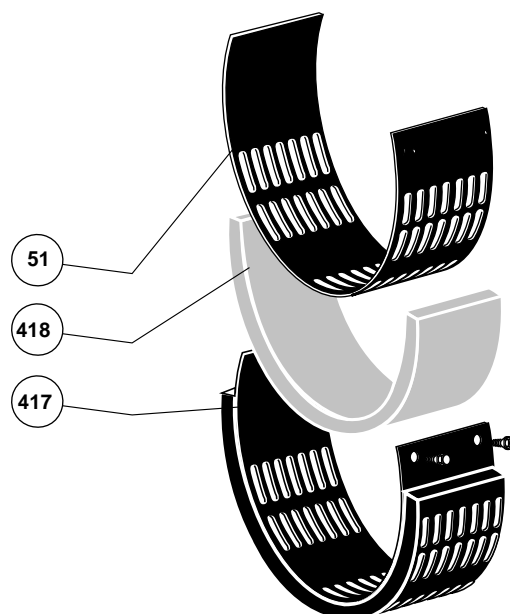
- Mount the rotor (4) in the stator (1).
- Position shield (30) on the stator (1).
- Tighten screws (31).
- Mount the inner bearing retainer (68) using the screws (62).



- Mount the circlips (284)
- Check that the machine is correctly assembled and that all screws are tightened.

4.6.10 - Dismantling and reassembly of the filters

- Remove the grille (417) then take out the filter (418) .
- Change the filter, if necessary, please refer to section 4.2.5 for cleaning the filter. To replace follow instructions in reverse order.



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WARNING

When removal of the rotor involves changing parts or rewinding, the rotor must be rebalanced.



After operational testing, replace all access panels or covers.

4.7 - Installation and maintenance of the PMG

In LSA 46.2 / 47.1, the PMG reference is : PMG 2.

4.7.1 - Mechanical characteristics

The components are :

- an adaptation shaft (to position the rotor on the alternator shaft).
 - an M16 tie rod and nut for assembling the rotor on the shaft.
 - a rotor with 16 magnets.
 - A housing + wound stator + plastic connection sleeve assembly + plastic ferrules.
 - the housing cover (4 CBLXS M5 screws).
 - 4 HM6 screws (mounting housing on the NDE shield).
- If mounting in kit form, follow the instructions below.

- 1 - Remove the PMG cover [297] and the seal (71) on the alternator NDE shield.
- 2 - Mount the PMG housing assembly [290] on the shield using the 4 HM6 screws.
- 3 - Put adhesive on the tie rod [295] and screw it fully into the tapped hole in the alternator shaft extension.
- 4 - Mount the magnetised rotor on the adaptation shaft, then using 2 M10 threaded rods screwed into the rotor slide the assembly onto the tie rod.
- 5 - Once the rotor is in position, remove the 2 M10 rods.
- 6 - Fit the cable gland washer [296].
- 7 - Tighten the assembly with the M16 nut.
- 8 - Close the PMG with the cover [297].
- 9 - Remove the plastic plug on the NDE panel and fit the plastic sleeve and its ferrule.
- 10 - Connect the PMG to the AVR (section 4.7.2.).

4.7.2 - Electrical connection

- Connect the 3 PMG wires (14/15/16), the 2 exciter wires (5/6) and the 2 previously mentioned voltage detection wires (2/3) in accordance with the connection diagram (see section 2.3.2).

Mounting the PMG on an AREP machine

- Connect the 3 PMG wires (14/15/16), to terminals X1,X2,Z2

on the AVR. The 4 auxiliary winding wires X1.X2.Z1.Z2 should be isolated using the domino fitting supplied with the kit. Both exciter field wires (5/6) and the voltage sensing wires (2/3) remain in place.

Electrical characteristics of the PMG 2

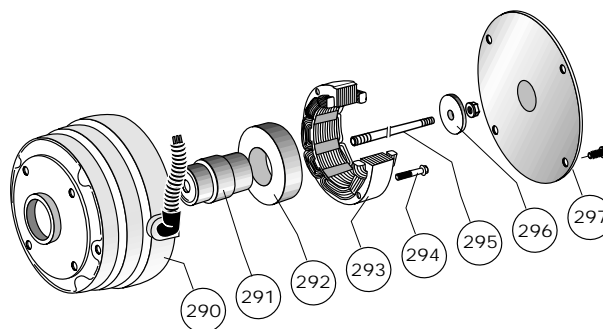
Stator phase/phase resistance 20°C : 2.1 Ω

No-load A.C. voltage between phases at 1500 rpm : 125 V.

ATTENTION

With the PMG, check that strap ST9 has been disconnected.

4.7.3 - Exploded view of the PMG



LSA 46.2 / 47.1

ALTERNATORS

SERVICING - MAINTENANCE

4.8 - Table of characteristics

Table of average values

Alternator - 4 poles - 50 Hz - Standard winding No. 6.
(400V for the excitation values)

The voltage and current values are given for no-load operation and operation at rated load with separate field excitation. All values are given at $\pm 10\%$ and may be changed without prior notification (for exact values, consult the test report).

4.8.1 - Average values for LSA 46.2

Resistances at 20°C (Ω)

LSA 46.2	Stator L/N	Rotor	Field	Armature
M3	0.022	0.23	8.8	0.035
M5	0.0182	0.24	8.8	0.035
L6	0.0148	0.264	8.8	0.035
L9	0.012	0.295	8.8	0.035
VL12	0.0085	0.343	10	0.037

Resistance of AREP auxiliary windings at 20°C (Ω)

LSA 46.2	Auxil wdg : X1, X2	Auxil wdg : Z1, Z2
M3	0.24	0.4
M5	0.215	0.36
L6	0.185	0.36
L9	0.19	0.32
VL12	0.17	0.32

Field excitation current i exc (A)

Symbols : "i exc": excitation current of the exciter field.

LSA 46.2	No load	At rated load
M3	1.1	4
M5	1.1	3.8
L6	1.1	4.1
L9	1.2	4
VL12	1.1	3.5

For 60 Hz machines, the "i exc" values are approximately 5 to 10 % lower.

4.8.2 - Average values for LSA 47.1

Resistances at 20°C (Ω)

LSA 47.1	Stator L/N	Rotor	Field	Armature
M4	0.0108	0.8	10.2	0.13
M6	0.0081	0.9	10.2	0.13
L9	0.006	1.04	10.2	0.13
L10	0.0053	1.1	10.2	0.13
L11	0.0053	1.1	10.2	0.13
VL 12	0.0028	1.13	10.2	0.13

Resistance of AREP auxiliary windings at 20°C (Ω)

LSA 47.1	Auxil wdg : X1, X2	Auxil wdg : Z1, Z2
M4	0.23	0.405
M6	0.21	0.335
L9	0.175	0.34
L10	0.173	0.29
L11	0.173	0.29
VL 12	0.18	0.325

Field excitation current i exc (A)

Symbols : "i exc": excitation current of the exciter field.

LSA 47.1	No load	At rated load
M4	0.9	3.8
M6	0.9	3.5
L9	0.9	3.2
L10	0.9	3.4
L11	0.9	3.7
VL 12	0.9	3.45

For 60 Hz machines, the "i exc" values are approximately 5 to 10 % lower.

4.8.3 - Voltage of auxiliary windings at no load

LSA 46.2	Auxil wdg : X1, X2	Auxil wdg : Z1, Z2
50 Hz	70 V	10 V
60 Hz	85 V	12 V

LSA 47.1	Auxil wdg : X1, X2	Auxil wdg : Z1, Z2
50 Hz	70 V	5 V
60 Hz	85 V	6 V

LSA 46.2 / 47.1 ALTERNATORS

5 - SPARE PARTS

5.1 - First maintenance parts

Emergency repair kits are available as an option.
They contain the following items :

Ref.	Description	Qty	LSA 46.2	Part ref
	Emergency kit	1		
198	AVR	1	R 448	ESC 220 CV019
343	Diode bridge assembly	1	LSA 471. 9. 07 LSA 471.9 / 0.08	ADE 461 EQ 004
347	Surge suppressor	1	LSA 461.9.01	CII 111 PM 005
	AVR fuse	2	250 V - 10 A	PEL 010 FG 008
	Other spare parts			
60	DE bearing	1	6316 2RS/C3	RLT 080 TS030
70	NDE bearing	1	6315 2RS/C3	RLT 075 TS030

Ref.	Description	Qty	LSA 47.1	Part ref
	Emergency kit	1		
198	AVR	1	R 448	ESC 220 CV019
343	Diode bridge assembly	1	LSA 471. 9. 07 LSA 471.90.08	ADE 471 EQ 007
347	Surge suppressor	1	LSA 461.9.01	CII 111 PM 005
	AVR fuse	2	250 V - 10 A	PEL 010 FG 008
	Other spare parts			
60	DE bearing	1	6318 2RS/C3	RLT 090 TS030
70	NDE bearing	1	6315 2RS/C3	RLT 075 TS030

5.2 - Technical support service

Our technical support service will be pleased to provide any additional information you may require.

When ordering spare parts, you should indicate the complete machine type, its serial number and the information given on the nameplate.

Address your enquiry to your usual contact.

Part numbers should be identified from the exploded views and their description from the parts list.

Our extensive network of service centres can dispatch the necessary parts without delay.

To ensure correct operation and the safety of our machines, we recommend the use of original manufacturer spare parts. In the event of failure to comply with this advice, the manufacturer cannot be held responsible for any damage.

5.3 - Accessories

5.3.1 - Space heater for use when stopped

The space heater must start up as soon as the alternator stops. It is installed at the rear of the machine. Its standard power is 250W with 220V or 250W with 110V on request.



Warning : the power supply is present when the machine has stopped.

5.3.2 - Stator thermistor temperature probes (PTC)

These are thermistor triplets with a positive temperature coefficient installed in the stator winding (1 per phase). There can be a maximum of 2 triplets in the windings (at 2 levels : warning and trip) and 1 or 2 thermistors in the shields.

These probes must be linked to appropriate detection relays (supplied optionally)

Cold resistance of thermistor probes:

100 to 250 Ω per probe.

5.3.3 - Connection accessories

- 6-wire machines

Requirements for coupling (F) :

- 3 flexible shunts

- 12-wire machines

Requirements for coupling (A) :

- 6 links

- 1 link for the neutral

Requirements for coupling (F.F) :

- 4 flexible shunts

- 2 flexible shunts

- 1 link for the central point

- 1 additional starting range

- 1 additional terminal

Requirements for coupling (F) :

- 3 flexible shunts

- 1 link for the central point

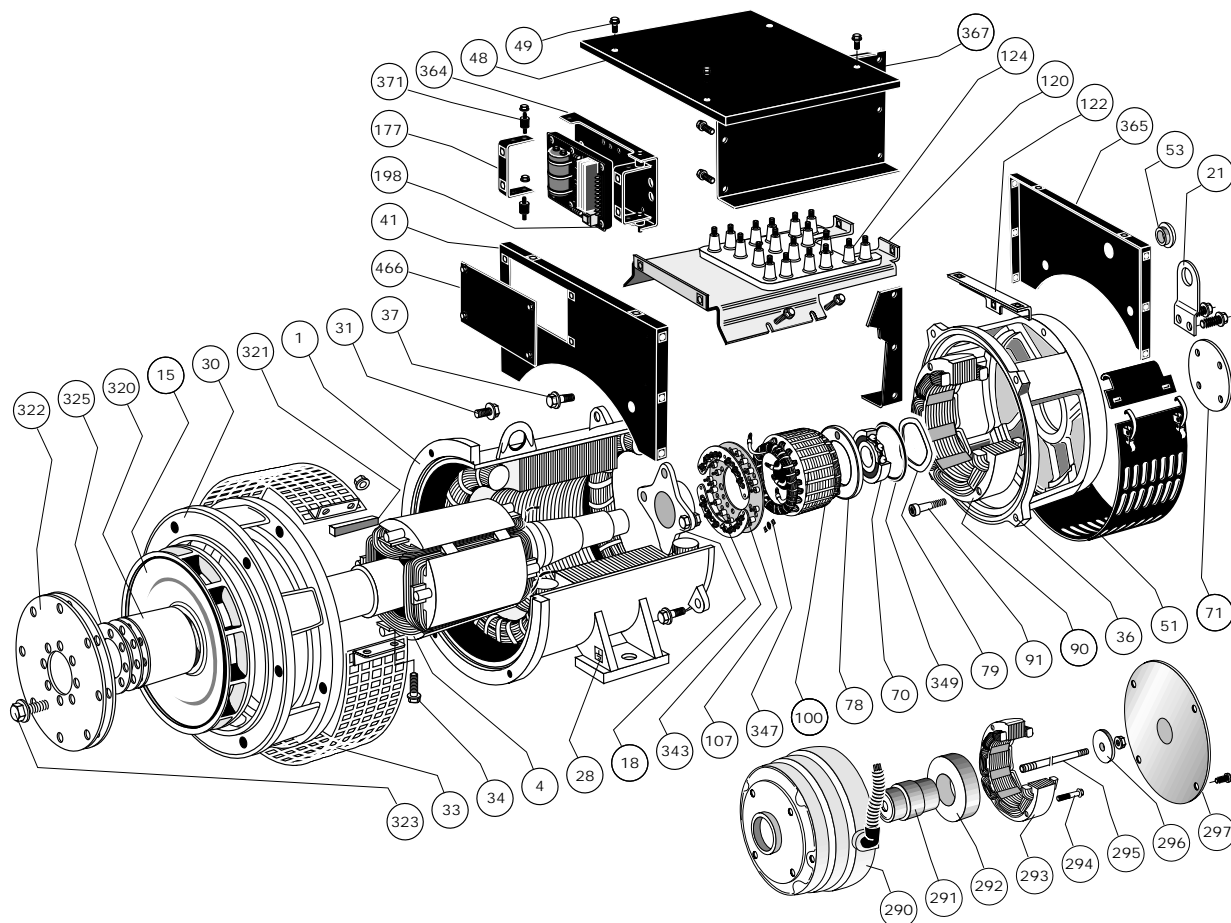
LSA 46.2 / 47.1

ALTERNATORS

SPARE PARTS

5.4 - Exploded view, parts list

5.4.1 - Single bearing



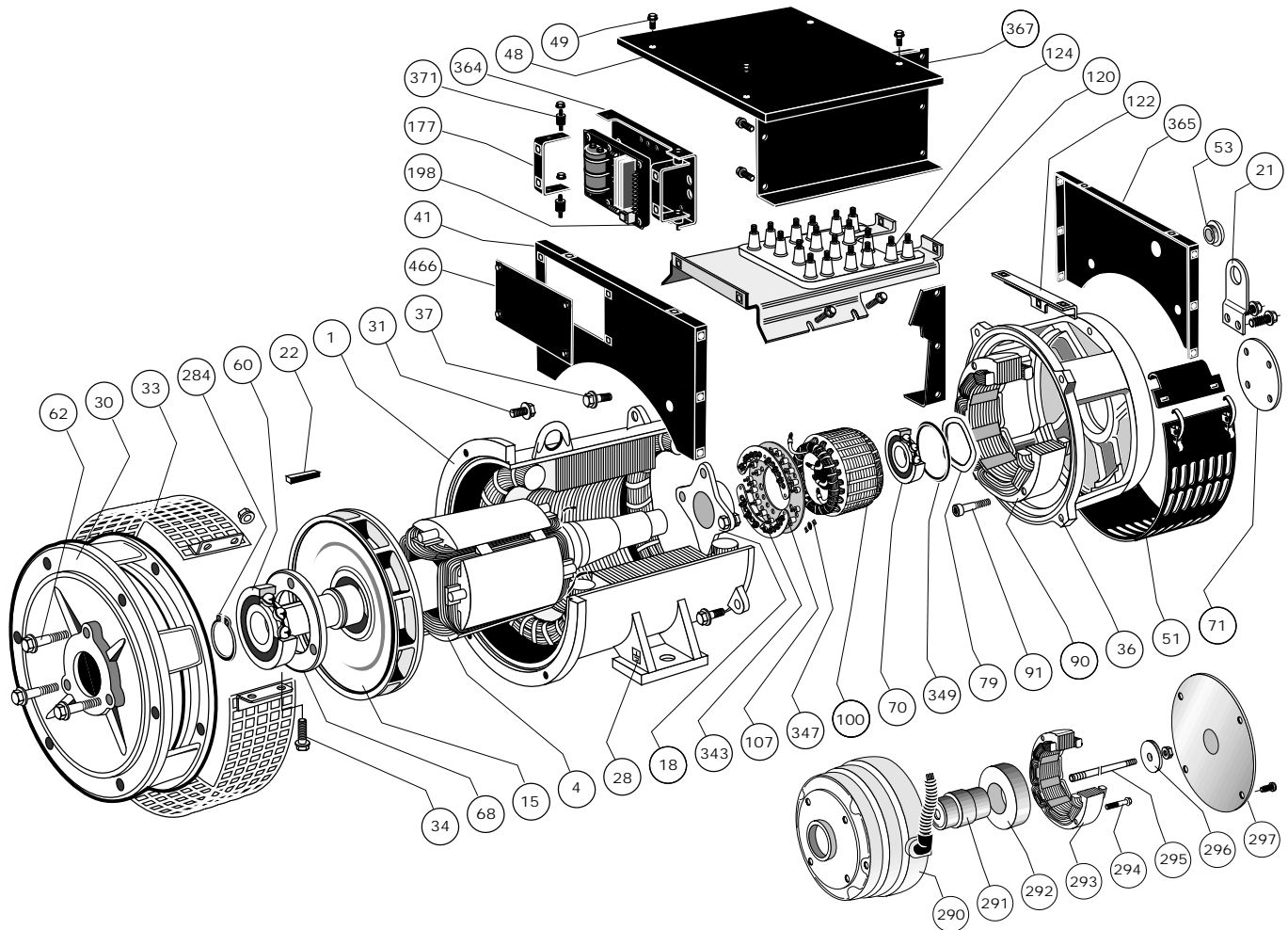
Ref.	Qty	Description	Ref.	Qty	Description
1	1	Stator assembly	124	1	Terminal block with terminals
4	1	Rotor assembly	177	2	AVR support bracket
15	1	Turbine	198	1	Voltage regulator (AVR)
18	1	Balancing disc	290	1	PMG housing
21	1	Lifting ring	291	1	Adaptation shaft
28	1	Earth terminal	292	1	Magnetic rotor
30	1	DE shield	293	1	Stator
31	6 or 4	Fixing screw	294	2	Fixing screw
33	1	Fan guard	295	1	Tie rod
34	2	Fixing screw	296	1	Cable gland washer + nut
36	1	Exciter end shield	297	1	End plate
37	4	Fixing screw	320	1	Coupling sleeve
41	1	Cover front panel	321	1	Sleeve key
48	1	Cover top panel	322	3	Coupling disc
49	-	Cover screws	323	6	Fixing screw
51	1	Air intake louvre	325	-	Spacer shim
53	1	Plug	343	1	Diode bridge assembly
70	1	NDE bearing	347	1	Protection varistor (+ PCB)
71	1	Outer bearing retainer	349	1	"O" ring
78	1	Inner bearing retainer	364	1	AVR support
79	1	Preloading wavy washer	365	1	Cover rear panel
90	1	Exciter field	367	2	Side panel
91	4	Fixing screw	371	4	Damper
100	1	Exciter armature	416	1	Filter
107	1	Crescent support	417	1	Filter support
120	1	Terminal support	466	2	AVR inspection door
122	1	Console support			

LSA 46.2 / 47.1

ALTERNATORS

SPARE PARTS

5.4.2 - Two-bearing



Ref.	Qty	Description	Ref.	Qty	Description
1	1	Stator assembly	100	1	Exciter armature
4	1	Rotor assembly	107	1	Crescent support
15	1	Turbine	120	1	Terminal support
18	1	Balancing disc	122	1	Console support
21	1	Lifting ring	124	1	Terminal block with terminals
22	1	Shaft extension key	177	2	AVR support bracket
28	1	Earth terminal	198	1	Voltage regulator (AVR)
30	1	DE shield	284	1	Circlips
31	6 or 4	Fixing screw	290	1	PMG housing
33	1	Fan guard	291	1	Adaptation shaft
34	2	Fixing screw	292	1	Magnetic rotor
36	1	Exciter end shield	293	1	Stator
37	4	Fixing screw	294	2	Fixing screw
41	1	Cover front panel	295	1	Tie rod
48	1	Cover top panel	296	1	Cable gland washer + nut
49	-	Cover screws	297	1	End plate
51	1	Air intake louvre	343	1	Direct diode crescent
53	1	Plug	347	1	Protection varistor (+ PCB)
60	1	DE bearing	349	1	"O" ring
62	3 or 4	Fixing screw	364	1	AVR support
68	1	Inner bearing retainer	365	1	Cover rear panel
70	1	NDE bearing	367	2	Side panel
71	1	Outer bearing retainer	371	4	Damper
79	1	Preloading wavy washer	416	1	Filter
90	1	Exciter field	417	1	Filter support
91	4	Fixing screw	466	2	AVR inspection door

LEROY-SOMER	INSTALLATION AND MAINTENANCE	Ref. 2981 GB - 4.33/a - 04.00
LSA 46.2 / 47.1 ALTERNATORS SPARE PARTS		

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