



# INSTRUCTIONS BOOKLET

for installation, use and maintenance

STEAM GENERATORS

# VR

pressure up to 5.88 bar

Dear Customer,

Thank you for choosing a boiler by IVAR.

In your interest and to maintain the highest level of performance and duration of your appliance, we recommend that you follow the instructions contained in this booklet and have regular maintenance performed by qualified personnel.

We would like to remind you that failure to follow the instructions contained in this booklet may invalidate the guarantee.

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## GENERAL WARNINGS

This instruction booklet is an integral and essential part of the product.

Should the appliance be sold or transferred to another owner, or if you move and leave the appliance behind, always ensure that this booklet accompanies the appliance so that the new owner and/or installation technician can consult it.

This appliance must be used for the purpose for which it was specifically intended. All contractual or non-contractual responsibility of the manufacturer is excluded in the event of damages to persons, animals or things caused by errors in installation, adjustment, maintenance and improper use.

The manufacturer's responsibility is excluded for all damage to persons and/or things resulting from a clear risk for the user which he could have avoided by taking suitable safety measures.

After having removed the packaging, check the contents for breakages. If you are in doubt do not use the appliance, contact your supplier.

Do not leave the packaging materials (wooden cage, nails, staples, plastic bags, polystyrene foam, etc.) within the reach of children, as they are potential sources of risk.

The installation must be performed in compliance with the regulations in force, following the manufacturer's instructions, by professionally qualified personnel.

The term "professionally qualified personnel" means persons with specific technical skills in the sector of steam systems.

To guarantee the efficiency of the appliance and ensure correct operation, it is indispensable to have regular maintenance performed by professionally qualified personnel, following the manufacturer's instructions.

Any repairs to the appliance must be carried out using only original spare parts.

If you decide not to use the appliance for a long period, ensure you have professionally qualified personnel to carry out the necessary operations to preserve the generator (see chapter "Turning Off the Generator", page 26).

## GENERAL SAFETY RULES

The use of any component utilising energy power, fuels and water requires that certain fundamental rules be respected, such as:

Do not allow children or unskilled people to use the appliance;

If you notice smell of gas, do not turn on electric switches, household appliances, telephone or any other objects that could cause sparks. If this is the case:

- open doors and windows immediately to clear the air in the room;
- turn off the fuel taps;
- contact professional qualified personnel.

Do not touch the appliance with wet or damp parts of the body and/or with bare feet.

Do not perform any maintenance and cleaning operations without having disconnected the electric power and turned off the fuel supply tap(s).

Do not pull, disconnect, unwind electric cables coming from the boiler, even if they are disconnected from the mains supply.

Do not block or reduce the ventilation openings in the room to prevent the formation or toxic and explosive mixtures caused by gas leakage; it is also uneconomic and polluting because it causes bad combustion.

Do not expose the appliance to atmospheric agents.

The generator has not been designed to work outdoors and is not provided with automatic anti-freezing systems. Keep the boiler turned on in freezing conditions.

Other important warnings to be respected:

- If the power cable of the appliance is damaged, have it replaced by professionally qualified personnel;
- do not fix (and do not allow other persons to fix) electric cables on the system pipes or near sources of heat;
- ensure that the earthing cables of the appliance are not connected to the water system;
- do not touch the hot parts of the system as they normally remain hot even for some time after the appliance has been turned off.

In the event of a water leak, turn off the system and contact exclusively professionally qualified personnel.

## DESCRIPTION OF THE APPLIANCE

“VR” steam generator structure consists of two concentric upright cylinders that form an air space for water and the steam chamber.

As a result, water content is kept to a minimum – qualified firemen are totally exempted -- but the steam chamber still in place makes it easier to adjust and use this type of boiler than spiral coil boilers

The “VR” steam generators are enbloc pressurised combustion steam generators: the flame produced by the burner develops in the furnace lower part and exits from the bottom.

Here smokes are forced to follow an ascending whirling path which increases the heat transfer due to convection to the outer cylinder. Later, on leaving the boiler, smokes are conveyed to the flue.

Any burner fired by traditional gaseous fuel and gas oil (no fuel oil) can be installed.

The openings on both the water and smoke sides facilitate inspection and cleaning operations.

The thermal insulation of the boiler body is obtained by applying a double pad of highly insulating mineral wall. Elegant aluminium panels complete the outside finish.

“VR” are totally automatic steam generators.

The “VR” generators have been built and tested in accordance with the Italian ISPESL regulations.

In addition to this booklet, the generator is supplied with an ISPESL test booklet which is strictly referred to the boiler tested and contains the identification numbers printed in the test plate of the generator.

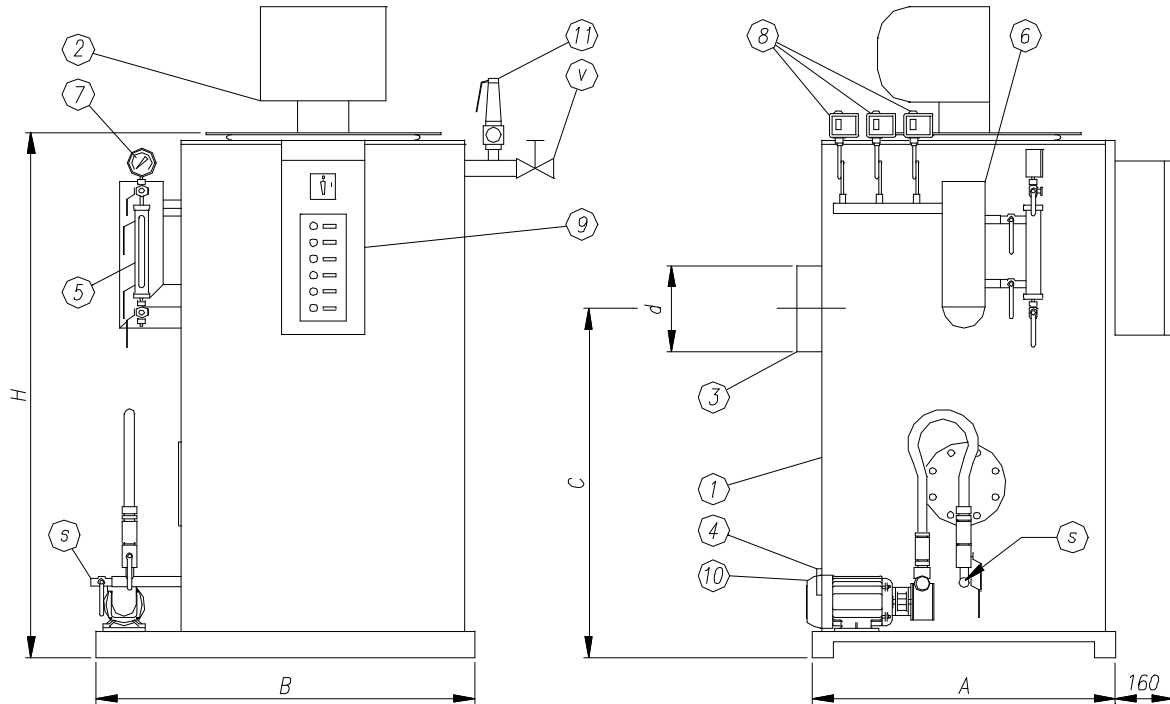
The test plate can be found in the front upper section of the generator, to the left.

For any servicing operations and spare parts it is indispensable to identify correctly the generator through its test plate.

The technical sheet of the “VR” generator is included in the following pages.

# VR

## STEAM BOILER (5.88 bar)



- |                         |  |                        |
|-------------------------|--|------------------------|
| 1 - Boiler              | 6 - Level regulator                    | 11 - Safety valve      |
| 2 - Burner              | 7 - Manometer                          | v - steam intake valve |
| 3 - smokes exhaust tube | 8 - Safety and service pressure switch | s - blowdown valve     |
| 4 - Cleaning door       | 9 - Panel                              |                        |
| 5 - Level gauge         | 10 - Feeding pump                      |                        |

TYPE		VR 50	VR 100	VR 140	VR 200	VR 250	VR 320
Nominal capacity	kW	35	70	98	140	175	224
Furnace capacity	kW	40	80	111	162	199	260
Steam production	kg/h (1)	50	100	140	200	250	320
Combust.chamber pressure	mbar	1,2	1,2	1,3	2,6	3,1	3,7
Water content	Full dm <sup>3</sup>	38	38	42	42	49,8	49,8
	at level dm <sup>3</sup>	30	30	33	33	38,5	38,5
Dimensions	A mm	740	740	840	840	840	840
	B mm	980	980	1045	1045	1045	1045
	H mm	1360	1360	1575	1575	1835	1838
	C mm	962	962	1100	1100	1335	1335
Connections	Stack d mm	180	180	200	200	250	250
	Steam v DN	1"1/4	1"1/4	1"1/4	1"1/4	1"1/4	1"1/4
	Discharge s DN	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"
Empty weight	Kg	430	430	580	580	790	790

(1) feedwater 60°C

I.VAR. INDUSTRY reserves the right to make any modifications considered necessary for improving production

For control and safety purposes the generator is delivered with a standard supply which includes:

- 1 manometer with three-way cut-off cock
- 2 regulation pressure switch
- 1 safety pressure switch
- 1 level gauge with cut-off cock and drain cock
- 1 straightway valve on the steam intake
- 1 safety valve certified by ISPESL
- 1 motor-driven pump feeding water with cut-off and check valves
- 1 drain valve
- 4 electronic probes for checking the level in the boiler
- 1 electric control panel
- 1 antiscala safety thermostat

The main regulation devices of the generators are:

- hydrostats with electronic probes
- regulation and safety pressure switches.

Hydrostats for conductive liquids are used to regulate the level of water: by exploiting the conductivity of water recorded by the probes of different length plunged in the generator body, in case of emergency due to lack of water, the feeding pump and the burner unit can be ignited and turned off through the hydrostats.

The burner can be ignited and turned off by the regulation pressure switch once the max working pressure is attained (never over 5.5. bar pressure).

The high/low flame pressure switch improves the generator operation and performance in periods of limited use. During the turning off/re-ignition break, the boiler pressure values could drop under working limits. Standard pressure setting is 1 bar lower than that of the working pressure switch and never lower than 3 bars.

The safety pressure switch on the contrary is set to the maximum pressure allowed by the generator (5.88 bar) and, in case of intervention, it blocks the burner.

The technical sheets of the devices described above are included in the following pages.

# 201

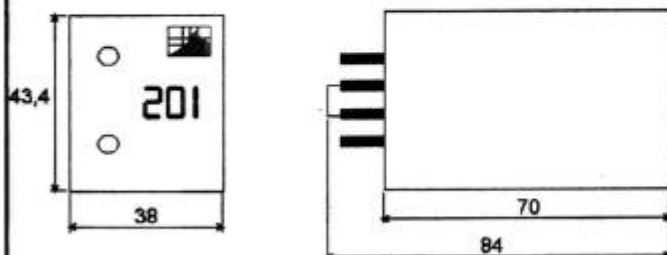
## REGOLATORE DI LIVELLO RITARDATO A CONDUITIVITÀ

### CARATTERISTICHE TECNICHE

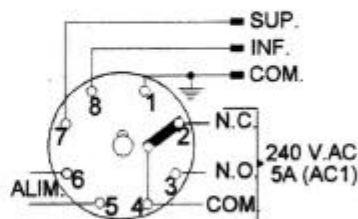


- **Connessione elettrica:** tramite zoccolo octal
- **Grado di protezione:** IP40
- **Componentistica interna:** superficiale (SMD)
- **Segnalazioni:** led verde: linea in tensione  
led rosso: eccitazione relè
- **Sensibilità:** gamma base 10 $\mu$ S - 10.000 $\mu$ S  
gamma a richiesta 1 $\mu$ S - 20 $\mu$ S  
gamma a richiesta 0,3 $\mu$ S - 2 $\mu$ S
- **Ritardo:** eccitazione o diseccitazione da 0,5 sec. a 12 sec.
- **Elettrolisi:** assente per i modelli in V a.c.
- **Contatto disponibile:** in scambio da 5A - 220V a.c.
- **Alimentazione:** 24 o 110 o 220 V a.c. a separazione galvanica
- **Frequenza:** 50 - 60 Hz
- **Assorbimento:** 5 VA
- **Peso:** 220 g

### DIMENSIONI DI INGOMBRO



### SCHEMA DI ALLACCIAMENTO



### PRINCIPALI IMPIEGHI

- caldaie a vapore
- impianti di riscaldamento
- impianti di trattamento acque
- impianti di irrigazione
- impianti alimentari in genere
- stazioni di pompaggio
- stoccaggio di bevande e liquidi alimentari
- pozzi, vasche, autoclavi, serbatoi
- imbottigliatrici e riempitrici
- protezione contro la marcia a secco di pompe

### CODICI DI ORDINAZIONE

CODICE	RESISTIVITA' INT.	CONDUCIBILITA' INT.	CARATTERISTICHE	ALIMENTAZIONE
201-000-0x	0-100 k $\Omega$	10+10.000 $\mu$ S	ritardo alla eccitazione	x=1 24V; x=2 110V; x=3 220V a.c.
201-100-0x	0-100 k $\Omega$	10+10.000 $\mu$ S	ritardo alla diseccitazione	x=1 24V; x=2 110V; x=3 220V a.c.
201-001-0x	0 + 10 k $\Omega$	100 + 10.000 $\mu$ S	Rit. ecc. + bassa sensibilità	x=1 24V; x=2 110V; x=3 220V a.c.
201-003-0x	500 k - 3 M $\Omega$	0.3 - 2 $\mu$ S	Rit. ecc. + alta sensibilità	x=1 24V; x=2 110V; x=3 220V a.c.

### ACCESSORI

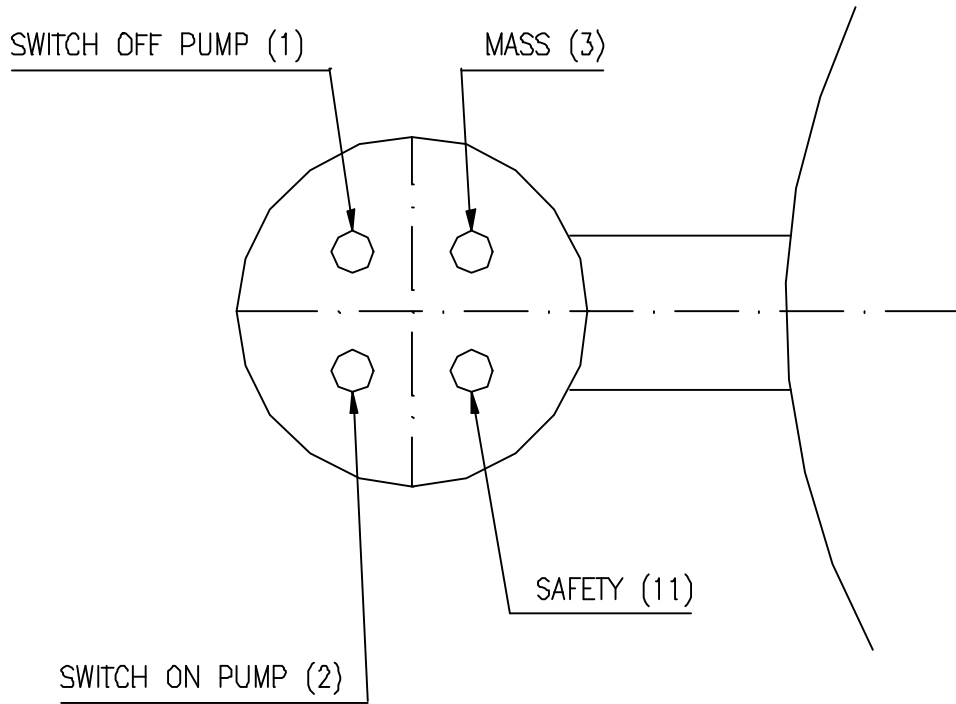
CODICE	DESCRIZIONE	NOTE
999-100-00	zoccolo octal	

Le informazioni riportate possono subire variazioni senza preavviso.

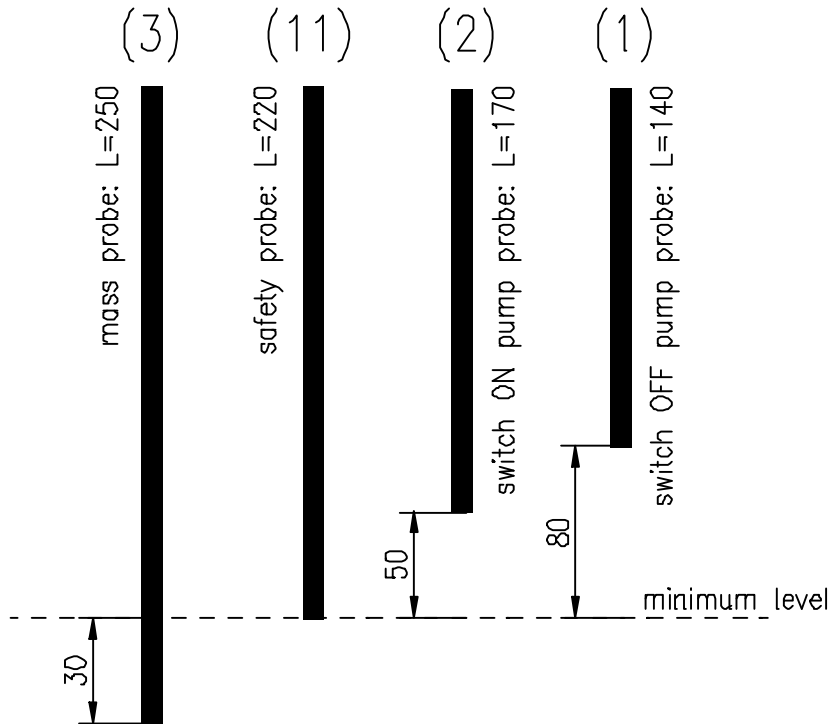
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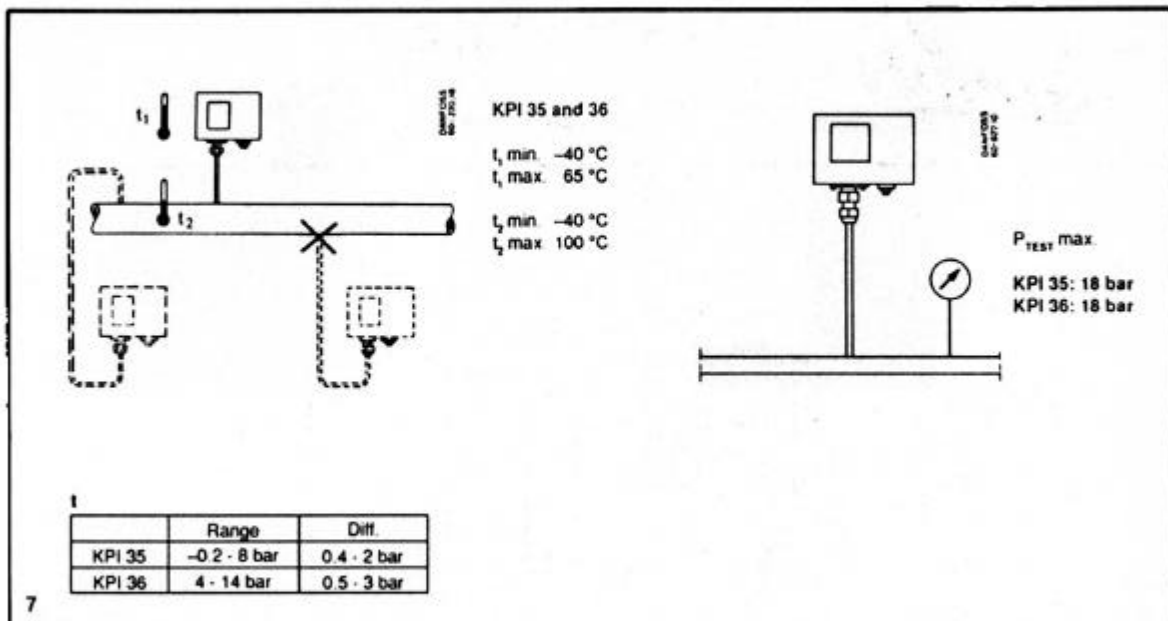
# ELECTRONIC PROBE LOCATION

## UPPER VIEW

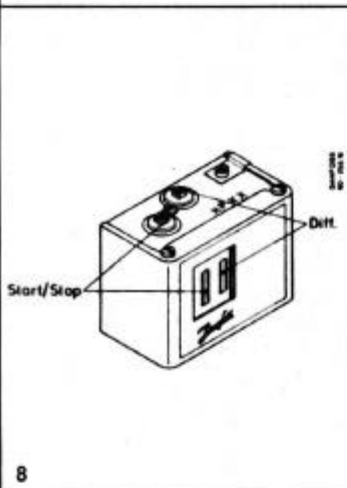


## TYPE LENGTH

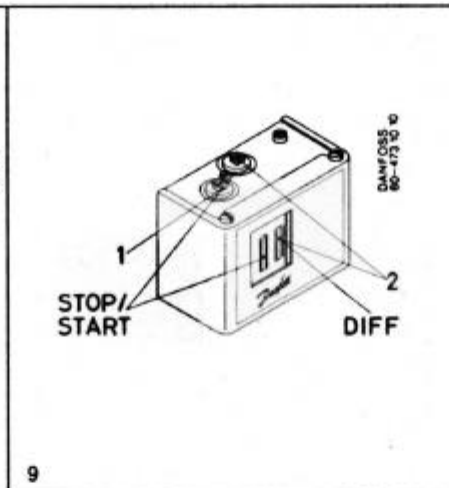




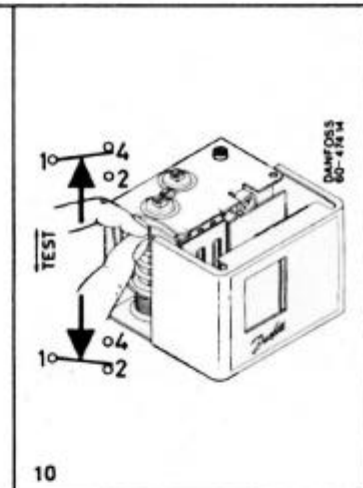
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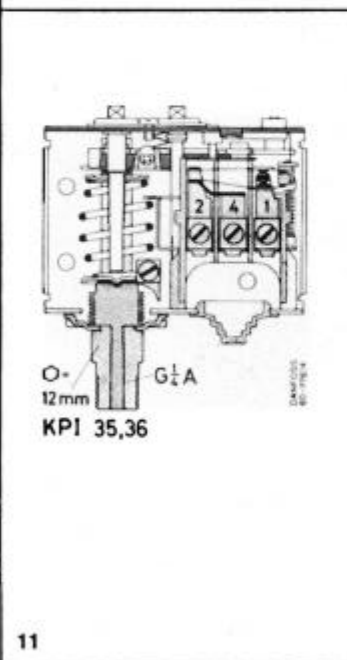
8



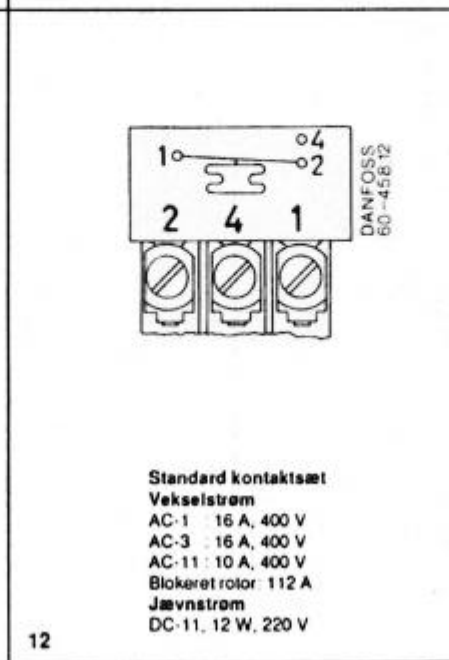
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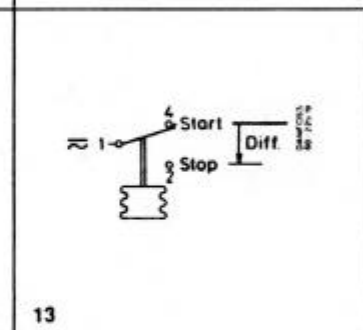
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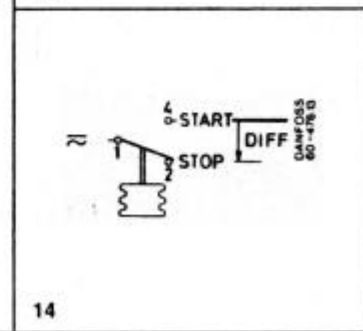
11



12



13



14

## **INSTALLATION**

### **INSTALLATION PREMISES**

When planning premises for steam generators, it is essential to comply with fire prevention provisions which may be obtained from the local Fire Departments.

In view of the frequent changes in legal regulations and their interpretation, the company recommends that the user keeps himself informed and updated in the matter.

The generator draining system must be conveyed and installed in such a way as to prevent any damages to people and allow for inspections of the draining area.

The discharge of safety valves must be conveyed to the outside as to prevent any damages to people.

The flat surface of the boiler must be positioned horizontally and capable of uniformly supporting the base section bars.

The flat surface should be raised from the floor.

**CAUTION:** if the burner is supplied with combustible gas with specific weight higher than the specific weight of air, the electric parts must be positioned above 0.5 meters from ground level.

The boiler must not be installed outside as it has not been designed for outdoor installation and is not provided with automatic anti-freezing systems.

### **DISCHARGE OF COMBUSTION PRODUCTS**

Correct burner/boiler/flue coupling drastically reduces consumption, optimises combustion with low emission of contaminants and provides effective protection against condensation.

The FLUE must be resistant to heat and condensation, thermally insulated, hermetically sealed, without bottlenecks or obstructions, as vertical as possible and sized according to current regulations.

The CONNECTION BETWEEN THE BOILER AND THE FLUE must comply with the current regulations and legislation and consist of rigid hermetically sealed pipes resistant to high temperatures, condensation and mechanical stress.  
For sealing the joints, use materials that can withstand at least 500°C.

Badly sized and shaped flues and couplings between boiler and flue can amplify the combustion noise, negatively affect the combustion parameters and cause condensation problems.

**CAUTION:** non-insulated outlet pipes are a potential source of danger.

## **ELECTRICAL SYSTEM**

The electrical system must comply with the current regulations and be installed by professionally qualified personnel.

Electrical safety of the equipment is ensured only when it is correctly connected to an efficient earth system in compliance with the current safety regulations.

The manufacturer will not be liable for any damage caused by failure to earth the system.

Call professionally qualified personnel to check that the electrical system is suitable for the maximum power absorbed by the equipment, ensuring in particular that the system cable sections are suitable for the power absorbed by the equipment.

Adapters, multiple sockets and extension leads must not be used for general power supply of the equipment from the mains.

For connection to the mains, a twin-pole switch must be provided in compliance with the current regulations.

The electrical board is installed on the generator and the operating voltage of the auxiliary circuit is 220 V: different voltages are available on request only.

The electrical board includes different parts manufactured by the leading domestic and foreign companies.

Cutting-edge technology used to assemble parts guarantees the highest operating safety and easy control of each appliance.

The following appliances are included in the electrical board:

- main switch with door block system
- selector switch to operate the motor-driven pump automatically and manually
- warning and operation pilot lights
- guided overload cut-out of the motor pump
- valve triads for circuit protection
- electronic regulators for safety probes
- electronic regulators for level control
- alarm systems release push-button.

The electrical board includes also the electric diagram and the certification of conformity.

### **FUEL SUPPLY**

The fuel supply line must comply with current regulations and be laid by professionally qualified personnel.

Before installation, you are advised to thoroughly clean the inside of all the fuel supply pipes in order to remove any debris that may affect correct operation of the boiler.

Check the internal and external seal of the fuel supply system.  
If using gas, the connections must be perfectly sealed.

Check that the fuel supply system is provided with the safety and control devices prescribed by the current regulations.

Do not use the fuel system pipes to earth electrical or telephone systems.

Check that the boiler is pre-set for operation with the type of fuel available.

## BURNER CONNECTION

For installation of the burner, the electrical connections and the necessary settings, consult the burner instruction manual.

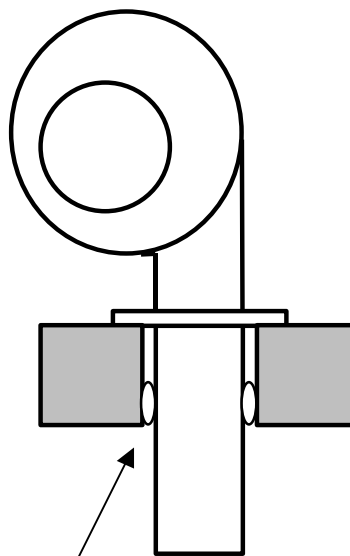
Ascertain that the correct type of burner has been chosen for the boiler, checking the technical specifications of both.

The burner draught tube length must be as follows: min = 160 cm; max = 220 cm

Secure the burner to the door by means of the fixing plate so that the flame is parallel and centred in the furnace; if not, combustion problems can occur with the risk of seriously damaging the boiler.

For gas oil-fired burners use nozzle – if possible – with a 45° pulverisation angle instead of 60° which enables an improved exploitation of the combustion chamber.

**IMPORTANT:** after installing the burner, fill any crack between the draught tube and the hole of the door with the material provided, resistant to 1000°C (ceramic fibre mat).



CERAMIC FIBRE

This operation prevents overheating of the plug which would otherwise be permanently deformed as well as the burner devices.

If the burner is provided with an air intake, connect it by means of a rubber tube to the intake located on the flame inspection window: in this way the glass will remain clear. If the burner is not provided with air intake, remove the intake on the flame inspection window and close the hole with a  $\varnothing$  1/8" BSP plug.

## HYDRAULIC CONNECTION

The choice and installation of the system components is the responsibility of the installer who must operate in accordance with correct working practice and the current legislation.

Prior to assembly all pipes must be thoroughly cleaned by using a strong vapour jet. In no way the pipe section must be reduced by seals.

The boiler fittings and the safety valves must not be strained by the weight of the system connection pipes as this can be dangerous and the latter must therefore be sustained and appropriately positioned.

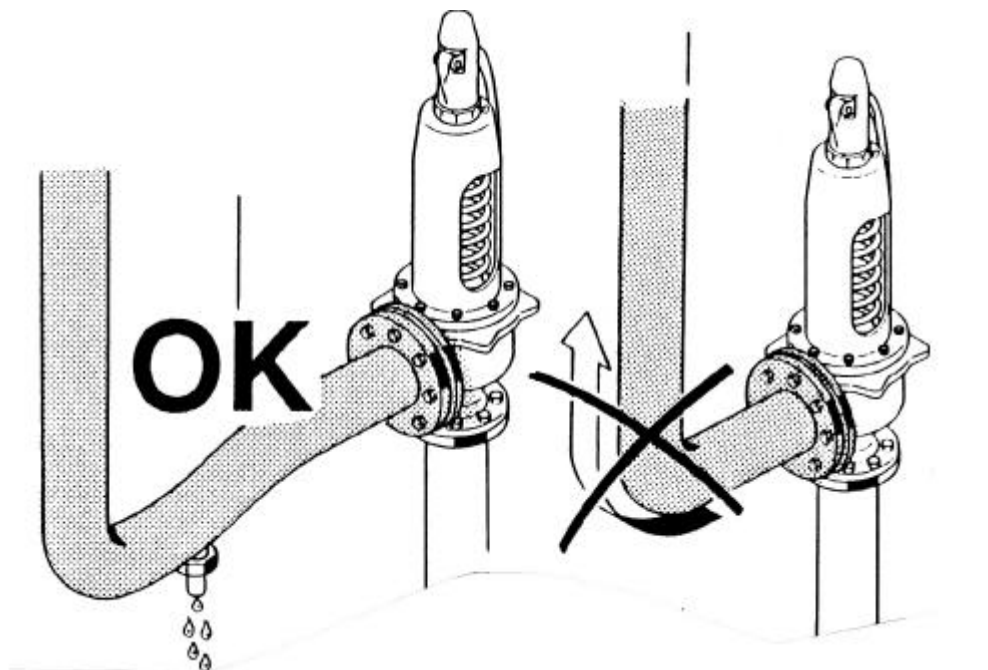
Safety valves must be installed only in upright position over the generator.

Ensure that no obstacle lies between the safety valves and the generator (on-off valve, etc.). At installation ensure that the valve inlet and the connecting pipe have been thoroughly cleaned.

Ensure that the safety valve outlets are conveyed to the outside in order to prevent any damages to people.

The exhaust pipe must guarantee the ventilation of the total flow rate of the safety valve; its diameter must be always larger than the valve outlet.

The valve ventilation pipe must be connected to the condensate draining system as it is illustrated in the following diagram.



In this way the valve shutter will not be damaged and blocked by stagnant condensate.

Ensure that the hydraulic pipes are not used as earth connections for the electrical or telephone system. They are not suitable for this use and can rapidly deteriorate leading to serious damage.

It is recommended that the heating system pipes be insulated to avoid heat dispersion resulting in increased fuel consumption and environmental pollution.

### FEED WATER – FEEDING DEVICES

The water to the steam generator is fed through 1 centrifugal motor-driven pump with suitable head and delivery

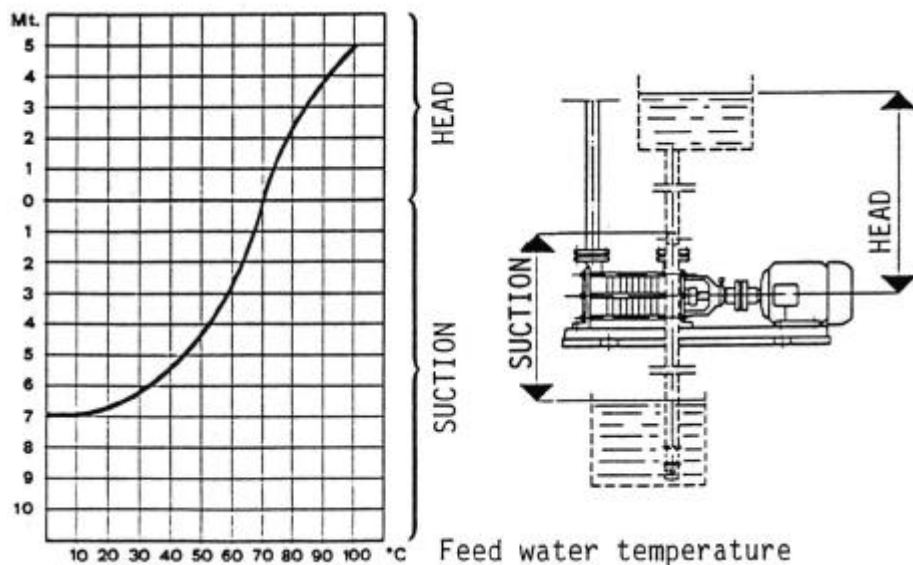
The water pump is an enbloc, single-rotor pump.

To ensure that the pump is correctly operated, two parameters should be kept under control: temperature and water head at the pump inlet (head).

The cold water contained in the tank can be easily sucked by the pump, but if the water is hot pump suction is inhibited and water inlet pressure must be increased.

For this reason, any resistance ahead of the suction either accidental or all along the pipe, will reduce the pumping efficiency.

These conditions are acknowledged as a point of reference: speed inside the suction pipe between 0.3 and 0.5 m/sec., and the head height as a function of the temperature, according to the following table.



The values stated for head suction comprise losses of pressure.

It can be clearly noticed that a minimum head is required for pumping water when the temperature of water raises.

Do not forget that feed water temperature should be high as this will reduce considerably the O<sub>2</sub> and CO<sub>2</sub> content which otherwise would be conveyed and discharged in the generator causing damages that cannot be always duly ascertained and remedied.

### **FEED WATER – THE CONDENSATE COLLECTING BASIN**

The basin size depends on the steam production per hour and the recovery temperature.

The condensate basin is connected to the pipes letting in the softened water by means of a float valve and an on-off valve.

The basin must be fitted with a vent pipe and overflow pipe that must be connected to the discharge.

If no condensate is collected, the water in the tank should be heated to about 50-60°C to prevent corrosion in the generator due to the presence of oxygen. Water temperature must never be lower than 10°C.

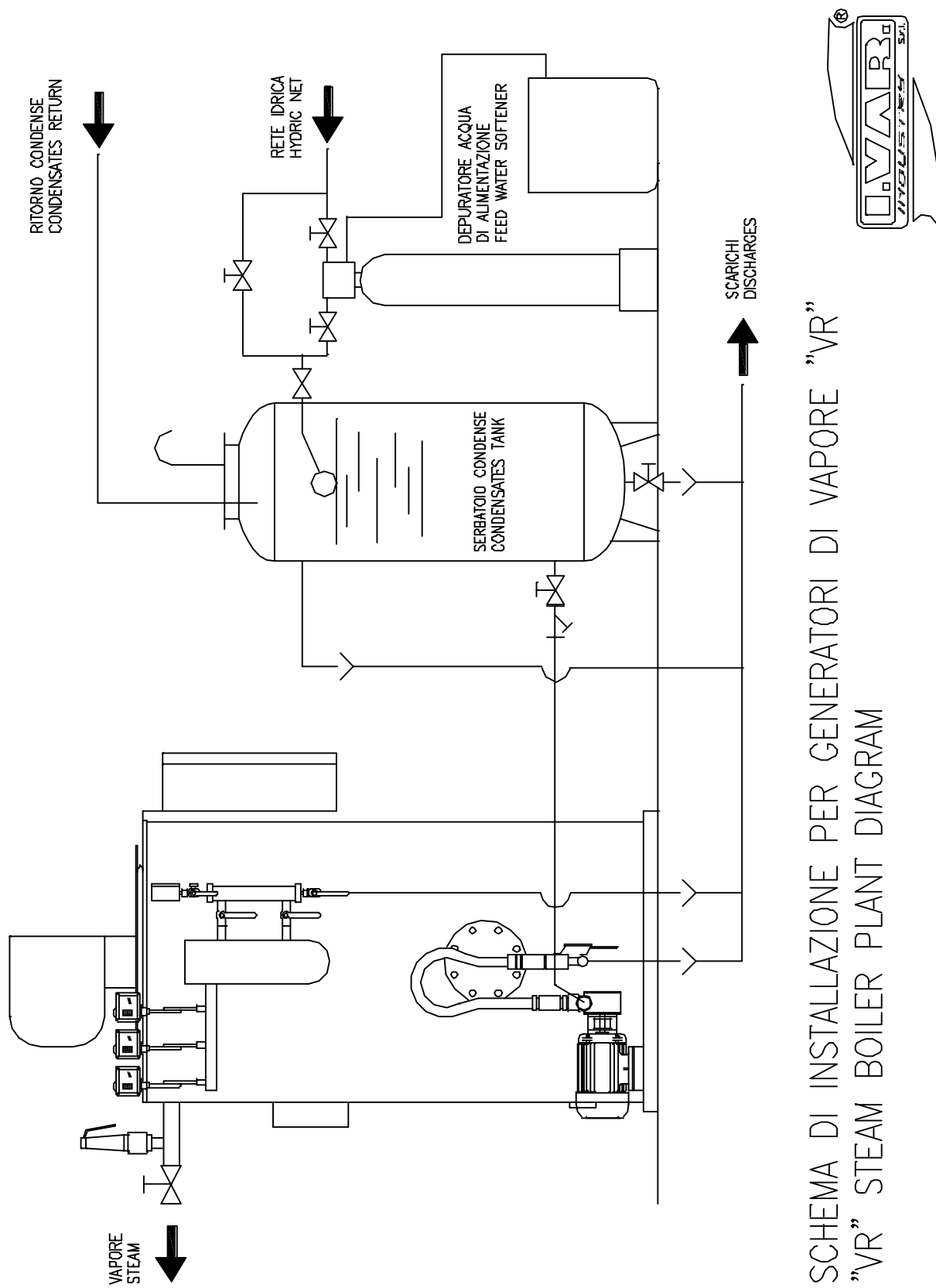
If all the condensate is recovered, check the head for the water pump as the temperature inside the basin will be extremely high: if it exceeds 70°C you can add cold water or raise the basin in order to ensure that the minimum head required is reached. If not, the pump cannot load the boiler.

There is another way to solve the head requirement: install a small circulator for heating systems with the same delivery as the pump and 0.5 head (5 cu m w.) that comes on together with the pump.

If the water level in the tank is higher than the water level in the boiler, when the system is off and without pressure, the boiler can be filled.

To avoid this inconvenience, a solenoid valve must be fitted on the tank suction area. The valve is controlled by the auxiliary contactor of the pump.

Installation diagrams for “VR” steam generators are contained in the following pages.



SCHEMA DI INSTALLAZIONE PER GENERATORI DI VAPORE "VR"  
 "VR" STEAM BOILER PLANT DIAGRAM

## FEED WATER – SPECIFICATIONS

It is known that the generator water and feed water must comply with certain specifications in order to prevent corrosion, lime, muds, etc.

The maximum water hardness limits permitted by ISPESL are:

- total residual hardness of feed water: max 0.5 French degrees
- total salinity of the water in the boiler: max 4000 ppm
- alkalinity of the boiler water as CaCO<sub>3</sub>: max 1200 ppm

The feed water and the generator water should be considered separately but in detail.

### Limit values for steam generators up to 25 bar

#### Feed water

#### Periodical inspections

pH:	7.5÷9.5	weekly
total hardness:	5mg CaCO <sub>3</sub> /kg	at each shift
oxygen:	100 µg O <sub>2</sub> /kg (up to 15 bar)	weekly
oxygen:	50 µg O <sub>2</sub> /kg (16 - 25 bar)	weekly
free carbon dioxide :	200 µg CO <sub>2</sub> /kg	weekly
iron:	100 µg Fe/kg	weekly
copper:	100 µg Cu/kg	weekly
oily substances:	1 mg/kg	at each shift
chlorides:	200 mg/kg	weekly

#### Generator water

pH:	9÷11.7	weekly
total alkalinity:	1000 mg CaCO <sub>3</sub> /kg (up to 15 bar)	at each shift
total alkalinity:	750 mg CaCO <sub>3</sub> /kg (16 - 25 bar)	at each shift
total hardness:	5 mg CaCO <sub>3</sub> /kg	at each shift
total conductivity:	7000 µS/cm (up to 15 bar)	daily
total conductivity:	6000 µS/cm (16 - 25 bar)	daily
total dissolved salts:	3500 mg/kg (up to 15 bar)	weekly
total dissolved salts:	3000 mg/kg (16 - 25 bar)	weekly
silica:	150 mg SiO <sub>2</sub> /kg	weekly
phosphates:	30 mg PO <sub>4</sub> /kg	weekly

Furthermore, water must be clear and colourless, free from solid matters in suspension and persistent foam.

## WATER-CAUSED TROUBLES IN STEAM GENERATORS

### Scaling

Scaling is mainly caused by the precipitation of calcium and magnesium salts, a phenomenon which increases when temperature is high.

When water is at 60°C there is heavy precipitation of almost exclusively calcium carbonate. With temperature exceeding 100°C, magnesium carbonate as well as calcium and magnesium sulphates precipitate heavily.

Precipitates are collected in form of muds partially from the mass of water and partially from the walls where they adhere in form of scaling.

Another element make things even more difficult: the solubility of silica decreases according to temperature and changes according to the alkali concentration.

Bound with other precipitates, it forms very strong scales that increase in volume according to the working temperature of the generator.

Scale is already a problem in hot water boilers and deserves greater attention in steam boilers as it can give rise to the following troubles:

- the generator decreases its performance because of the insulating action caused by scaling (in terms of heat conductivity, 1 mm of scaling corresponds to approximately 83 mm of steel);
- uneven distribution of thermal loads which affects the mechanical features of metal sheets that in consequence will “roast”.
- hardness of water pipes with progressive loss in capacity of the generator.

### Corrosion

Corrosion is a wide and complex problem which affects steam generators. Here again, this is a far greater issue than for hot water boilers.

Corrosion is caused by:

- carbon dioxide that is released in transformation reactions by the salts in the water after the latter has been heated (do not forget that the carbon dioxide solubility decreases as temperature increases);
- free oxygen that is present in water and decreases as temperature increases but never disappears;

- chemical-physical features of water;
- solid matters in suspension or water impurities.

These fundamental elements play different roles but always enhance the phenomena occurred which are basically of electrochemical nature.

Water often turns into cathode while the generator walls turns into anode and polarised atoms are transferred from one electrode to the other (in more simply but wrongly-used words: the walls of the generator melt in water).

The phenomena described above have always an adverse impact on the generator life span. Failures, holes and damages that cannot be repaired are the consequences that one suffers for having disregarded these problems.

It is also worth mentioning another extremely severe phenomenon that occurs when the generator is serviced carelessly: “caustic embrittlement”.

This can be interpreted as a modification in the molecular structure of the iron in a very alkaline environment such as when drainage is not sufficient versus the quantity of salts contained in the generator water.

This phenomenon causes irreversible damages and eventually mechanical failure.

### Entrainment

The salts precipitated in the water mass become mud and eventually pollute steam if above certain limits.

Besides muds, steam can be also affected by foams too that originate by combining with the organic materials contained in water.

In similar events, steam “entrains” other elements too that contaminate its purity and eventually jeopardise technological plant operations.

In addition to this severe situation, entrainment can damage seriously the safety and regulation appliances of the generator.

Damages caused by insufficient drainage versus mud are dramatic and result in failures of the product and production plant to burst of the generator.

## **PRELIMINARY OPERATIONS PRIOR TO STARTING UP FOR THE FIRST TIME**

Before starting up:

- check that thermostats are calibrated: the safety thermostat at the maximum pressure permitted by the generator (5.88 bar); the regulation thermostats at the maximum working pressure required and however never over 5.5 bars; high/low flame is set at 1 bar working pressure and never lower than 3 bars. The differential selected for intervention is usually the instrument permitted minimum level.
- check that the furnace is free from foreign matters;
- check that the refractory lining of the upper plug has not been damaged;
- check that the burner draught tube has been correctly plugged (see page 14);
- check that the plug has been correctly tightened;
- ensure that there is enough fuel available and that the fuel cocks are open;
- check that the discharge valve and the valve under the level gauge are closed and the on-off valves of the water pump are completely open;
- check that the steam intake valve is close;
- ensure that the electric motor of both the burner and the motor-driven pump ventilator run in the correct direction of rotation;
- check that the water treatment system is correctly operated;
- turn on the water pump (selector on “manual”) and check through the level gauge that the boiler is filled to the minimum level.

The little water that leaks initially from the pump seal is normal as the seal must get adapted. However, if the leak continues for some working hours or increases, tighten the screws which regulate the seal.

## FIRST START UP AND FURTHER CHECKS

After performing the preliminary checks, power on the burner.

During the heating phase, the volume of water increases and the level tends to increase: check the gauge and maintain it at the set level by actuating slowly the discharge at intervals.

After the pressure required is reached, the burner must stop automatically. Now set the operation selector switch on “automatic” .

At the next operation, which must be performed very slowly, the steam inlet valve is opened so that steam can heat the pipes slowly thus preventing any sudden expansion (this measure is necessary when the plant is new; if the plant is old, empty thoroughly the pipes to prevent water hammering).

As soon as the pressure decreases, pressure switches must give again the burner consent.

Repeat this operation until the minimum level of the generator is reached. In this way, when the water pump runs automatically, the level is reset in its working position.

Check the safety of the minimum level by powering off the pump (selector switch on “O”): let the burner run and open the steam intake. Once the minimum level is reached, the burner must block.

Once all the conditions are satisfied, the burner must be correctly set to the maximum power permitted by the boiler as it is contained in the ISPESL booklet supplied with the generator, analysing the combustion products to obtain correct combustion and lowest possible emission of contaminants.

Check the seal on all the gaskets on the water and fume side; they must be further tightened while hot in order to guarantee a perfect seal.

It is also very important to check the boiler/flue coupling seal for the above reasons.

As pressure increases, it is also extremely important to tighten progressively the seal of the generator hatch for a perfect seal. If not, at the first leakage the seal must be replaced.

The steam intake valve must be closed partially to prevent pressure from dropping under 2-3 bars during the working cycle at peak steam delivery.

Should the valve be left entirely open, a sudden delivery could make pressure lower to zero and causing the subsequent block of the minimum level due to the rapid emptying of the vapour chamber.

### **ANTISCALE SAFETY DEVICE**

The thermostat housed in the junction box is set at 330°C controls smoke temperature. Once the first start up operation has been performed, the burner has been correctly set and the working pressure has been reached, check smoke temperature by means of a thermometer and, if needed, modify the built-in thermostat temperature.

This setting must be 40°C over smoke max temperature measured under working conditions.

The intervention of the antiscale thermostat – the burner stops and all red lights turn on – means that the generator is getting scaled: scale has an insulating action which reduces heat transfer while smoke temperature increases.

To reset the thermostat, open the junction box and press the button of the thermostat itself.

Once the boiler has been powered off and emptied, check inside for scale via the inspection flange. Have the boiler washed with antiscale chemicals and the water treatment system inspected.

If you leave the generator with scale deposits for too long, this may cause irreversible damages at short.

### **ALKALINE WASHING OR “BOILING”**

This treatment must be carried out by qualified companies on new generators.

After the boiler has been prepared and installed, all deposits are removed such as residues of oil, grease, metal oxides.

If these substances are not removed, they help the onset of corrosive phenomena caused by the formation of a passivating film on water-exposed surfaces.

How to perform the alkaline washing:

Fill the boiler with water until the normal level is reached.

Before starting the washing, pressure switches, the manometer and the level gauge must be cut out.

Add a quantity of caustic soda or sodium carbonate or trisodium phosphate ranging from 0.3 to 1% according to total water content.

These substances must be added with a quantity of specific surface-active products ranging from 0.05 to 0.15% versus total water content.

Slowly bring the water (through the burner) to 80-90°C and make it circulate in the boiler for 12-14 hours.

Drain slowly the content and let in clean water to rinse well.

### **DRAINING AND CHECKING**

Drain daily the level gauge following this procedure: open the draining of the level gauge very slowly to prevent any breakage of the crystals.

Close the lower valve in order to clean the upper one using steam; open the lower and close the upper one to clean the lower valve with water.

Finally open the upper valve and close the discharge valve.

After performing this operation, the level must promptly return to its correct position.

Each idle or delay in the water motion proves a partial obstruction of the gauge and the reading can be misinterpreted.

Ensure also that level testing cocks are cleaned and open them at least once a day.

Every day open the boiler draining system to remove the newly formed muds. Power off the boiler at the end of the working day to carry out this operation.

The manometer of the generator should be inspected every day: its operation must be continuous and without joggling (malfunction).

Test both feed water and boiler water following the schedule listed in the chapter “feed water – specifications” (page 19).

Inspect weekly the efficiency of the level regulator (minimum level alarm test) and safety pressure switch (maximum pressure alarm test).

Ensure that no steam or water is leaking from valves and seals: if yes, fix immediately the leakage by servicing the valves and tightening or replacing the seals.

## **TURNING OFF THE GENERATOR**

Follow this procedure to turn off daily the generator:

- Ensure that the pressure is off;
- Close the on-off valve on the pump flow to prevent depression caused by steam condensation caused by the sucking of water from the tank and the filling of the boiler. This problem can be solved by installing a vacuum-breaker valve which acts on the steam chamber of the generator (usually near pressure switches). If the tank is provided with an on-off solenoid valve (as described in the chapter “feed water – condensate collecting basin”), it is not necessary to close the valve or to install a vacuum-breaker valve.
- Turn off the main switch on the electrical board.
- If the main switch remains on, the burner and pump switches must be turned off anyhow.

To turn off the generator for a longer period of inactivity, follow this procedure:

- The “wet” conservation procedure of the water side must be performed ;
- Turn off the main switch from the electrical board and disconnect power supply;
- Close the fuel on-off valve;
- Protect all control, adjustment and safety devices against dust and humidity.

“Wet” conservation requires the boiler to be completely flooded adding water with preservatives or neutralizers. The plant is sealed by closing all on-off valves. This type of conservation is not recommended in case of frost.

## **MAINTENANCE**

Periodical maintenance is essential for safety, output and the generator life span.

Before servicing:

- Power off the system by turning off the main general switch on the electrical and plant boards;
- close the fuel on-off cocks;
- wait until the generator has cooled and pressure is off.

Clean the smoke side every six months if you use gas oil , every year if you use methane.

Before cleaning the smoke side it is recommended that a fuel analysis be performed to find out the operating conditions that will be compared to those after cleaning.

Cleaning on the smoke side:

- remove the upper plug – remove the burner first, if needed -- and open the cleaning door on the bottom, and remove the flue fitting;
- mechanical wash of the furnace from the top and smoke circuit at the smoke exit;
- vacuum dirt from the cleaning door;
- re-insert the disk in the furnace;
- connect the flue fitting, close the cleaning door, install the upper plug and re-start the burner.

After performing maintenance and cleaning operations, repeat the preliminary start up inspection (see page 22), check the burner calibration and perform a smoke analysis to ensure that the correct degree has been reached.

Check the seal of the fuel supply system. This inspection is absolutely necessary when gaseous fuels are used.

Check the perfect seal of the smoke circuit and, if needed, replace worn seals.

Inspections to be carried out every 6 months:

- open the hatch when the generator is cold and check that scale thickness is not above 0.5 mm: if not, contact qualified companies to have a chemical washing carried out and check the softening system.

Caution: every time the hatch is opened, replace its hatch gasket and tighten it gradually both in cold and hot conditions.

- When the generator is cold, disassemble the probes and ensure that they are clean. If necessary clean them with an extra-finely grained sandpaper. It is recommended that they are dismantled one at a time to avoid making mistakes when re-connecting the electrical board.

- Check that the contact of the remote control switches on the electrical board is not oxidised. This operation must be carried out once every month when the generators installed are located by the sea.

## RECOMMENDED SPARE PARTS

Spare parts recommended for two working years:

- 1 regulation pressure switch
- 1 safety pressure switch
- 3 level probes
- 2 electronic level regulators
- 4 hatch gaskets
- 3 sets of gaskets for the door and the small cleaning door.

## TROUBLESHOOTING

Below is the description of the most common faults and their remedy:

**FAULT:** the burner does not turn on.

**REMEDY:**

- check electric connections;
- check the regular fuel supply;
- check the integrity and the cleanness of the fuel supply system and that no air is present;
- check that ignition sparks form regularly and the burner appliance works correctly;
- check that the generator alarms are functioning;
- check the calibration of the regulation pressure switch.

**FAULT:** the burner turns on well but turns off immediately after.

**REMEDY:**

- check the pilot flame, the air calibration and that the burner appliance works correctly.

**FAULT:** the burner is difficult to be adjusted and/or no output.

**REMEDY:**

- check for the cleanness of burner, boiler, boiler/flue pipes and flue;
- check the hermetic seal of the smoke circuit (door, burner plate, smoke box, boiler/flue connection);
- check that the fuel supply is flowing regularly and verify the effective power of the burner;
- check for the presence of scale and carry out a chemical washing.

**FAULT:** the boiler gets easily covered with soot.

**REMEDY:**

- check the burner regulation (smoke analysis);
- check the fuel quality;
- check the flue for clogging and the cleanliness of the burner air intake (dust).

**FAULT:** the boiler does not reach set pressure.

**REMEDY:**

- check that the smoke side and water side of the boiler are clean;
- check the combination, regulation and performance of the burner;
- check the regulation of the pressure switches and that they work correctly;
- check the seal of the nonreturn valve;
- ensure that the boiler capacity is appropriate for the plant.

**FAULT:** the safety pressure switch intervenes.

**REMEDY:**

- check that the pressure switches are calibrated and work correctly.

**FAULT:** the low level alarm is set off.

**REMEDY:**

- Check that probes are clean and inspect the contact on their caps;
- Check that the level regulators on the board are working correctly;
- Check that the pump is working correctly.

**FAULT:** smell of gas and/or unburnt products.

**REMEDY:**

- check the seal of the fuel supply system (if gas fuel);
- check the hermetic seal of the smoke circuit (door, burner plate, smoke box, boiler/flue connection);
- check that the rubber holder on the pilot flame is connected to the burner air intake or clogged.

**FAULT:** the safety valve of the boiler intervenes.

**REMEDY:**

- check the calibration of the pressure switches and that they are working correctly;
- check the calibration of the valve itself.

**FAULT:** membranes overheating due to lack of water in the boiler.

**REMEDY:**

- Turn off the burner, do not pour water and do not open the door; wait until the ambience temperature is restored before performing any operation.

**FAULT:** the pump does not load or loads too slowly

**REMEDY:**

- Check feed water temperature and the head at the pump inlet;
- Check that no valves are partially closed or clogged;
- Check that the inlet water pipe of the generator is not clogged for scaling.

**FAULT:** all red warning lights turn on and the burner stops. The antiscalant thermostat has intervened (see pag. 24)

**REMEDY:**

- check the presence of scale and perform the chemical de-scaling wash;
- check that the water treatment system is working well.





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