aguilera extinción

Water Mist

microaqua

Manual installation

and commissioning

ISO 14001 TÜV SÜD ISO 9001

Contents

This manual is intended for installers and users belonging to the pump group. It provides indications on its intended use, on their technical specifications and instructions for installation, adjustment and use.

The manual should be considered part of the group and should be kept throughout the life of the product. This manual reflects the technical structure of the equipment once it has been purchased.

1 Safety, symbols in the manual

For safe operation, it is essential to comply with all safety and handling instructions.

Always complying with regulations on accident prevention and safety regulations in force at the place where the equipment will be used.

The hydraulic (high pressure), pneumatic (low pressure) and electrical installation, must be performed by authorized personnel and comply with all applicable regulations. It is not the responsibility of Extinction Aguilera if this is not complied with.

The qualified personnel must have read and understood the operating instructions before beginning any work.

Aguilera Extinción is exempt from any liability for damage caused by a non-suitable use of the equipment and its intended purpose, failure to respect the indications given by this instruction manual, work done by any unqualified personnel and any unauthorised modifications to the equipment.

The instructions for assembly, testing and start-up, as described in this manual, as well as the drawings, diagrams, figures, etc. included, must be interpreted from a general point of view, since, according to the model provided and the specific characteristics of each system can have custom variations listed in the project report.

Subject to technical changes.

In this manual, symbols are used to mark parts of high importance.

Electrical Hazard:
We recommend paying special attention to the warnings marked with this symbol to avoid injury caused by electric components.

Warning-Danger:
It indicates a potentially dangerous situation that can cause serious injury or property damage if it is not used.

Information:
States useful recommendations and advice, as well as information and key points which are essential for efficient and error free usage.

Warning:

* The pressure pump is supplied fully assembled and factory tested by Aguilera Extinción.

* It is essential to carry out hydraulic tests in the pipeline at a test pressure for 10 minutes and at the working pressure for 110 minutes, according to NFPA 750.

* The surge pump supplied by Aguilera Extinción cannot be used to perform hydraulic tests.

* The closed diffusers supplied by Aguilera Extinción cannot be used to perform hydraulic tests. In order to carry out the test, the diffusers will be replaced by 18x1.5 metric caps.

* In particularly sensitive areas such as CPD rooms, it is necessary to mount drip valve adapters.

* If a trigger alarm is activated in Data Centre rooms, we must ensure the shutdown of the air handling units (AHU), have emergency procedures and appropriate action ready to be taken in order to avoid an unnecessarily long discharge, as well as subsequent action plans on equipment according to their characteristics.

* Material reception. Check the shipping list to ensure all the pieces have been delivered.

* Check whether the equipment and the accessories have been damaged during transportation. It is essential to notify Aguilera Extinción about any damage that could have occurred immediately.

Note: With the objective of achieving a better understanding, several concepts, definitions and working processes are repeated in the different sections of this instruction manual

2 Types of installations and pressures

The configuration and programming of the equipment is conditioned to the type of system and work pressure resulting from the hydraulic calculation indicated in the project memory.

2.1.- INSTALLATION TYPE.

These are the possible scenarios where installation can take place:

2.1.1.- Dry System (Ds).

Is the one in which no point of the system has water running until the main pump is activated via activation command from the central fire extinguishing panel, etc.

2.1.2.- Dry System with risks (Dsr):

Is the one in which no point of the system has water but incorporates directional valves for each of the risks. The order of activation of fire systems activate the piloting set's control circuits and this in turn activates the pumping equipment if certain specific conditions for the system status are met. For systems without hydraulic equipment, a pneumatic system is required.

2.1.3.- Wet System (Ws).

Is the one in which the entire system has water with a pressure of 40 Bar maintained by the jockey pump. The system activation occurs on demand, rapid loss of pressure.

2.1.4.- Mixed System (Ms).

It is the combination of a wet system (see 2.1.3) and a dry one with risks (see 2.1.2).

2.2.- PRESSURE.

Pressure levels shown are operating normally, although in some cases they may vary depending on the purpose of the system (see project report). The pressure is controlled by a pressure transducer with an analogue controller (4-20 mA) and a digital SP1 control managed by the PLC or automatically by the computer.

2.2.1.- Inlet pressure (Ip).

Maximum pressure supply inlet for filling the tank (10 Bar).

2.2.2.- Working pressure (Wp).

Pressure at which the equipment is regulated (see project report).

2.2.3.- Suction pressure (Sp).

It is the pressure at which the suction manifold's relief valve is set (3 Bar) in all systems with more than three pumps.

2.2.4.- Return pressure (Rp).

Return manifold's pressure. Negligible, the relief and return pressure is voided by the expansion that occurs in the manifold.

2.2.5.- Pressurisation Pressure (Pj).

Pressure maintained by the Jockey the pump in wet or mixed systems (40 Bar). Range of 35-40 Bars.

2.2.6.- Activation Pressure (Pac).

The system's activation pressure by demand <30 Bar, on wet or mixed systems.

2.2.7.- Overpressure (Ps).

Pressure at which an emergency stop occurs (160 Bar). Range of 145-160 Bars.

2.2.8.- Failure Pressure (Pfa).

When the system is running and the pressure in the discharge manifold is lower than 100 Bar. In this case, a start-up failure signal and a warning alarm are activated.

2.2.9.- Relief Pressure (Pal).

Excess of relief pressure generated by the appropriate valves, suction manifold, Jockey pump and dischar ge manifold.

2.2.10.- Test pressure (Pp).

It is the result of multiplying the working pressure by 1.5.

2.2.11.- Final pressure (Pf).

It is the pressure in the most unfavourable point of the system, as a result of taking off the load losses to the working pressure.

2.2.12.- Pneumatic Circuit Pressure (Pcn).

Pressure the compressor is adjusted at for the pneumatic circuit (8 Bar). Range of 6-8 Bars. Only used in wet or mixed systems.

2.2.13.- Pneumatic verification pressure (Pv).

Pressure the pneumatic circuit pressure gauge is adjusted at (4 Bar). Adjustment range of 0-6 Bars.

3 Materials to be used in the systems

Regardless of the type of project settings, the following pipelines and auxiliary resources, admission and return with high density PVC materials will always be included:

3.1.- PIPELINE INSTALLATION.

The pipes that make up the entire system must be made of stainless steel, except for the following pipelines:

3.1.1.- Supply network pipe.

This pipe connects the water supply network to the shut-off valve of the inlet section of the tank . It can be installed with the same char acteristics as the existing outlet.

3.1.2.- Auxiliary piping.

This high density PVC pipe is necessary to empty the tank and take the overflow channel to the sewer manhole. We recommend installing a siphon. The diameter is specified in the plans of the deposit.

3.1.3.- Intake piping.

High density PVC pipe connecting the tank's outlet valve with the pressure pump's inlet vibration damper. The diameter is specified in the plans of the deposit and the pr essure pump.

3.1.4.- Return piping.

High density PVC pipe joining the flange with anti- vibrating or return outlet with the pressure pump's connecting tube to the deposit's return outlet. The diameter is specified in the plans of the deposit and the pressure pump. A shut-off valve should not be installed under any circumstances.

3.1.5.- Discharge piping.

To carry out installations with high pressure water mist it is r ecommended to always use AISI 316L pipes and stainless steel.

The support should be suf ficient to ensure the integrity of the installation in the most unfavourable conditions. Wherever possible, STAUFF type metal brackets will be used.

Iron pipes, galvanized iron, etc. won't be used, since they cause oxidation that can damage the hydraulic system components.

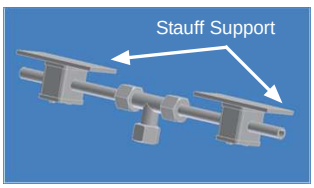


Figure 1: Stauff

Maintaining the quality of materials, three types of pipe for the installation of these systems can be used, the reason for choosing one option or another is economic.
In all cases, it is necessary to perform a complete cleaning of the pipe.

3.1.5.1.- Option 1:

ASTM A240 SCH piping 40 or 80 with ASA welding accessories.

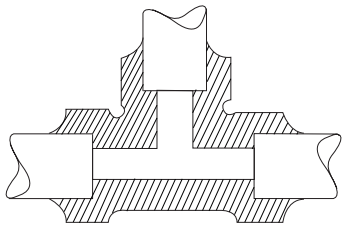


Figure 2: Welding

We proceed as usual for a normal welded high pressure system.

3.1.5.2.- Option 2:

ASTM A240 SCH piping 40 or 80 with ASA 3000Lbs accessories NPT nut.

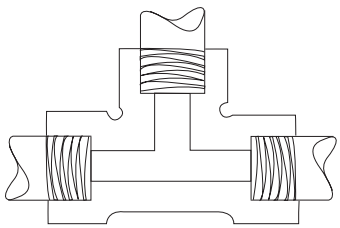


Figure 3: NPT Nut

We proceed as in any installation using the appropriate thread sealant.

3.1.5.3.- Option 3:

DIN 17458 ASTM A213 Metric Pipe with bic onic accessories ISO9434 DIN 2393/1 (ring system with profiling cut). This system is usually used up to a diameter of 30 to 35 mm and is the conventional way metric fitting has always been known. It consists of a cutting ring, biconic as an intermediate element between the fitting and the tube, which ensur es a tight and secure connection. During assembly of the connector the two cutting edges penetrate into the tube ring so that the pressure is concentrated at the front of the ring, obtaining an airtight connection.

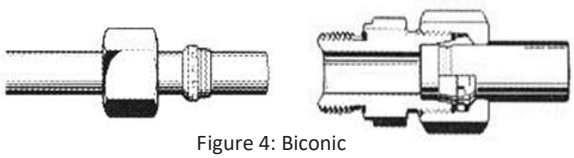


Figure 4: Biconic

3.1.6.- Drainage circuit pipeline and setting-up test.

Piping alignment for wet or mixed systems identical to described in the previous section (3.1.5.x). The shut-off valve and the test outlet will be installed in the most unfavourable point of the segment and it will be easily located.

The drain circuit will always be channelled to the sewerage inlet and will be installed with a siphon. It is completely forbidden to drain the system through the pressure pump returning to the tank.

3.2.- PNEUMATIC SYSTEM.

The pneumatic system is in the pipeline section connecting the compressor outlet to the auxiliary pilot closet and from this to the input of each of the directional valves through quick connect fittings.

The pilot set comes with a few meters of flexible tubing for its set-up. If this wasn't enough, a tube with similar characteristics will be used.

For those systems that require a set-up with copper cable, it is essential to apply for a production requirement in order to replace the quick connection couplings and change them for connecting elements suitable for this kind of piping.

In flexible tubing facilities, attention to the physical conditions of the route will be provided if it is necessary to protect the tube. Also to be taken into account are the implementation of curves and obstacles which may cause a choke tube.

3.3.- WATER RESOURCES.

This section describes the water resources included in any system. In some cases it is optional and recommended in others (see product catalogue).

3.3.1.- Inlet filter (recommended).

We recommend installing this 200 microns filter in the tank inlet. If it is to be installed in the inlet of the suction manifold, the volume of size of the equipment must be taken into consideration.

3.3.2.- Dampers and connecting tubes.

These resources are supplied with the equipment. Installation is essential because it reduces the transmission of vibrations from the pump assembly to the different pipes, admission, installation valve.

3.3.3.- Fuse adapter (biconic and thread).

Adapter for the spray head (diffuser) to the pipe. There are several models used to connect to the pipe, male bic onic (diameter 12) or threaded, with or without drip valve (M20x1.5 male thread) and female thread M18x1.5 for attaching the diffuser.

It is important to choose the type of adapter, especially in installations in which the diffuser is to be oriented correctly.

3.3.4.- Heat sensors (optional).

These sensors will be included in those facilities where the thermal effect needs to be enhanced on the bulbs of the diffusers (closed).

3.3.5.- Diffusers.

During the project study, we select the diffuser type to be installed, indicating the separation angle, number of nozzles and flow.

All diffusers for fixed installations have the same thread, the same watertightness system and include an inle t filter.

In any diffuser, especially in closed ones, tightening the fixing upon installation is performed with a suitable wrench. Under no circumstances will any other type of tool be used to tighten clamp, nozzles, etc.

In humid facilities, pay attention when handling diffusers. Always use appropriate personal protective equipment as the bulb may otherwise break. Also ensure that the hydraulic system is depressurised.

3.3.6.- Directional valve (risks).

High pressure directional valve consisting of PN400 ball valve, pneumatic piston and manual lever. The activation pneumatic control is made up of the pilot assembly through the electro-pneumatic valves associated with the fir e system.

3.3.7.- Cover for hydraulic testing.

M18x1.5 cover, essential for hydraulic testing (includes gasket).

3.3.8.- Control valve with flow sensor and pressure gauge (optional).

This is manufactured in stainless steel for four different diameter tubes, ½", ¾", 1½" y 1 ¼".

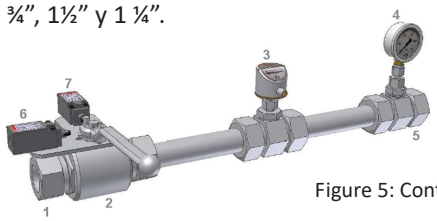


Figure 5: Control and return

Resources:
1 collector inlet (biconic connection).
2 ball valve (manual block).
3 Flow Sensor (supplied with 5 m connecting tube).
4 Pressure gauge with glycerine (range 0 to 250 Bar).
5 Collector outlet (biconic connection).
6 Open valve switch (cc-n/a-n/c).
7 Closed valve switch (cc-n/a-n/c).

It will be installed in cases where that is necessary to have a cut-off, pressure indication and alarms in case of programmable minimum flow (see manual Ae x-man-100-0.0 v1.0).

Depending on the position in the facilities, switch 7 (valve closed) can be used to force a closed valve emergency stop in the pump group.

The flow sensor requires a power supply of 24 Vdc. The outlet can be programmed for positive or negative flow when making a connection to others including switch 6 (valve open).

4 Pump room

The room where the computer is located must have a water supply, drainage (sewer) and electricity depending on the power required.

It must have good lighting, easy access, be free of obstacles, clean and airy.

A gap will be maintained which allows access to all equipment elements in order to facilitate the preventive and corrective maintenance on the system.

When locating equipment and deposit, the weight of the resources are taken into account. They will be handled appropriately and then anchored on to a flat, solid base.

If the location of the reservoir is in the open, it must be noted that the weather might cause the water to freeze, both in the reservoir and the associated piping.

During storage and installation, resources will remain protected to prevent the accumulation of dirt, especially in the openings in the tank, equipment, piping, diffusers, assembly accessories, etc.

We recommend mounting the drain valve after the equipment's discharge valve and at the lowest point of the system to take it towards the drainage.

5 Hydraulic testing

It is essential to perform hydraulic tests in the facilities before implementing the system.

It is very important to take extra security measures with respect to people and property, controlling at all times that the testing areas are free of all staff other than the technicians performing verification work (these tests cannot be performed with the pressure equipment or with diffusers in closed positions).

5.1.- NECESSARY ELEMENTS.

Personal protective equipment.

- Lifts, scaffolding, platforms, etc. (work).
- Water connections, minimum 3/8" (work).
- Water supply hose (30-40 m) with quick disconnect fittings for irrigation (6-8 bar) and male-female threaded fittings.
- 0-35 bar hand pump with medium pressure hose.
- Pressure multiplier.
- High pressure hose ½" (minimum 300 bar and 3-4 metres).
- Accessories for hose.
- Plugs for the diffuser connector outputs.
- Nitrogen bottle.
- Pressure regulator for nitrogen
- 3 way valve ½" to connect to the installation.
- Bucket or container for water.
- Hand tools.

5.2.- PROCEDURE

[1] Mount 3-way valve in the system inlet adapting to the tube connection.
[2] Connect the water mains to the 3-way valve, closed. Put plugs in the diffuser connection outputs, making sure the O-rings are fitted in the housing and tighten the caps without forcing.
[3] Open water supply.
[4] Open 3-way valve to fill the network.
[5] Empty each of the branches by loosening the last of the plugs in each branch and collecting the water in the container.
[6] Tighten the cap opened to empty the water when no air is coming out.
[7] Close the 3-way valve when the pressure stabilises.
[8] Connect the manual pump to the 3-way valve.
[9] Fill the pot with water.
[10] Open the 3-way valve.
[11] Increase the pressure manually to 40 bar.
[12] Check for leaks and correct if necessary to ensure Water tightness.
[13] Close the 3-way valve.
[14] Remove the hand pump hose from the 3-way valve.
[15] Connect the multiplier to the 3-way valve.
[16] Install pressure regulator to the nitrogen bottle.
[17] Connect the water and nitrogen hoses to the multiplier keeping the multiplier valves closed.
[18] Loosen the adjustment screw until the pressure regulator is loose.
[19] Open the valve on the nitrogen bottle.
[20] Adjust the pressure regulator by tightening the screw until the gauge reaches 18 bar.
[21] Open the 3-way valve.
[22] Open the water valve.
[23] Start the multiplier, adjusting the speed with the nitrogen inlet valve.
[24] Increase the pressure to 100 bar and check for leaks.
[25] If there are leaks, reduce pressure and correct.
[26] Increase to test pressure.
[27] Check for leaks.
[28] Maintain the test pressure for 10 minutes.
[29] Decrease working pressure by opening the multiplier drain valve.
[30] Maintain the work pressure for 110 minutes.
[31] Remove the pressure using the drain valve.
[32] Remove water by keeping open the drain and removing last plugs from each branch and collecting the water.
[33] Remove the multiplier.
[34] Clean the installation using air.
[35] Install diffusers.

If the facility has several rooms with directional valves, this procedure will be individually applied in each room to the test pressure. Then all directional valves will be opened and the procedure followed.

6 Elements of pump equipment

In this section, the main r esources that make up the pump equipment are indicated.

1. Main Pump: Pump responsible for supplying the required flow to meet demand for the pressure.

2. Jockey Pump: Pump responsible for maintaining a pressure of 40 bar (pr essurisation) in w et and mix ed facilities.

3. Surge pump: Pump r esponsible for feeding the suction manifold to ensure flow and prevent any pump from running on empty. It is installed in equipment with more than 3 pumps.

4. Intake manifold: Manifold through which all pumps are fed except the surge ones.

5. Discharge manifold: Manifold downstream of the main pumps through which the entire facility is fed.

6. Return manifold: Manifold through which excess water is returned to the reservoir.

7. Discharge valve: Valve connected to the delivery manifold through which the whole facility is supplied.

8. Testing valve: Valve for performing tests of operations in the equipment which returns water to the tank. Depending on the configuration, 2 units can be included.

9. Main control valve: Valve responsible for preventing surges in the delivery manifold. Water is discharged into the return collector. Depending on the c onfiguration, 2 units can be included.

10. Auxiliary control valve: Jockey pump r egulating valve, responsible for relieving excess water, returning it to the intake manifold.

11. Relief valve: Pressure relief valve in the intake manifold.

12. Drain valve: Drain or purge valve in the intake manifold.

13. Anti-return valves: One installed per main pump and jockey pump. One is also provided to be installed in the intake, pump or manifold inlets.

14. Pulse damper (delivery manifold): Its function is to stabilise the pressure transducer reading.

15. Filters: A general one is installed for all pumps except the surge pump.

16. Delivery connecting tube: Flexible connecting tube joining the outlet of the discharge valve to the facility's outlet pipe in order to minimise the tr ansmission of vi brations from the equipment.

17. Intake connecting tube: Flexible connecting tube joining the intake pipe (tank outlet) with the anti-return valve on the surge pump (for equipment > 3 pumps) or the anti-return valve of the intake manifold (equipment <3 pumps), with the objective of minimising the transmission of vibrations from the equipment.

18. Flange with anti-vibration and return connecting tube: The flange connects the return manifold with the return pipe to the tank (equipment> 3 pumps) and with the return connecting tube to join the outlet of the testing and regulation valves with the return pipe to the tank (equipment <3 pumps), in or der to minimise transmission of vi brations from the equipment.

19. Pressure gauge: Indicates the pressure in the discharge manifold.

20. Pressure transducer: Indicates the pressure in the discharge manifold on a 4-digit dis play. Generates a 4-20 mA analogue signal depending on the pressure in the delivery manifold. It also activates a digital signal (led SP1) when the pr essure exceeds 160 bar. If the equipmen t is not c onnected, an emergency shutdown of the pressure equipment occurs.

21. Control panel: Electrical control panel from which the pumps can be managed.

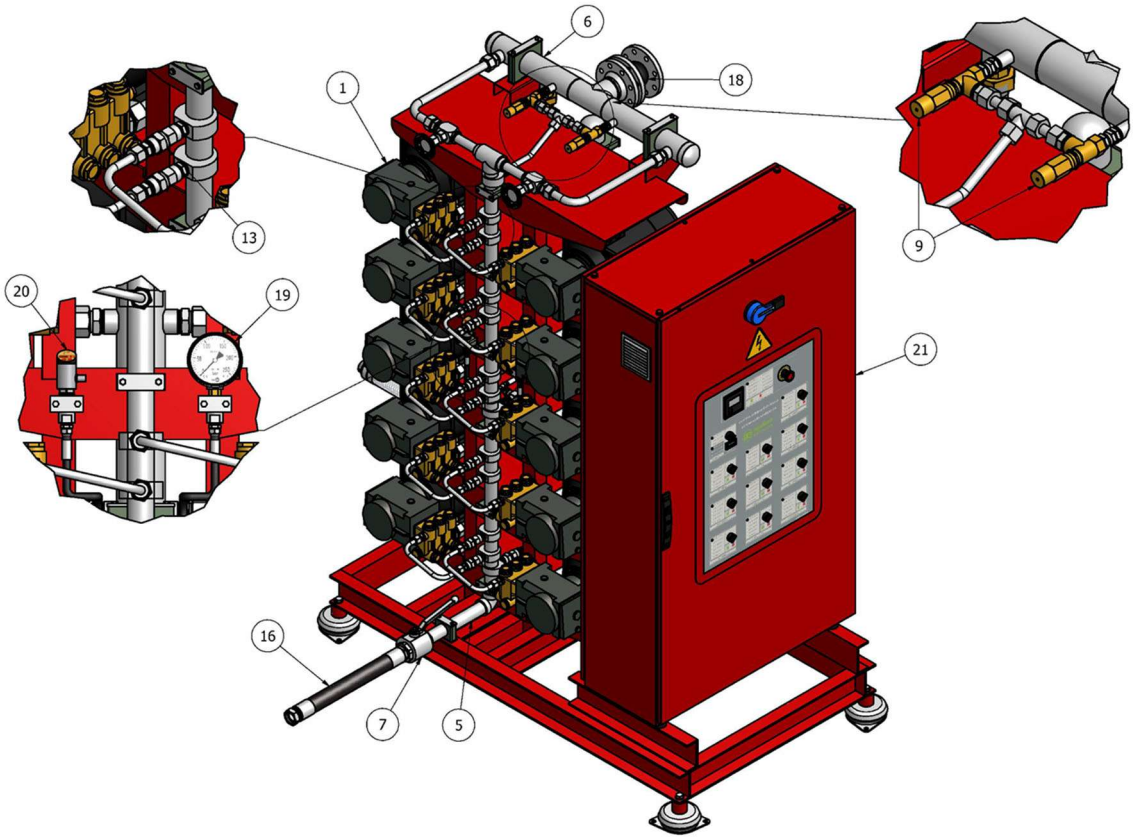


Figure 6: Group > 3 pumps

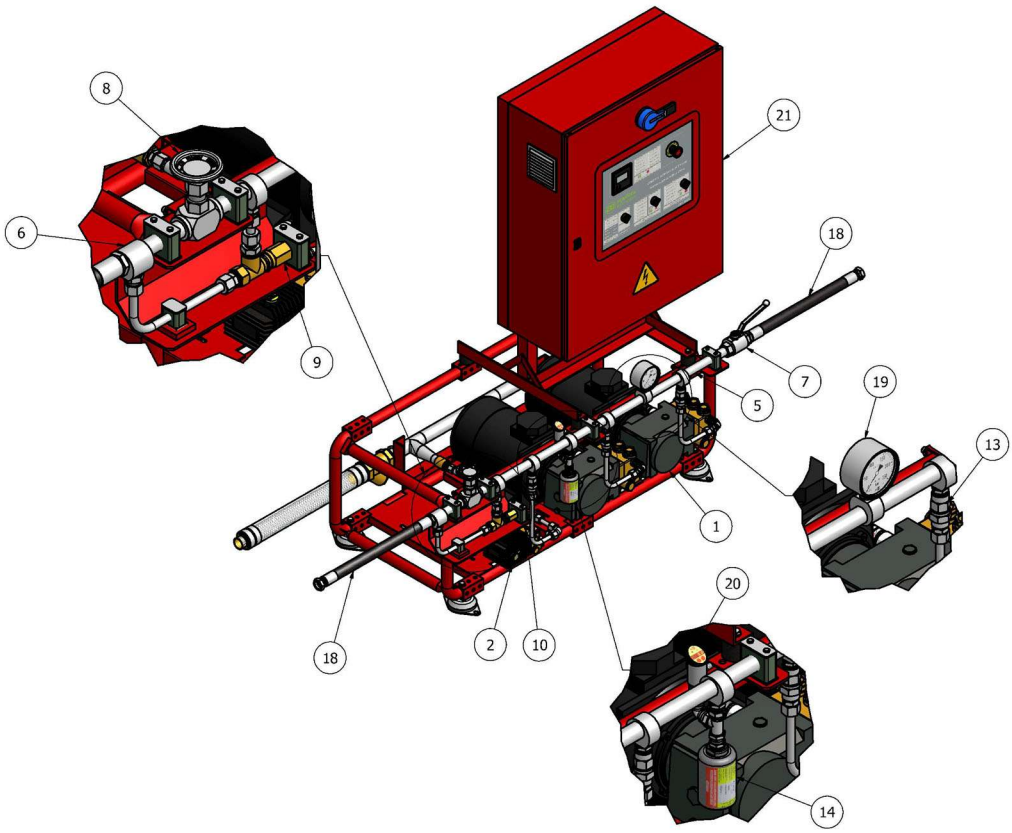


Figure 7: Group < 3 pumps

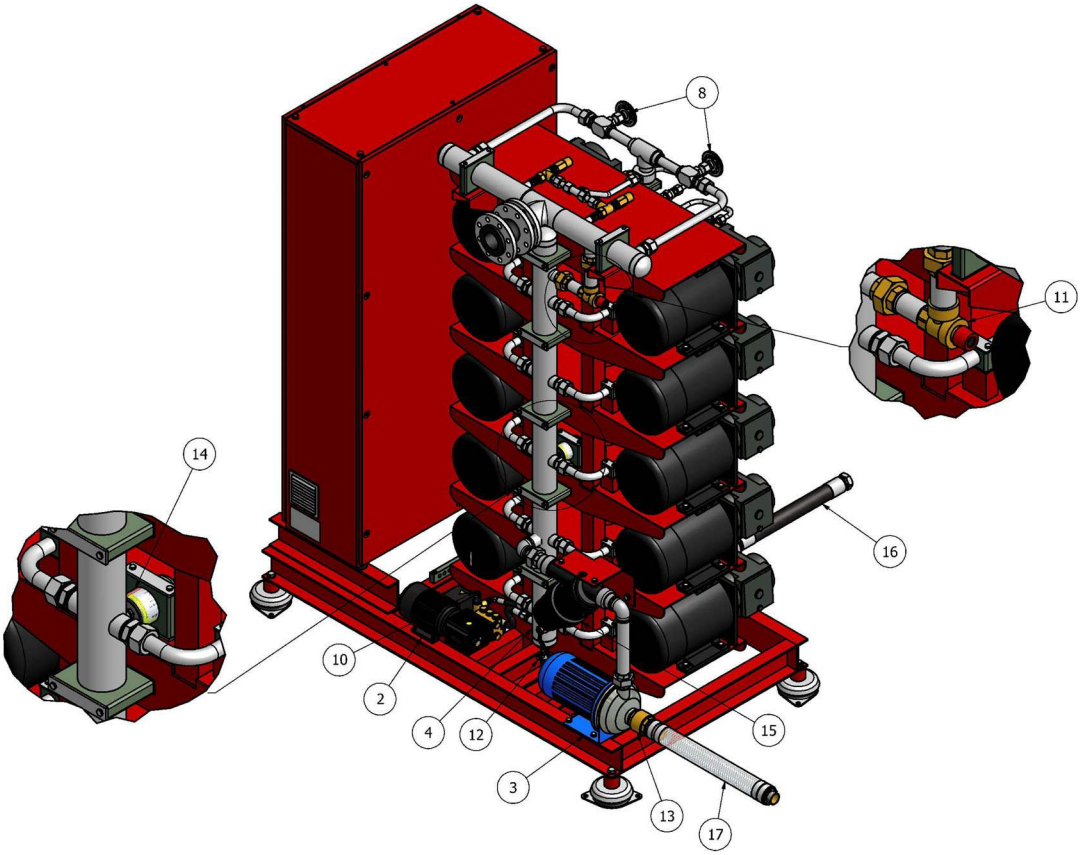


Figure 8: Rear group > 3 pumps

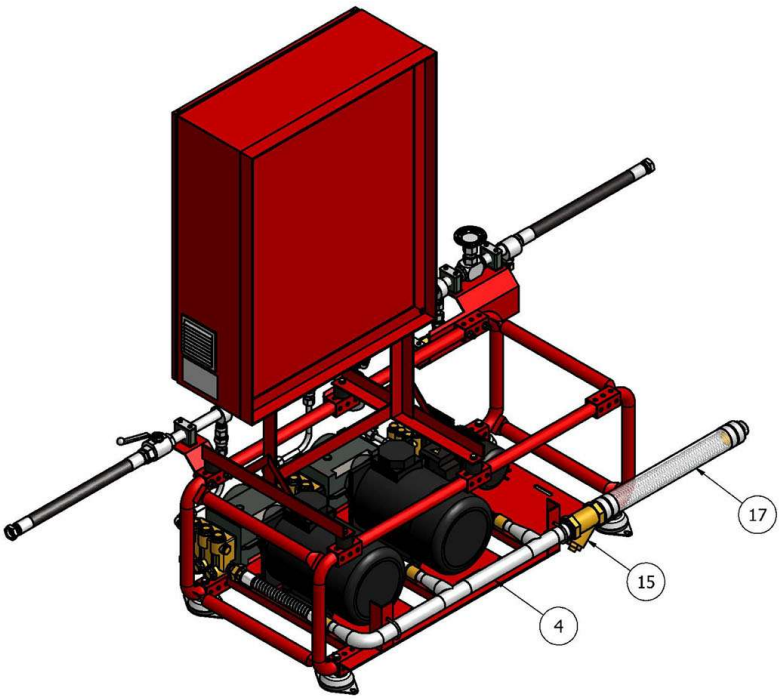


Figure 9: Rear group < 3 pumps

7 Connection to the water tanks

The reference guidelines for pumps, control panels, installation and, in general, everything that can provide guidance until specific regulations are released, are UNE-23500, NFPA-20 and Cepreven technical guidelines.

7.1.- CONNECTION DIAGRAM FOR GROUP OF MORE THAN 3 HORIZONTAL TANK PUMPS.

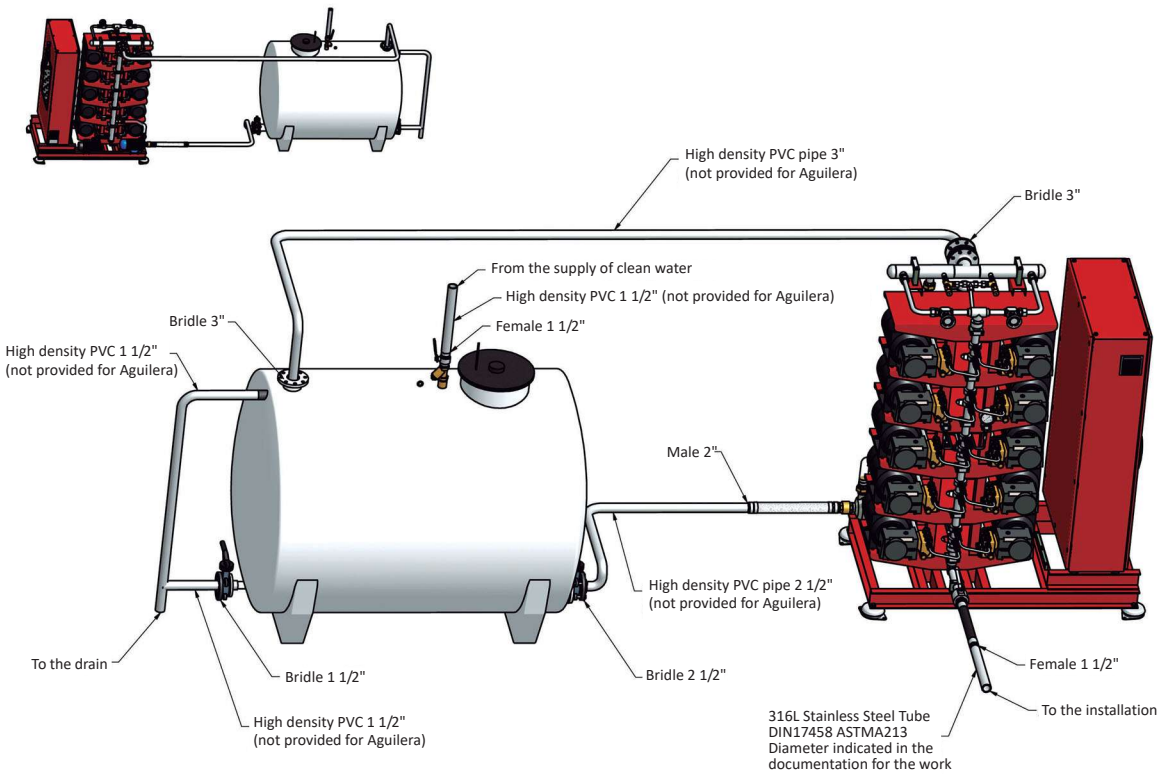


Figure 10: Horizontal deposit connection < 3 pumps

7.2.- CONNECTION DIAGRAM FOR GROUP OF LESS THAN 4 VERTICAL TANK PUMPS

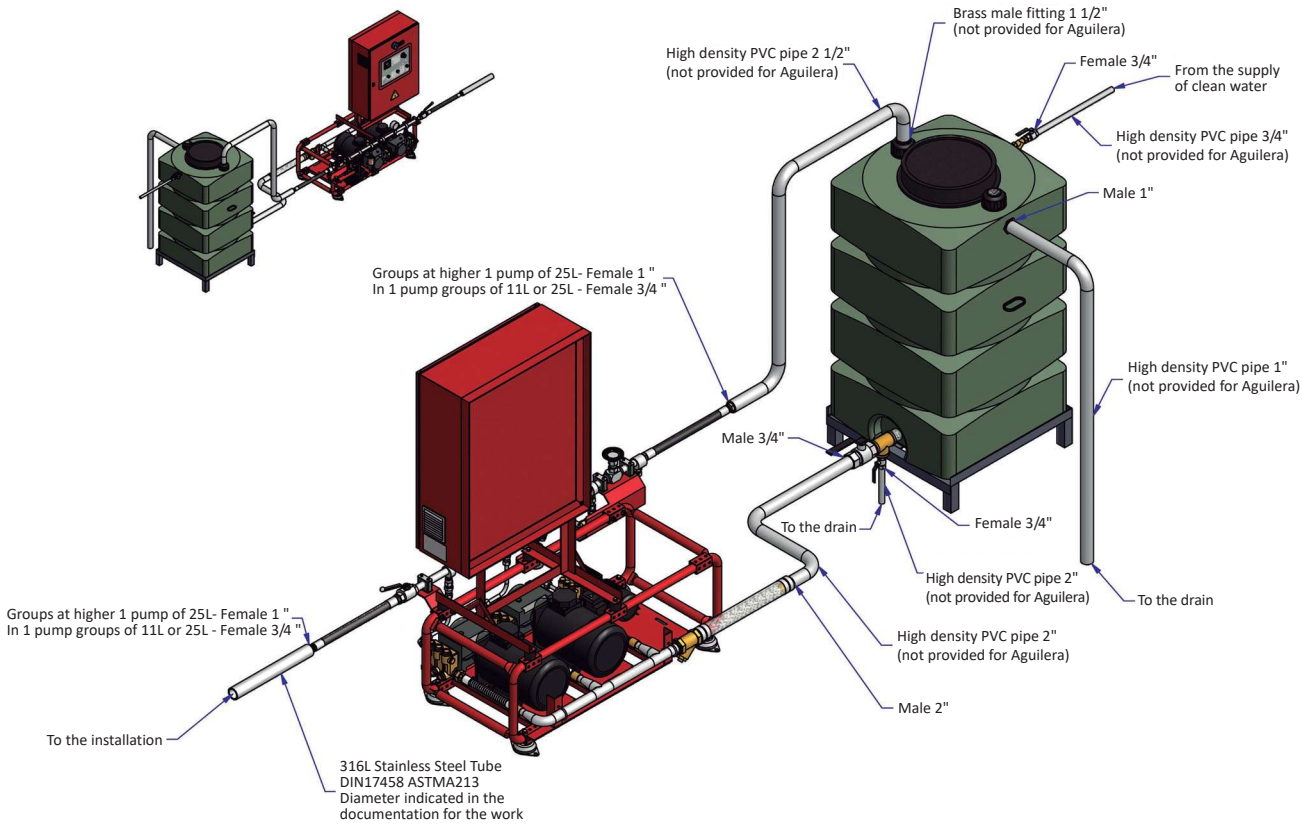


Figure 11: Horizontal deposit connection < 4 pumps

7.3.- CONNECTION DIAGRAM FOR GROUP OF LESS THAN 4 HORIZONTAL TANK PUMPS.

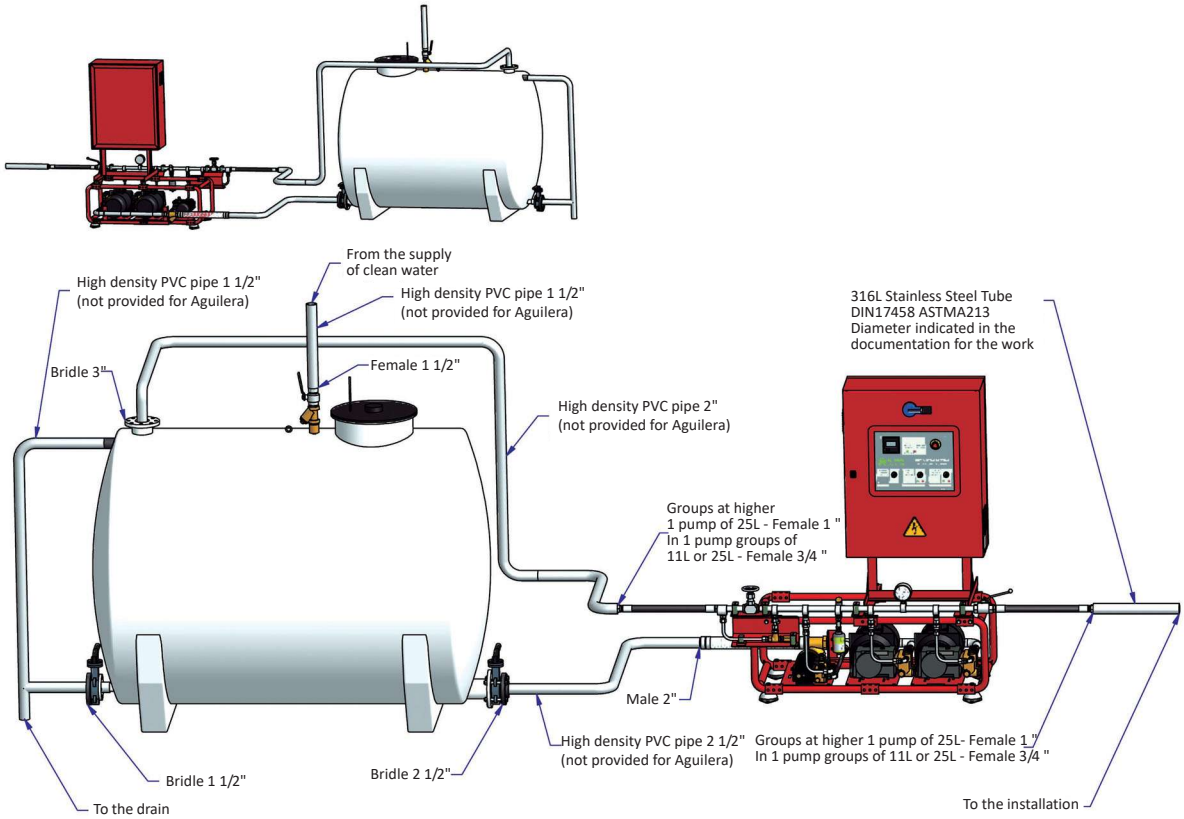


Figure 12: Horizontal deposit connection < 4 pumps

8 Electrical panel

Electrical resources incorporating equipment are indicated in this example, corresponding to the structure of an electrical panel planned for a mixed installation. The electro-pneumatic control of directional valves is installed in an auxiliary closet "Pilot Assembly". This equipment, designed for a flow rate of 120 l/min at 140 bar, with "n" risks, is composed of three main pumps, a jockey pump, a priming pump and an outlet for a compressor (pneumatic circuit).

The topology of the resources listed in the following figure varies depending on the type of equipment, but the basic structure and general nomenclature is maintained in all cases.

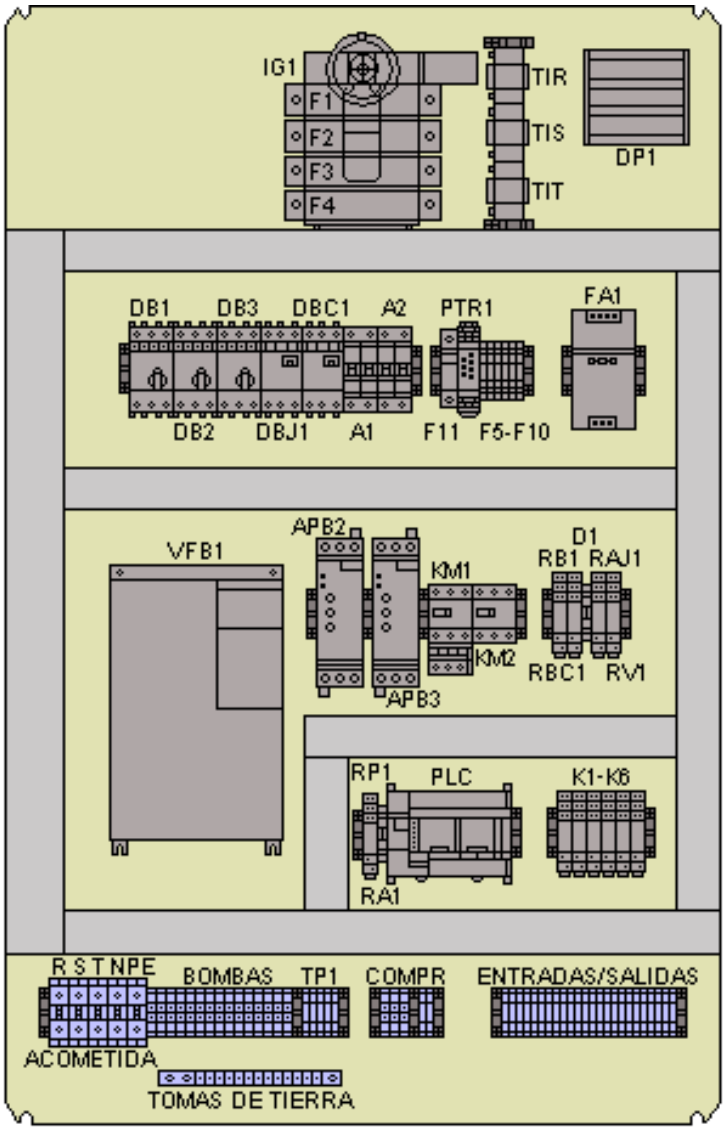


Figure 13. Electrical panel topology

Resources:

IG1	General switch.
F1-F4	General protection fuses.
TIR	Type-"R" transformer.
TIS	Type-"S" transformer.
TIT	Type-"T" transformer.
DP1	Power distributor.
DB1	Pump magnetic breaker 1.
DB2	Pump magnetic breaker 2.
DB3	Pump magnetic breaker 3.
DBJ1	Jockey pump magnetic breaker.
DBC1	Priming pump magnetic breaker 1
A1	Magneto-thermal switch with internal power supply.
A2	Magneto-thermal switch with compressor circuit.
F11	Auxiliary fuse (indoor fan, etc.).
PTR1	Network voltage presence relay - phase sequence.
F5-F10	Fuses (network analyser and PTR1).
FA1	24V power supply.
VFB1	Pump frequency drive 1.
APB2	Pump progressive starter 2.
APB3	Pump progressive starter 3.
KM1	Switch with jockey pump thermal relay.
KM2	Surge pump switch.
RB1	Switching pump relay 1.
RBC1	Surge pump manifold relay.
D1	Fuse holder with diode.
RAJ1	Cistern level operation relay (tank).
RV1	Intake and discharge valves control relay.
RP1	Control relay "Run PLC".
RA1	Fuse holder with resistance.
PLC1	PLC.
K1-K6	Control relays for repetition of states.
X0.1-5	Electrical connection terminals.
X0.6-20	Pump connection terminals.
X0.21-25	Pressure transducer terminals.
X0.26-30	Pressure switch and compressor terminals.
X0.31-54	Input and output connection terminals.

All internal wiring is numbered for monitoring interconnections.

The electrical panel incorporates a fan controlled thermostatically with manual adjustment depending on needs. By default, it is set at 30°C.

8.1.1.- Power circuit (blocks).

The following figure shows the basic blocks in the power lines distribution.

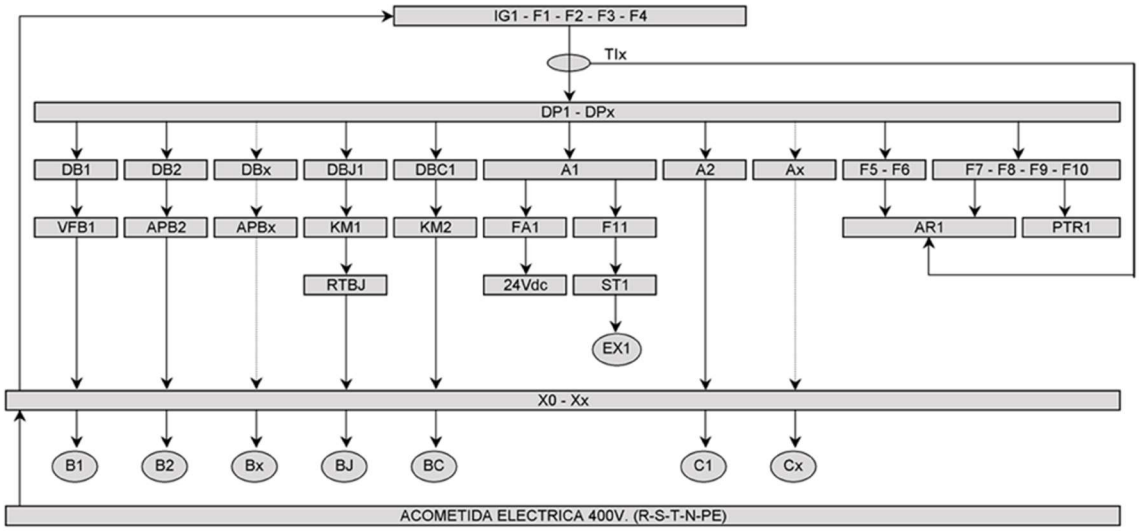


Figure 14. Power circuit (blocks)

8.1.2.- Control circuit (blocks).

In the figure below, the building blocks of the control, switching and signalling line distributions are indicated.

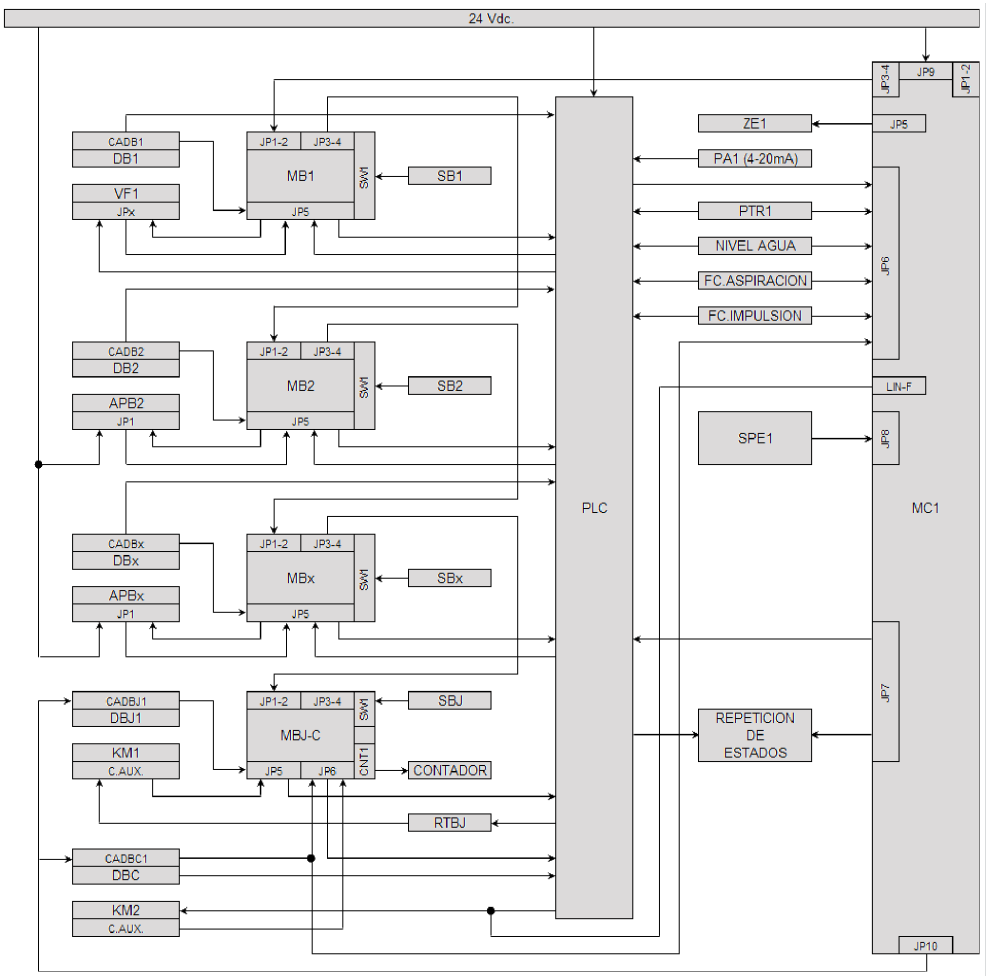


Figure 15. Control circuit (blocks

Safety and security signs are redundant (two individual circuits), one for active control of each pump module and the common module and another for PLC control.)

8.2.- PILOT ASSEMBLY.

The electro-pneumatic resources which include a pilot assembly are indicated in the following figure, for an example with a structure corresponding to the control of four risks.

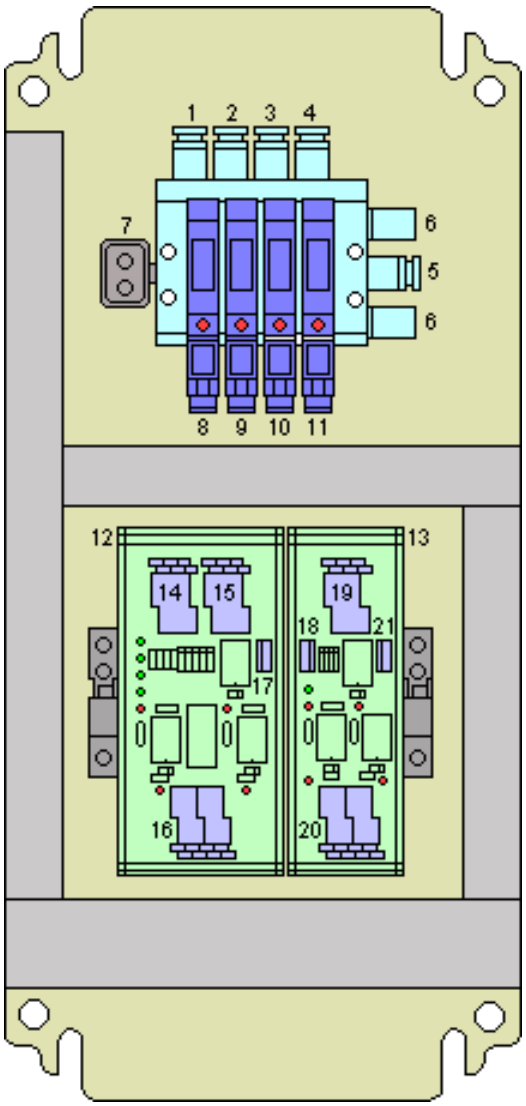


Figure 16. Pilot assembly 4 risks

Resources:

1) Pneumatic output for directional valve risk 1.
2) Pneumatic output for directional valve risk 2.
3) Pneumatic output for directional valve risk 3.
4) Pneumatic output for directional valve risk 4.
5) Compressed air pneumatic inlet (compressor).
6) Pneumatic outlet valves.
7) Pressure switch (confirms pressure in common chamber).
8) Power connection input (24V) electro-valve risk 1.
9) Power connection input (24V) electro-valve risk 2.
10) Power connection input (24V) electro-valve risk 3.
11) Power connection input (24V) electro-valve risk 4.
12) Master control circuit for two risks, ref. AEX-CVDM.
13) Slave control circuit to extend two risks, ref. AEX-CVDA.
14) Internal wiring terminals and electrical equipment box.
15) Internal wiring terminals and electrical equipment box.
16) Input terminals, triggers and switches for risks 1 and 2.
17) Connector output, connecting tube leading to slave module (extension).
18) Connector input, connecting tube leading to master module.
19) Internal wiring terminals and electrical equipment box.
20) Input terminals, triggers and switches for risks 3 and 4.
21) Terminal connector (inserted at the last slave module).

Note: Correspondence for wiring of terminals 14 (MJ1), 15 (MJ2) 19 (EJ2) is shown in the diagrams of the project memory interface.

Input in connecting terminal and confirmation of trigger (16) for risks 1 and 2 (master):

J3.1 +AR1 24Vdc. Activation of risk 1 (+ PX2.1 trigger).
J3.2 -AR1 0Vdc. Activation of risk 1 (- PX2.1 trigger).
J3.3 FC1O Common terminal directional valve risk 1.
J3.4 FC1I Contact n/c terminal directional valve 1 (closed).
J3.5 +AR2 24Vdc. Activation of risk 2 (+ PX2.2 trigger).
J3.6 -AR2 0Vdc. Activation of risk 2 (- PX2.2 trigger).
J3.7 FC2O Common terminal directional valve risk 2.
J3.8 FC2I Contact n/c terminal directional valve 2 (closed).

Light indicators:	Master Circuit	Slave Circuit	Master Correspondence	Slave Correspondence
	DL1	-	Pressure compressor, pneumatic circuit.	
	DL2	-	Trigger authorisation.	
	DL3	-	Service OK.	
	DL4	DL4	Risk service.	Risk service.
	DL5	DL5	Trigger directional valve risk 1.	Risk 3.
	DL6	DL6	Confirmation opening directional valve risk 1.	Risk 3.
	DL7	DL7	Trigger directional valve risk 2.	Risk 4.
	DL8	DL8	Confirmation opening directional valve risk 2.	Risk 4.

Check the pilot assembly manual before handling selectors SL1 and SL2.

There are three types of cabinets that vary depending on the number of risks. In all cases, the pneumatic inputs and outputs are connected to the outside of the cabinet. This includes bushing with quick insertion sockets.

Inputs and outputs for wiring to the electrical box, fire panels, etc. is done through the bottom of the cabinet and the entry of each directional control valve terminals goes through the top packing box (can be replaced by fittings).

The pilot assembly can also be supplied with another similar circuit. The reference is AEX/CVD (see instruction manual).

9 Control panel

All use of the mist water pumps is done from the controls of the electrical panel. No implementation operations, either automatic or manual, need to be carried out which do not use these elements.

Inside the box there are several points running at 400V on AC. Work on them should be carried out only by qualified personnel.

It is necessary to provide the pumps with 400V three-phase power + neutral according to the power required for the simultaneous operation of all pumps. See table of electrical characteristics for the pump assembly.

Connections to the mains (MSBs) must include an efficient earth. Any negligence on this point may involve serious risks to service personnel.

When creating the bushing for the incoming electrical connection, especially in the boxes when going through the top, the resources incorporated must be properly protected to prevent mechanical damage from metal drill shavings, etc.

Before connecting the water mist pump to the system, it will be necessary to verify that the piping has been previously tested and has withstood the corresponding pressurisation tests. The insertion of all diffusers will also be checked.

The group of water mist pumps cannot be used, under any circumstances, to test pressurisation for the system.

The water mist pumps should only be used at the facility for which they were designed and dimensioned, according to their type (wet, dry or mixed piping), its operating pressure at rest and activation, minimum and maximum flow demand, risks or areas selected by directional valves, etc.

Any variation which occurs at the facility with respect to the calculations used in the design and dimensioning of the pumps can affect their performance and the effectiveness of the fire suppression system. Contact Aguilera Extinción to verify that the new operational performance requirements are tailored to the characteristics of the supplied water mist pumps.

The dimensions and electrical elements of the panel will vary depending on the number of pumps. It consists of the following elements.

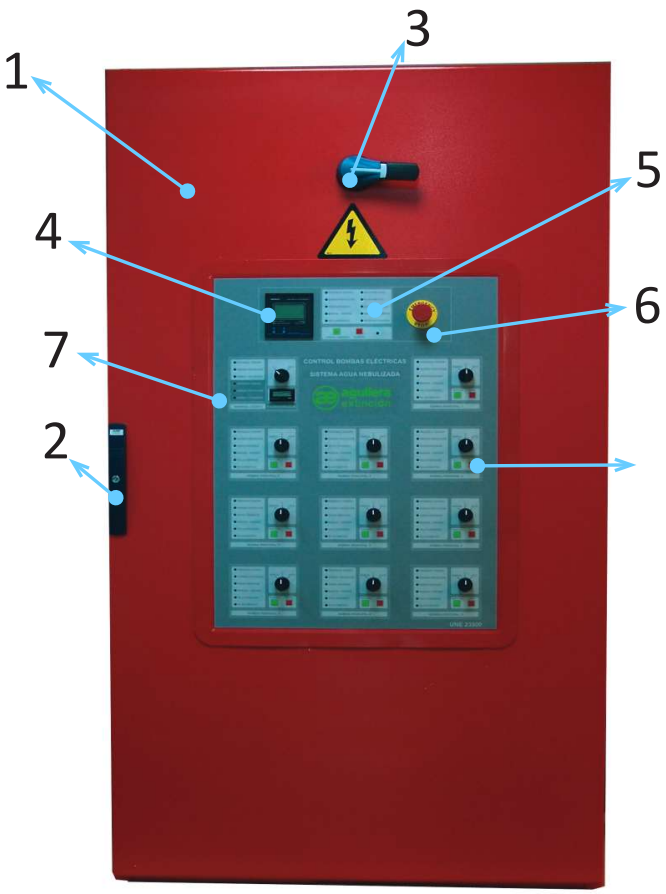


Figure 17. Control panel

1. Electrical panel cabinet.
2. Mechanism for opening and closing the door of the electrical panel.
3. Main switch.
4. Electrical analyser.
5. Common module with general indicators, test button with lights, mute sound button and audible warning device.
6. Emergency stop button.
7. Auxiliary pump module.
8. Main pump module, one for each existing pump in the group.

9.1.- ELECTRICAL PANEL CABINET.

Sheet steel cabinet 1.2 to 1.5 mm thick (depending on size) in red finish and IP66 protection, mounted on the pump structure (bank).

The door can open from left to right to an angle of 130° for comfortable access into the cabinet. On the door and the mounting plate, the different control elements are attached.

It incorporates a thermal regulation system using filter fans for forced ventilation, with IP54 protection, regulated by an adjustable thermostat.

Inside, on a mounting plate, is all the electrical equipment necessary for the functioning of the water mist pumps.

At the bottom is the packing box for introducing the electric cables required for making the connection.

When placing the pump group, there should be a space of at least 1m in front of the cabinet door, to allow access to the pumps and to open the door.

The electrical panel cabinet has at least one opening and closing mechanism with a special 3-mm DIN device supplied with 90° rotation.

9.2.- ELECTRICAL PANEL OPENING AND CLOSING MECHANISM.

The main switch acts as a complement to the closure system of the cabinet as it prevents the door from being opened if the cabinet is powered.

The operation of the pump assembly is only possible with the door closed.

9.3.- GENERAL SWITCH, IG1.

It controls the power to the pumps acting on the switch according to their position.

When the main switch is in position I-ON, the door to the electrical panel cannot be opened, preventing it being touched when there is electricity flowing.

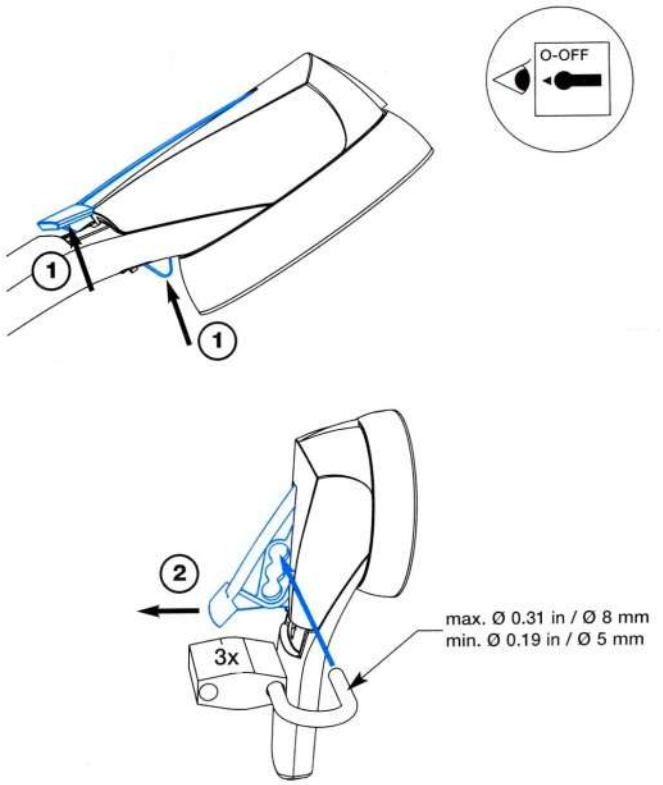


Figure 19. Handle block

It will also be necessary to act on the main switch when necessary to perform a full stop of the pumps after automatic activation, to force a reset in the PLC program.

0-OFF
Electrical panel
No power

I-On
Electrical panel
Powered

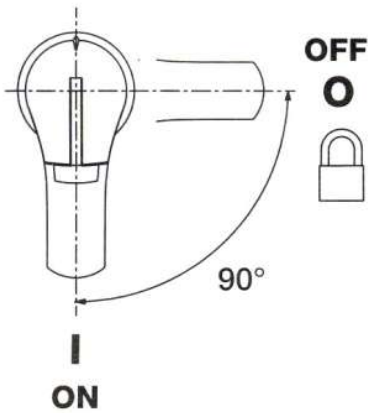


Figure 18. Main switch lever

9.4.- NETWORK ANALYSER, TYPE 1.

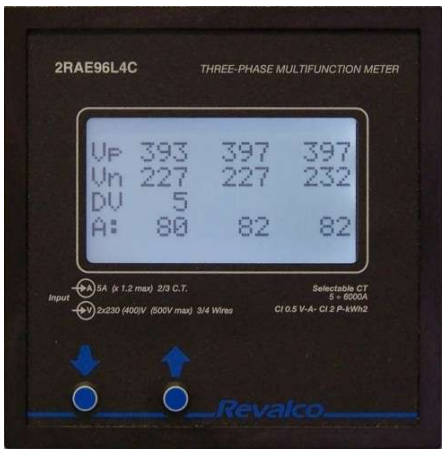


Figure 20. Type 1 network analyser

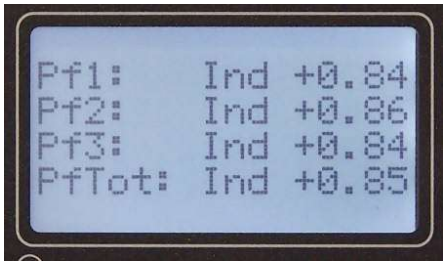
It displays information about the mains voltage to the water mist pump electrical panel.

It works only when the switchboard is powered and the IG1 main switch in position I-ON.

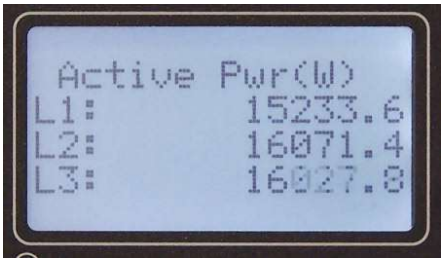
The information displayed by default is:

Vp: Voltage between R-S-T phases
Vn: Voltage in each phase with respect to neutral.
DV: Voltage difference between phase and neutral (asymmetry).
A: Current to each of the phases.

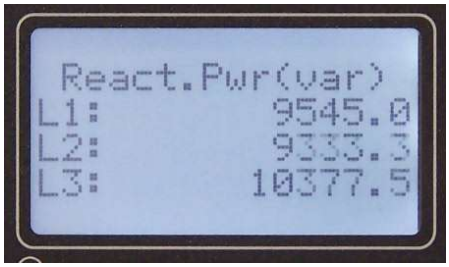
Using the keys, the display of data can be changed in the following sequence:



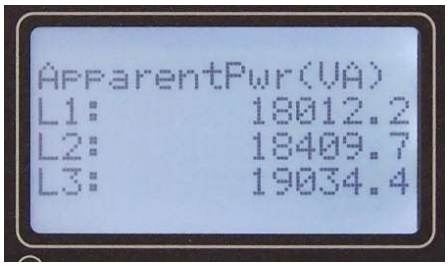
Power factor



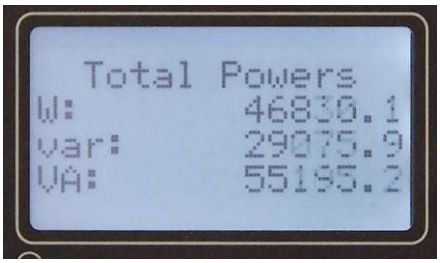
Active power (W)



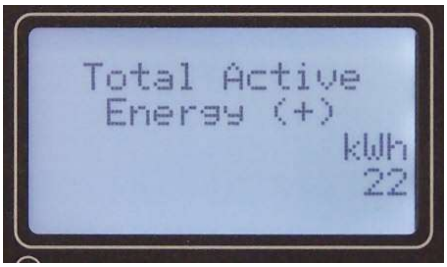
Reactive power (var)



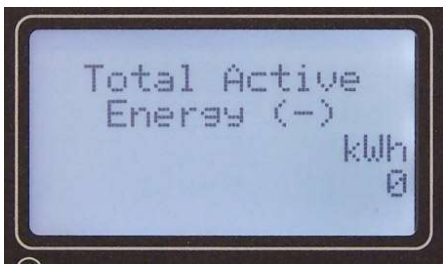
Apparent voltage (VA)



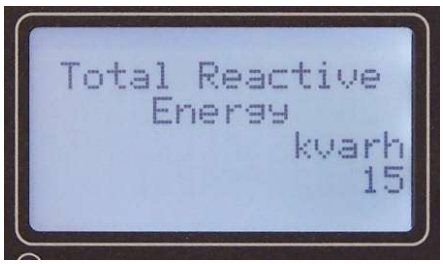
Total power



Total active energy consumed

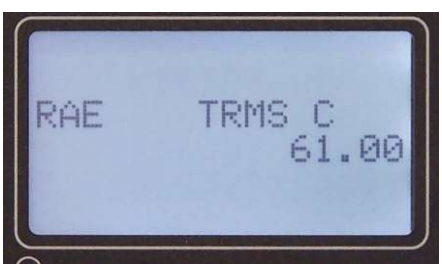


Total active energy generated

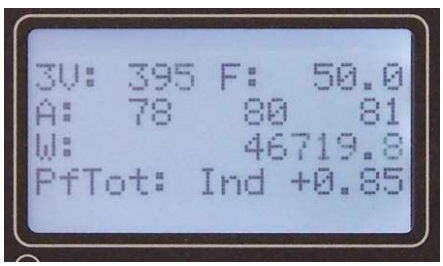


Total reactive power

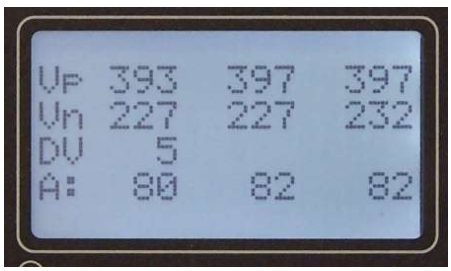
Total operating time



Phase sequence/software version



General indication



Home screen by default

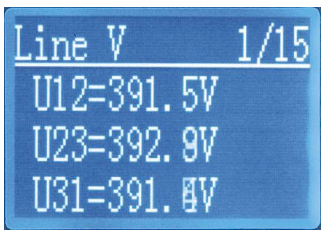
9.5.- NETWORK ANALYSER, TYPE 2.

Figure 21. Type 2 network analyser

It displays information about the mains voltage to the water mist pump electrical panel.

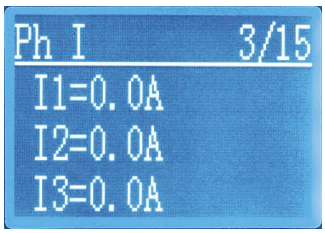
It works only when the switchboard is powered and the IG1 main switch in position I-ON. The information displayed by default corresponds to the last screen viewed before the panel was powered down.

Keyboard:
Key 1: Down/Reset.
Key 2: Up/Programming.
Key 3: Rotate and maximum value.
Key 4: Enter/average value.
Key 5: Second function selection.

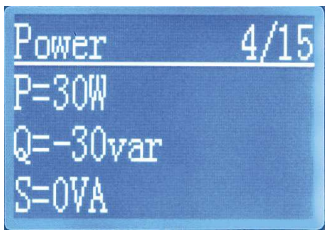


Voltage between phases

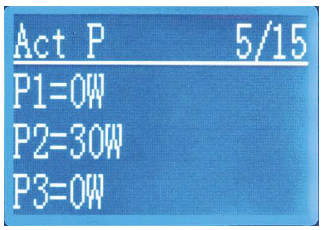
Voltage between phases and neutral



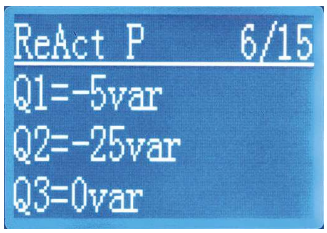
Current per phase



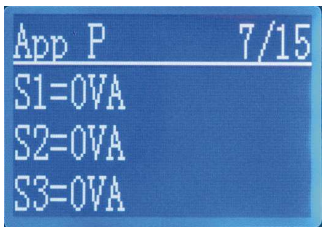
Power



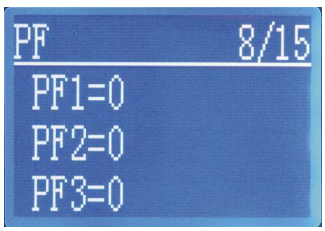
Active power



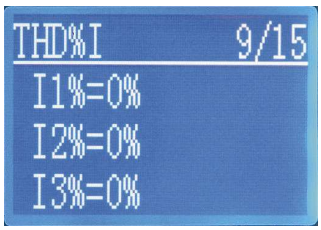
Reactive power



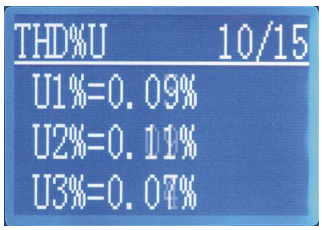
Apparent power



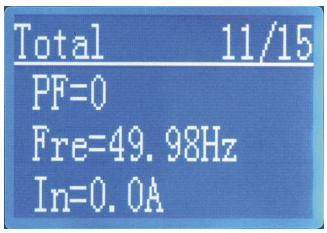
Power factor



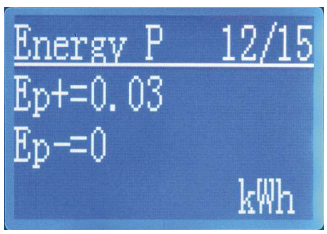
Harmonic distortion in current



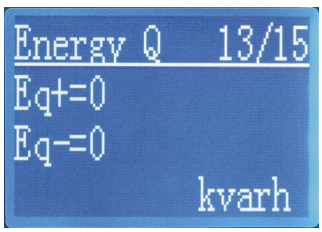
Harmonic distortion in voltage



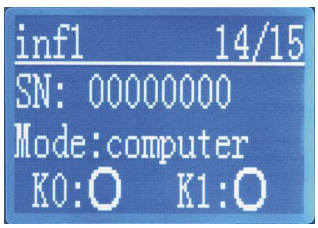
Power/frequency/In factor



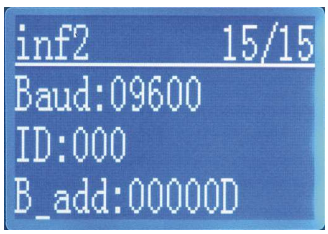
Active energy consumed/generated



Inductive/capacitive reactive energy



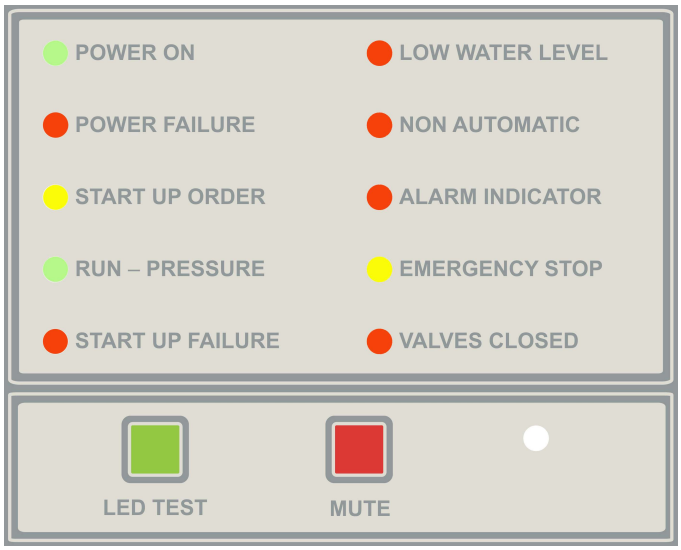
Info_1 serial number/relay mode/status



Info_2 Velocity/ID/direction

9.6.- COMMON MODULE.

The common signalling and control module is located in the centre between the network analyser and the emergency stop button.



It has the following indicator lights:

POWER ON Power on

It becomes green when the following conditions are met:

• The panel is supplied with a three-phase voltage at 400V.
• The IG1 power switch is in position I-ON.
• The R-S-T- phase sequence is correct.
• The 24Vdc. power supply is operational.

POWER FAILURE Power failure

It becomes red if:

• The three-phase voltage drops by 10%.
• The three-phase voltage is increased by 10%.
• The order of the R-S-T- phases is not correct.

START UP ORDER Start-up command

It becomes yellow if:

• Any of the main pumps, automatically or manually, is told to start up.

RUN – PRESSURE Start with pressure

It becomes green if:

• The running order in any of the main pumps is confirmed.

START UP FAILURE Start-up failure

It becomes red if:

• The emergency stop button is activated.
• There is no water in the tank.
• The intake and/or drive valves are closed (the valve must include a device to control the open/closed status).
• Failure in pressure transducer.
• The surge pump (if any) is not operational.
• Automatic start-up and main pump 1 are not operational.
• A pressure of 100 Bar was not reached after 30 sec of operation with all available pumps running.
• The PLC battery backup has no charge (only if the panel is equipped with this resource).

LOW WATER LEVEL Low water level

It becomes red if:

• The water level in the reservoir is below the minimum necessary for operation. An emergency stop will be generated until the water level is sufficient for proper operation.

NON AUTOMATIC Not automatic

It becomes red if:

• Some of the main pumps are set to manual or are offline. The pump assembly cannot provide 100% of the expected flow, if necessary.

• The Jockey pump (in wet or mixed pipe systems) is in offline mode (0). In this case, it is not possible to pressurise the system to 40 Bar.

ALARM INDICATOR Grouped alarm

It turns red if:

• Start-up with pressure.
• Start-up failure.
• Low water level
• Status not automatic.
• Surge protection (> 160 Bar).
• Emergency stop
• Inlet and/or drive closed (the valve must incorporate a device for controlling the state of the open/closed status).

EMERGENCY STOP Emergency stop

It becomes yellow if:

• The emergency stop button is pressed.
• A malfunction of the PLC operation occurs (only if the panel is equipped with PLC).
• The surge pump (if any) is not operational.
• There is a low level of water.
• The intake and/or drive valves are closed (the valve must include a device to control the open/closed status).

VALVES CLOSED Closed valves

It becomes red if:

• The intake valve is closed. The valve must incorporate a device for controlling the open/closed status.
• The discharge valve is closed. The valve must incorporate a device for controlling the open/closed status.

The light test button activates all the lights on the electrical panel, both for the common module modules and for the auxiliary and main pumps.

The mute sound button stops the water mist electric pump audible warning sound.

9.7.- EMERGENCY STOP BUTTON.

Located to the right of the common module, this causes an emergency stop of the water mist pumps.

To activate the emergency stop, press the emergency stop button.

The button stays down and the lights on the common module will indicate that it has been activated.

To reset the emergency stop, the button must be turned in the direction of the arrows (shown).

9.8.- AUXILIARY PUMP MODULE.

Module to control the Jockey pump and the surge pump. The module is located to the left under the common module.

9.8.1.- Jockey pump module (1/2).

The Jockey pump is responsible for pressurising and maintaining the delivery manifold pressurised at 40 bar. It has the following indicator lights:

POWER ON Power on

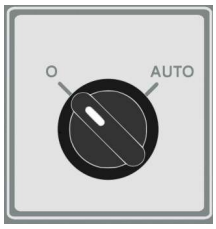
It turns green if there is voltage in the Jockey pump control circuit and it is operational.

PROTECTION TRIP Protection trigger

This becomes red if the Jockey pump protection is activated. The pump becomes inoperable.

JOCKEY PUMP ON Jockey pump running

This turns green when the jockey pump is running.



Operation selector (SBJ)

0: The Jockey pump is disconnected or out of service.

AUTO: Automatic mode.

The Jockey pump will activate automatically if:

• During the process of initial pressurisation of the system, the pressure is below 40 bar.

• When idle, the system pressure slowly drops to 35 bar. (Range 35-40).

Meter: This displays the number of times the Jockey pump has been launched.

9.8.2.- Surge pump module (2-2).

It has the following indicator lights:

POWER ON Power on

It turns green if there is voltage in the surge pump control circuit and it is operational.

PROTECTION TRIP Protection trigger

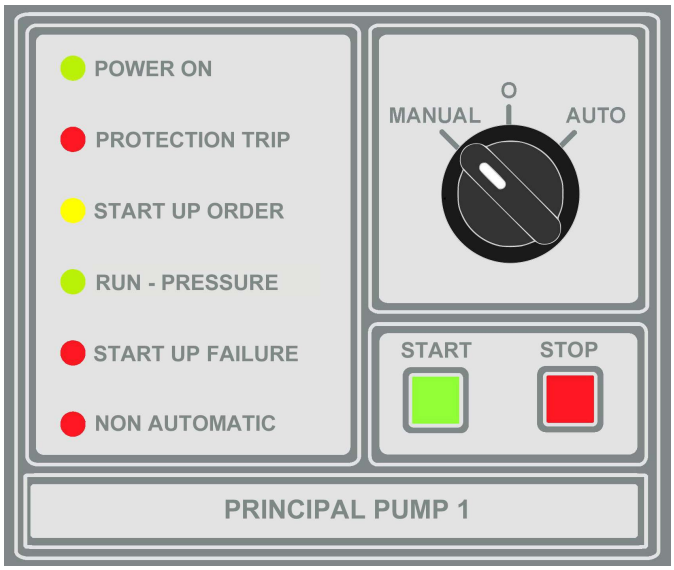
This becomes red if the surge pump protection is activated. The pump becomes inoperable.

SURGE PUMP ON Surge pump

This turns green when the surge pump is running. This condition occurs when placed in any of the pumps making up the pressure group starts up.

9.8.- MAIN PUMP MODULE.

The main pump module is loc ated to the right of the jockey pump module, below the common module. It is responsible for providing the flow required to meet the risk demand for the pressure.



It has the following indicator lights:

POWER ON Power on

It turns green if there is voltage in the main pump control circuit and it is operational.

PROTECTION TRIP Protection trigger

This becomes red if the main pump protection is activated. The pump becomes inoperable.

START UP ORDER Start-up command

This turns yellow if a start-up command is given to the main pump, automatically or manually.

RUN – PRESSURE Start with pressure

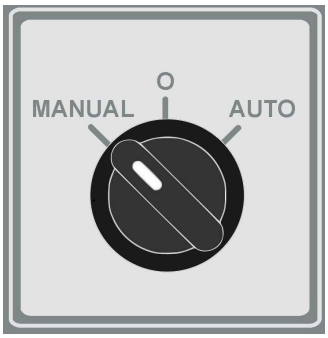
This turns green is the main pump start-up command is confirmed.

START UP FAILURE Start-up failure

This turns red if the after start-up command, a fault is produced in the operation of the main pump.

NON AUTOMATIC Not automatic

This becomes red if the main pump is set to manual or offline.



Operation selector

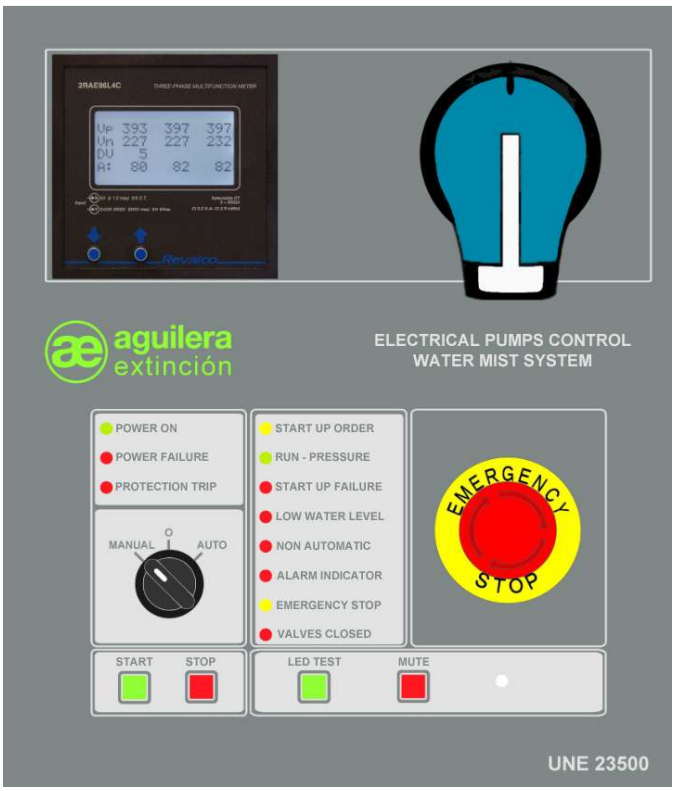
MANUAL: The pump runs only manually using the start and stop buttons.

0: The main pump is disconnected or out of service.

AUTO: The pump is activated automatically when receiving a start-up command.

The ON and OFF keys are operational only in the manual mode.

9.9.- 1 PUMP PANEL (Dry Installation).



Control panel of a pump for dry systems. The lights associated with the common module and the main pump are integrated.

The meanings of the indic ators and the manual oper ation elements are the same as explained above.

10 Operation

This section contains the summary (reminder) of the operating processes for each of the pumps in the mist water equipment as well as all possible functional states indicated.

10.1.- PUMPS.

The equipment is made up of the following pumps:

- Surge pump.
- Jockey pump.
- Main pump 1.
- Remaining main pumps.

For proper operation of the group of water mist pumps, all pump selectors (SBx) must be set to "AUTO" for automatic operation, so that:

• If the main pump or jockey pump are set to "0", they cannot be activated either automatically or manually.

• If the main pump is set to "MANUAL", it will only be activated by pressing the "START" button and will continue until the "STOP" key is pressed.

10.1.1.- Surge pump.

Centrifugal pump responsible for feeding the suction manifold to ensure flow and prevent any pump from running on empty. It is installed in equipment with more than 3 pumps.

Activation is simultaneous to the operation of any other pump with two activation control points, one in the common module and another through a PLC signal in the equipment which include it. The supply voltage is switched through the KM2 switch.

Signalling indicators are available but there is no selector switch for manual activation.

10.1.2.- Jockey Pump.

Positive displacement pump (pistons) only in wet or mixed systems. Responsible for pressurising and maintaining pressurized the system to 40 bar. May be disconnected using the SBJ selector switch. The supply voltage is switched through the KM1 switch, which includes motor protection relays.

10.1.3.- Main pump 1.

This pumps, depending on the equipment configuration, can be activated using one of the following options:

10.1.3.1.- Equipment with PLC.
This is the pump controlled by a variable frequency drive (VF1).
The power adjustment is done here based on the flow requested by the installation (demand), maintaining the working pressure in the manifold drive and providing a maximum flow of 11, 25 or 40 l/min depending on the type of equipment. The operation can be automatic or manual.

10.1.3.2.- Devices without PLC.
In this case, the pump is controlled by a progressive starter (AP1), and so with 100% power for flow rates of 11, 25 and 40 l/min. The excess flow, should the working pressure increase, will be removed to the container via the control valve such that the pressure in the delivery manifold is maintained at the working pressure. It can also be disconnected using the SB1 selector switch.

10.1.4.- Main pumps.

The rest of main pumps in the team.
These pumps start operating when the previous one is working at 100% but the water flow demand continues to increase.

In all cases, they are controlled with a progressive starter (APx). They can also be disconnected by the selector switches (SBx).

10.2.- POSSIBLE FUNCTIONAL STATES.

En In normal operation, the pumps can be in one of the following states:

10.2.1.- Initial stabilisation.

Only required in wet or mixed systems. This is the initial state of the pumps when powered using the main switch (IG1). It is checked through the transducer that the delivery manifold pressure is 40 bar and the following process is performed:

• If the pressure is 40 bar or higher, it enters an idle mode, "Equipment stabilised".

• If the pressure is below 40 bar, the Jockey pump is activated until that pressure is reached. Once reached, it stops and becomes idle.

10.2.2.- Idle state.

Only used in wet or mixed systems. This is the state in which the pumps are normally found upon completion of the initial stabilisation process. The discharge manifold pressure is checked to be at 40 bar, analysing any variations occurring and acting accordingly.
The protocol is as follows:

• If the pressure drops very slowly due to leaks in the system, once the pressure drops below 35 bar, the Jockey pump starts up until the pressure reaches 40 bar again.

• If the pressure drops rapidly upon demand for water for any reason, it is put in an activation state.

10.3.- ACTIVATION STATE.

When an alarm (in dry pipe equipment) is triggered or demand for flow is detected in wet or mixed systems, main pump 1 is started, pressurising the delivery manifold to the working pressure.

The protocol is as follows:

Main pump 1 is started using a smooth acceleration ramp, adapting to the required flow until the working pressure is reached at the delivery manifold. If the required flow increases and main pump 1 is not able to maintain this pressure, the rest of the pumps in the equipment will be sequentially started until the working pressure is reached.

Any excess flow is discharged into the container through the delivery manifold control valve. This is set in the factory and must not be manipulated in any way except by permission from Aguilera Extinción.

In both cases, if a minimum pressure of 100 bar is not reached within 30 sec, a general start-up failure is indicated since the pressure equipment is not capable of providing the required flow demand at the required operating pressure, and so the efficiency of the system may be reduced. The pump assembly does not stop working and the fault condition disappears once it has reached a pressure equal to or above 100 Bar.

Any those pumps with the switch set to automatic will be started.

During the main pump activation process, the Jockey pump will stop.

10.3.1.- Activation by risks.

If the installation includes directional valves, we must take into account the correspondence of the risks since the pump activation ramp is programmed in order to optimise the timing of water filling the piping.

Activation signals from the central fire extinguishing panels, etc. are managed in the control panel in total dry systems and in the control circuits in the pilot assembly when there are two risks or more. In such cases, an exchange of signals occurs between the pilot assembly circuit and the electrical panel, so that:

• If the electrical panel is operational, it sends an acknowledgement state signal to the control circuit and then awaits confirmation that the air pressure exceeds 4 bar and that the activation order of the corresponding risk of the fire detection system is correct. When this condition is satisfied, the output of the electro-pneumatic valve is activated with the same voltage that caused the trigger, and if the opening of the directional valve is confirmed through the status switch terminal, the control circuit returns an activation signal to the electrical panel and this process and activates the main pumps.

• If the electrical panel is not operational or proper operation is not guaranteed, either due to malfunction or error in selecting the mode of operation of main pump
1 (or more), the electrical panel state confirmation signal is cancelled, and in this case the pilot assembly control circuit will force an opening in the fire system activation circuit which will report a breakdown (open line) in the trigger output, the same as if there was not enough pressure in the pneumatic circuit.

• If the pilot assembly control circuit operating conditions are idle, when given an activation order and confirmation of opening of the directional valve, it sends the corresponding risk activation signal individually or collectively depending on the configuration installation.

10.4.- EMERGENCY STOP.

The assembly includes a resettable emergency stop button (see 9.7) allowing the pumps to be stopped if necessary. In all cases, the operation is as follows:

• When the button is pressed, an emergency stop occurs immediately, causing all pumps which were activated to cease working.

• While the button is pressed, it is not possible to automatically or manually activate any existing pump.

• Activation of the button dies not change the state of operation of the system.

• The emergency stop can be reset by turning the button in the direction of the arrows.

• When the emergency stop is reset, the equipment will continue in the same working condition, so that:

• In wet piping equipment, if the operation status is initial stabilisation, only the Jockey pump is activated until the working pressure is reached (40 bar).

• In wet piping equipment, if the operation status is idle and:

a) The pressure is 40 bar or higher, it remains idle and no pump is activated.

b) The pressure is below 35 bar but greater than the activation detection level due to the demand (<30 bar), the Jockey pump is activated until it reaches 40 bar and then becomes idle.

c) The pressure is below the detection level of activation (<30 bar), it moves into a state of activation.

• If the operating status is activated, the pumps are activated sequentially according to the flow demand, until the working pressured is reached and maintained.

Prior to resetting the emergency stop button, it is essential to check the pressure level in the manifold (transducer display or gauge) to prevent an unwanted activation occurring in the pumps due to a leak or manipulation of the valves of the facility which may have been caused by lowering pressure in the delivery manifold.

If the emergency stop did not occur in an activation state, it is advisable to work also on the main switch as this will cause a general stop and move to the initial stabilisation state.

It is also important to remember that if the emergency stop was not caused by manually pressing the button and was not forced by the equipment, the operating process would be the same as above, if the source that caused the technical stop is reset.

10.5.- STOPPING PUMPS.

To perform a total shut-down of the pump assembly, the main switch on the electrical panel (IG1) should be activated.

The control lever (handle) of the power switch can be locked in the "0-OFF" position by placing a lock, to prevent accidental or unauthorised use of the electrical panel.

The change in position of the main switch to "I-ON" forces a reset of the PLC program that controls the operation of the pump group, starting the initial stabilisation process. If this occurs with an open diffuser in an enclosed system or a leak which prevents correct pressurisation in the delivery manifold, the Jockey pump will remain in operation indefinitely.

10.6.- PROTECTION.

The control panel has the following protection systems to prevent the discharge manifold pressure going over a maximum of 160 bar, where:

• Pressure control by PLC. If pressure analysed by analogue measurement (pressure transducer) exceeds 160 bar, an emergency stop is generated causing a shut-down of all pumps.

• Digital alarm signal from the pressure transducer. If the pressure exceeds 160 bar, the pressure switch itself causes an emergency stop. The signal is reset when the pressure is equal to 145 Bar.

• Regulating valve, if the manifold pressure is greater than the operating pressure (140 bar). This pressure causes it to open, relieving pressure and diverting water to the return and back to the tank.

11 Instructions for start-up

Operating pressures in some cases may vary depending on the system, so it is convenient to verify the project notes testing before starting up the system.

The start-up tests shall be carried out only if the system is in completely safe operating condition.

11.1.- PRELIMINARY CHECKS.

This point indicates the preliminary hydraulic, electrical and pneumatic checks to be done before starting up the system.

11.1.1.- Hydraulic checks.

[1] Ensure that the test has been performed for the entire high pressure hydraulic system to 1.5 times the working pressure for 10 minutes and the working pressure for 110 minutes.

[2] Check the mechanical fixings on the tank, manifold and pressure system.

[3] Check that the intake, delivery and return manifolds include anti-vibration elements (dampers, connecting tubes, etc.). Verify drainage and overflow pipes.

[4] Check all valves in the system, verifying that the insertion of each of the handles corresponds to the orientation and condition of opening and closing (we recommend labelling them).

[5] Ensure that the tank and pipeline network have been cleaned.

[6] Check the inlet filters.

[7] Open the general water supply valve and check the tank fill valve (opening and closing).

[8] Fill the water container. Water quality must be suitable for the type of system and must be free of impurities (we recommend installing a 200-micron filter tank inlet).

[9] Close the discharge valve (system outlet).

[10] Open the tank outlet valve and the test valve pump assembly.

[11] See if any water loss occurs in the intake circuit.

[12] Purge the intake manifold and, if applicable, each of the pumps.

When field tests are performed, it is essential to take extra security measures as regards the protection of people and property.

11.1.2.- Electrical Checks.

[1] The mains power supply circuit for the pressure water mist system must be used exclusively for the fire fighting system, be designed for the required power, have the corresponding differential 4-pole magneto-thermal protection and properly marked with the text "DO NOT SHUT DOWN, AUTOMATIC FIRE FIGHTING SYSTEM".

[2] The electrical wiring section (RSTN- PE) must be suitable for the power required by the equipment. See project notes, flat terminal (interior door) or nameplate of the equipment (cabinet right side).

[3] The electrical connection depending on the characteristics and composition of the equipment is connected via terminal sections up to 50 m/m. including connection of PE ground (bottom-left input) or directly to the main switch IG1. In this case, the PE ground connection is made directly to the mounting plate which has a connection point as a screw located in the upper left corner (upper or lower left input).

Connection correspondence regardless of the type of equipment is as follows:

Line	Correspondence	Terminal	Switch
L1	Phase R (black)	X0.1 (grey)	R
L2	Phase S (brown)	X0.2 (grey)	S
L3	Phase T (grey)	X0.3 (grey)	T
N	Neutral N (blue)	X0.4 (blue)	N
PE	Earth PE (y/g)	X0.5 (ama/ver)	Chassis

[4] Open the cabinet (with main switch IG1 set to OFF) box and make sure all the DBx breakers and Ax magneto-thermal protection are set to OFF (supplied from the factory in this position).

[5] Check the connections made by the installer:

[5.1] Electrical connection, switches, correspondence connections, firm contacts, etc.

[5.2] Deposit level switch (float). Contact normally closed (n/c) with water above the minimum level. The unit is supplied with this circuit bridged.

[5.3] Intake valve terminal (recommended). Contact normally closed with the valve open 100%. If there is more than one valve installed in the intake circuit, the terminals are connected in series. The unit is supplied with this circuit bridged.

[5.4] Discharge valve terminal (recommended). Contact normally closed with the valve open 100%. If there is more than one valve installed in the discharge circuit, the terminals are connected in series. For local testing without opening the valve (system), this circuit will have to be bridged. Otherwise, it will cause an emergency stop. The unit is supplied with this circuit bridged.

[5.5] 230Vac output. (A2) for powering the compressor. Only in systems which include a directional valve with electro-pneumatic activation.

[5.6] Check the pneumatic pressure switch circuit (for systems including directional valves only). It is recommended to install a pressure switch for confirmation of the circuit pressure. This can be installed in the pilot assembly upon request.

[5.7] Start-up command signal from the fire detection system (open or mixed systems). In general, the activation voltage is 24Vdc. The internal circuit includes a valid polarisation diode for monitoring the trigger of Aguilera Electrónica's fire fighting panels. Should a state occur in the internal control of the equipment which prevents individual or total risk activation, those fire panel trigger circuits will cause the an open line breakdown event to be triggered, also individually or in total. Depending on the configuration, there are two possible cases:

[5.7.1] General activation (one single risk). The trigger signal is routed to the electrical equipment and connects directly to terminals.

[5.7.2] Activation per risk (pilot assembly). In these cases, we recommend looking at the project notes as the directional valve control circuits can be located in the control panel itself or in an auxiliary cabinet (see the pilot assembly manual).

[5.8] Signs of repetition of individual status (connections to third parties), can be connected by common point (cc), normally closed (n/c) or normally open (n/a). The voltage network status relay (K1) is permanently powered, while other relays are idle (K2 to K6).

Relay	Status repetition signals
K1	Lack of voltage.
K2	Switch set to “Not Automatic”
K3	Start-up error.
K4	Grouped alarm.
K5	Start-up command.
K6	Pump running.

Special attention should be paid to safe earthing (PE) of the electrical box, the pressure group and the piping network.

The equipment is supplied with pumps connected and the pressure in the transducer set up. These should not be changed.

11.1.3.- Pneumatic checks.

[1] Pneumatic checks will be done once the control panel is powered.

[2] Check the compressor once powered (magneto-thermal A2) is pressurised (> 6 and <8 bar) and that when idle, there is no pressure loss.

[3] Check that the connection of the compressor pneumatic outlet to the pilot assembly inlet is done correctly and has no defects or other problems.

[4] Slowly open the compressor discharge valve.

[5] Check there is no pressure loss to the pneumatic system.

[6] Check that there is no loss of air through the pneumatic connections to the pilot assembly.

[7] Connect the output pneumatic tubes from the pilot assembly to each of the directional valves and check for any defects present.

[8] Maintain the pressure in the circuit while other tests are performed to ensure that there is no pressure loss. It is recommended to check all connections with soapy water and, if this is done, then to wipe away the excess.

[9] Check that each of the directional valves is oriented correctly, has no obstacles in the opening area of the handle (automatic movement) and is marked correctly. If it is located in a hidden area, check that it includes an action indicator (recommended).

The pilot assemblies are supplied with protective caps for pneumatic inlets and outlets to prevent them becoming dirty.

11.2.- IMPLEMENTING WATER MIST PRESSURE EQUIPMENT.

After carrying out the preliminary checks, the implementation process of the pressure equipment can be started.

11.2.1.- General testing.

The first tests should be performed with the system set to return (recirculation), keeping the discharge valve closed. Regardless of the configuration of the equipment, the following test procedure will always be performed. Practise good safety and security measures.

[1] Set the main switch IG1 to OFF (if it is ON, give it a quarter turn anti-clockwise).

[2] Open the door of the electrical panel (for security, this may only be done if IG1 is set to OFF).

[3] Activate the low-voltage main panel protection switches (MSBs).

[4] Check the supply voltage at the service entrance, input switches or terminals:

[4.1] Voltage between phases: R-S, R-T and S-T (approximate value of 400 Vac).

[4.2] Voltage between phases and neutral: R-N, S-N and T-N (approximate value of 230 Vac).

[4.3] Voltage between phases and ground: R-PE, S-PE, T-PE (approximate value of 230 Vac).

[4.4] Voltage between neutral and ground: N-PE (approximate value of 0 Vac. There may be a small difference in current).

[5] If the voltage is correct and the magneto-thermal and protection circuit breakers DBx, DBJ1, DBC1, A1 and A2 are kept in the OFF position, the main switch IG1 may be turned ON. This can be done in two ways. With the door closed without an anchor, turn the handle to unlock and mechanically open it so that the cabinet can be opened with the presence of voltage, or, keep the door open with the switch in the OFF position and use a wrench to turn the long axis of the switch to turn it ON. In both cases, these operations are carried out with extreme security measures and individual protection.

[6] Once the main switch is on, the network analyser AR1 (on the front) and the voltage and phase sequence relay PTR1 will be switched on. The factory setting is 400Vac with +10/-10% with a 15-second delay in switching controls.

[7] Check the network analyser AR1 for the phase voltages, 1/15 screen, and the voltage between phases and neutral display, 2/15 screen.

[8] The PTR1 relay includes four LED indicators. If the voltage and phase sequence is correct, the top two LEDs (PWR-RV) will light up and the bottom two LEDs will remain off (OVER-UNDER). If this operating condition does not occur, it is recommended to contact the commercial technicians at Grupo Aguilera who manage the project and do not change the factory settings without prior permission.

[9] Check that all front switches are set to "0" and the emergency stop button is reset.

[10] Activate the A1 magneto-thermal switch, internal power supply (24Vdc). The current status will be displayed in the common and pump modules, and the local alarm will activate (press the mute button). Inside the panel, the PLC will be activated, the start-up indicators will come on, the control relay RP1 will be switched on, and the status repeater relays K1, K2, K3 and K4 are activated. The VFB1 frequency inverter must be off. The signs displayed on the front modules are as follows:

[10.1] Common module: Presence of voltage, start-up failure, not automatic, grouped alarm.

[10.2] Jockey pump and surge module: Protection trigger.

[10.3] Main pump module (in all cases): Protection trigger and Not automatic.

[11] Press the light test button and verify that all indicators are lit up.

[12] Activate the breakers (ON) and as they connect, individually check that the protection trigger signs disappear and that the voltage presence, DBC1 (priming pump), DBJ1 (Jockey pump), DB1 (main pump 1) are all activated. Verify that the frequency inverter turns on and the display shows 0000, DB2 (main pump 2), DB3 (main pump 3) and the magneto-thermal switch A2 (compressor). The main pump modules and the common module must continue to show "Not Automatic".

[13] Deactivate the main switch IG1, moving it to OFF.

[14] Close the door of the electrical panel.

[15] Activate the main switch IG1, position ON.

[16] Manually activate the float tank level float and check that the indicator displayed on the front shows "Low water level" and "Emergency stop".

[17] If the system includes limit switches on the valves of the suction and discharge manifolds, individually test each valve, checking that "Valve closed" and "Emergency stop" are displayed on the front.

[18] Recheck the positioning of the valves on the manifolds, outlet open tank, closed discharge (system outlet) and return is 100% open (wheel).

Before carrying out the equipment activation tests, it is essential to check the oil level for all positive displacement pumps through the viewer included. The optimum level is in the middle of the viewer. Excess oil will be removed by the pump safety valve and a low level will cause unnecessary heating. In the case of having to fill it up, SAE-20-40W oil will be used (see the pump features plate).

11.2.2.- Manual activation test.

The equipment manual activation test is always run regardless of the configuration of the equipment (dry, wet, mixed, etc.).

In general, it is important to note that the priming pump is activated at the same time as a manual or automatic start-up order is given from any other pump. As such, the signals will be sent simultaneously upon activation of any other pump.

[1] 100% Open the test valve (closed delivery valve). Set the front switches SB1, SB2, SB3, SBx (for pump module 1, 2, 3, etc., respectively) to "Manual".

[2] Press the "Start" button on pump 1. On the module itself and on the common one, it will show "Start-up command" and "Pressure start-up". Check that water returns to the tank through the access inlet. If the water does not return, press the emergency stop button. If it returns, repeat the process with pumps 2, 3, etc. individually checking the signs. Repetition relays K5 and K6 will be activated.

[3] The drive manifold will not maintain pressure if the test valve is 100% open. The pressure gauge and pressure transducer should indicate 0 bar.

[4] For the delivery manifold to reach pressure, the test valve (wheel) will slowly be closed until the pressure (140 bar) is reached. During this process, the pressure should be checked to ensure it increases on the transducer display and the gauge, verifying that there are no leaks in any hydraulic component of the equipment. Also, check the network analyser AR1 for the current per phase data (page 3/15).

[5] Stop each of the pumps with the "Stop" button and check that the status display responds to the order.

11.2.3.- Automatic activation test.

The automatic activation test depends on the type of system. As indicated in previous sections, different scenarios are considered:

a. Dry system, fully open.
b. Dry system with risks.
c. Wet system (closed).
d. Mixed system (dry with risks and wet).

Once the system is activated automatically, the process can only be stopped by turning the main switch IG1 to OFF.

In any case, we must take into account the following considerations:

If we press the emergency stop button, all pumps (ramp) will stop but not the operation process, so that if we reset the emergency stop button, the activation process will restart, regardless of whether the activation order is given or not.

If we set the pump switches to "0", the same process is maintained. When set instead to "automatic", the pump(s) will start working.

In summary, for a complete shutdown of the system set to activate automatically, the procedure is as follows:

[1] Press the emergency stop button or set one of the SB switches to "0".

[2] Turn the general power switch IG1 to "OFF".

[3] Reset the trigger that caused the activation of the system (demand, panel or fire control panel).

[4] Turn the power switch IG1 back to "ON" to restart the system.

The automatic activation tests must be performed in all cases with the equipment idle and stabilized (in wet or mixed systems), the SBx switches set to "AUTO", the emergency stop button reset, and the trigger circuits in operation (in wet or mixed systems).

11.2.3.1.- Automatic activation test for dry systems.

[1] Check that the discharge valve is closed and the return valve is open (100%).

[2] The equipment starts up when given an activation order (24Vdc) from the fire extinguishing panel, etc. The main pumps in the equipment will be activated gradually (activation slope) and the system is locked; as such, even if the start-up order disappears (24Vdc), the equipment will continue to be operational.

[3] Close the test valve slowly until the working pressure is achieved. Keep the system running for 10 minutes, checking phase currents (AR1, screen 3), temperature of the motor and pump.

[4] Once the test is finished, stop the system by pressing the emergency stop button, resetting the fire activation signal and turning the main switch IG1 to "OFF".

To run the system test (maximise all security measures), repeat the process closing the test valve and opening the valve of implusion (output and functioning)

11.2.3.2.- Automatic activation test for dry systems with risks.

[1] Check that the discharge valve remains closed and the valve return open (100%).

[2] The activation order (24Vdc) from the central fire extinguishing panel, etc. associated with a risk will activate the pilot assembly control circuit corresponding to the risk. So that the pressure equipment activation order is given, it must meet the following conditions:

a. Pressure equipment idle. If this is not the case, it will cause a blockage in the control trigger circuit if the minimum resources which guarantee the proper functioning of the system are not in operation.

b. Pressure in the pneumatic circuit> 4Bar.

c. Directional valve open when the associated risk is activated. The terminal contact will be closed (n/a when idle).

[3] When these conditions are met, the pilot assembly control circuit sends an activation signal to the PLC electrical panel and the main pumps in the equipment will be activated gradually (activation slope) depending on the risk demand and the system is locked; as such, even if the start-up order disappears (24Vdc), the equipment will continue to be operational.

[4] Check the physical correspondence of the risk activated with the directional valve which has been opened.

[5] Close the test valve slowly until the working pressure is achieved. Keep the system running for 10 minutes, checking the phase currents (AR1, screen 3), temperature of the motor and pump.

[6] After the first risk test has finished, stop the system by pressing the emergency stop button, reset the fire signal activation, set the main switch IG1 to "OFF" and close the associated directional valve.

[7] Turn IG1 to "ON" and repeat the process with the remaining risks.

To test the system (maximise all security measures) repeat the whole process, closing the testing valve and opening the discharge valve (output to system).

11.2.3.3.- Automatic activation test for wet system.

[1] Fully close the test and discharge valves.

[2] The SBJ switch (jockey pump) is set to ON, the pump start occurs automatically and stays on until a manifold pressure of 40 bar is achieved.

[2.1] Check status signal and verify that the start counter CNT1 has increased by 1 relative to the previous reading.

[2.2] Check the increased pressure on the gauge and on the pressure transducer display.

[2.3] After reaching the idle pressure (40 bar), the pump stops and the system is "stabilised" and ready to be started on demand. If the pressure drops slowly, the pump will activate again when it reaches a level of 35 bar, and will stop when it reaches 40 bar again. This process is repeated over time and causes an increase in the start counter CNT1.

[3] Having gained the stabilisation of the system (at 40 bar), set the switches SB1, SB2, SB3, SBx (for pumps 1, 2, 3, ..., respectively) to "AUTO". In this condition, the "Not Automatic" sign will disappear on each individual control module, as well as the common module "Grouped Alarm" and "Not Automatic" signs, the repeat relays, K2, K4, K5 and K6 must be idle.

[4] The system activation test in wet facilities is carried out on demand. It is initially performed in recirculation, slowly opening the test valve (return). Based on the opening (demand), each of the main pumps will be activated progressively (the Jockey pump should not work). When all main pumps are in operation, adjust the test valve (opening or closing) until the operating pressure (140Bar) is reached and hold it for 10 minutes, checking the phase currents (AR1, screen 3), temperature of the motor and pump.

[5] After the test, stop the machine by pressing the emergency stop button and then turn off the main switch IG1 to restart the system.

[6] To test the pressurisation system (maximise all security measures), open the discharge valve, fill the system and empty each branch using the corresponding test valves (system), channelling the water and collecting it in a container. Depending on the length, volume of water, etc. the pipes can be filled by manually activating a main pump since the jockey pump supplies a flow of 1 l/min. and the filling time can be excessive. Set the jockey pump switch to "0". This process will take place in conjunction with the test valve (equipment) to prevent a surge in pressure and with the system test valve (purge).

[7] When the system manifolds are filled with water and the circuits are purged, the following should be done:

a. Close the system purge valve.
b. Stop the pump which was activated manually and set its switch to automatic.
c. Close the equipment test valve.
d. Set the Jockey pump to automatic. This will remain operational until the pressure reaches 40 bar and the system will remain "stabilised" to be activated upon demand.

[8] Install a diffuser in the system test inlet and open the valve. The equipment should start working due to the working flow pressure (140 bar).

11.2.3.4.- Automatic activation test for mixed systems.

[1] Fully close the test and discharge valves.

[2] The SBJ switch (jockey pump) is set to ON, the pump start occurs automatically and stays on until a manifold pressure of 40 bar again.

[2.1] Check status signal and verify that the start counter CNT1 has increased by 1 relative to the previous reading.

[2.2] Check the increased pressure on the gauge and on the pressure transducer display.

[2.3] After reaching the idle pressure (40 bar), the pump stops and the system is "stabilised" and ready to be started on demand. If the pressure drops slowly, the pump will activate again when it reaches a level of 35 bar, and will stop when it reaches 40 bar again. This process is repeated over time and causes an increase in the start counter CNT1.

[3] Having gained the stabilisation of the system (at 40 bar), set the switches SB1, SB2, SB3, SBx (for pumps 1, 2, 3, ..., respectively) to "AUTO". In this condition, the "Not Automatic" sign will disappear on each individual control module, as well as the common module "Grouped Alarm" and "Not Automatic" signs, the repeat relays, K2, K4, K5 and K6 must be idle.

[4] Automatic activation test (local-return): For this example of a mixed configuration, which includes part of a wet installation to directional valves (risks), this section may include thermal opening diffusers (closed) and open from these valves to the rest of the system (open diffusers). As such, there are two activation modes, one on demand (loss of pressure) and another triggered by the fire detection system (risks).

[4.1] Activation test demand: Keeping the discharge valve closed, open the test valve (return). As it opens (demand), each of the main pumps will be activated progressively (the Jockey pump should not work). When all main pumps are in operation, adjust the test valve (opening or closing) until the operating pressure (140 Bar) is reached and hold it for 10 minutes, checking the phase currents (AR1, screen 3), temperature of the motor and pump. After the test, stop the machine by pressing the emergency stop button and then turn off the main switch IG1 to restart the system.

[4.2] Risk activation test (pilot assembly): Obviously, the manual or automatic opening of a directional valve will causes the system to activate due to pressure loss. The control of the risk activated requires the optimisation of the start-up time (activation slope) once the expected demand for each of the risks (hydraulic calculation) is known and programmed in the PLC. The correspondence test for the activated risk with the directional valve can be performed with stabilised equipment (idle) by closing the discharge valve and opening the directional valve terminal opening confirmation, since in this condition, upon generation of an activation order by the corresponding risk in the control circuit of the pilot assembly, the directional valve will be pneumatically activated but the control circuit will not send the activation order signal to the electrical panel PLC. This operation must be repeated for all risks.

[5] System automatic activation test: To test the pressurisation system (maximise all security measures), open the discharge valve, fill the system and empty each branch using the corresponding test valves (system), channelling the water or collecting it in a container. Depending on the length, volume of water, etc. the pipes can be filled by manually activating a main pump since the jockey pump supplies a flow of 1 l/min. and the filling time can be excessive. Set the jockey pump switch to "0". This process will take place in conjunction with the test valve (equipment) to prevent a surge in pressure and with the system test valve (purge).

[6] When the system manifold is filled with water and the circuit is purged, the following operations will be performed:

a. Close the system purge valve.
b. Stop the pump which was activated manually and set its switch to automatic.
c. Close the equipment test valve.
d. Set the Jockey pump to automatic. This will remain operational until a pressure of 40 bar is reached and the system will be "stabilised" and ready for activation upon demand due to flow or risk.

To test the system (maximise the security measures), repeat the process specified under point 11.2.3.2.- Automatic activation test for dry system with risks, and point 11.2.3.3.- Automatic activation test for wet system.

12 Maintenance protocol

In this industry, maintenance tasks are designed to prevent and correct any faults, breakages and damages which may arise during the use of different equipment.

This chapter is structured according to the element where maintenance is performed in a logical order and in inspecting them.

Keep in mind that not all equipment operates under the same conditions, so regardless of the maintenance plan applied, correct usage and care will help keep it properly functioning and will avoid any possible damage to the entire system, equipment and the facilities.

Maintenance tasks should be performed at a minimum frequency of once a year, although this should be less frequent in some cases depending on the specific characteristics of each facility and on the requirements of those responsible for maintenance and safety of the location.

All maintenance tasks are always performed using the appropriate tools for the job. All protection must be taken where considered suitable for this use as well as all precautionary measures required from the point of view of individual and collective prevention as well as assets to protect.

12.1.- PUMP ROOM.

[1] The pump room should be clean and free of objects which are not used there.

[2] Visually inspect the general condition of the pump assembly, banks, electrical panel, water container, connecting pipes, valves, manifolds, compressor, pneumatic circuit, directional valves, etc. Any anomaly detected during this inspection must be corrected prior to any tests being run on the pumping equipment.

12.2.- WATER CONTAINER.

[1] The water in the tank should be clean to avoid it dirtying the system upon activation which could cause clogging of the diffusers.

Therefore, a visual check of the condition of the stored water prior to starting up the equipment is essential. If any dirt is found, it must be cleaned through the inlet provided for this purpose with the resources considered adequate.

[2] If the above operation does not succeed in cleaning the tank, it must be emptied through the valve for this purpose and it must be cleaned from the inside by access through the inlet.

[3] Clean the tank inlet filter.

[4] Manually move the inlet float valve to ensure that the opening and closing operation is correct.

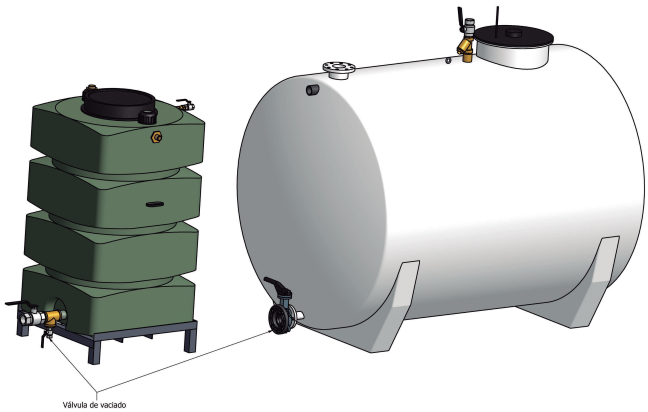


Figure 22: Drain valves

[5] Move the ball valves in the tank's input, drain and output circuits, repeatedly opening and closing it to verify that the operation goes smoothly. Once complete, ensure that all valves are in the correct position.

Prior to filling it with water, in cases where it is partially or completely emptied, at least the installation, intake and delivery manifolds should also be emptied depending on the state of the pressurised water. This operation will always be done through the system's drain valve and never through the equipment return manifold through the test valve.

Prior to filling it with water, in cases where it is partially or completely emptied, at least the installation, intake and delivery manifolds should also be emptied depending on the state of the pressurised water. This operation will always be done through the system's drain valve and never through the equipment return manifold through the test valve.

12.3.- PUMPING EQUIPMENT.

Prior to carrying out the equipment operating test, a series of checks and operations on different elements of the equipment must be carried out first.

[1] Set to "SB" switches to "0" on all main pump modules and "SBJ" for the Jockey pump (wet or mixed systems).

[2] Carry out a general readjustment of the bolts, etc., securing the pumps to the chassis, manifold supports, pressure transducer, pressure gauge, pulse damper, etc. (Stauff).

[3] In equipment with >3 pumps, close the outlet valve of the tank, open the drain valve of the intake manifold and drain the water contained therein. Once the operation is complete, close the drain valve and keep the outlet valve of the tank closed for the next test.

[4] Clean the inlet filter of the in take manifold (on some equipment with <3 pumps, a filter may be included per pump).

[5] Move the intake and discharge manifold ball valves repeatedly, opening to closing them to verify that the operation can be performed without any problems.

[6] Open the tank outlet valve.

[7] Check the oil level through the viewer that incorporates each of the main pumps and jockey pump in wet or mixed systems.

[8] Set the main switch IG1 and the mains protection elements to 0-OFF. Once verified that there is no voltage from the mains supply, carry out a general retightening of the electrical contacts in the cabinet with the appropriate tools. Perform this operation at least once every two years on the switching and signalling circuits and once a year on power lines. Once the retightening is finished, set all mains protection elements and the main switch on the electrical panel of the equipment to "I-ON".

[9] Check that the earth connecting lines (PE) of the electrical box, bench and pipe network are correct.

[10] Check the fan operation of the electrical panel, setting the thermostat.

12.4.- DIRECTIONAL VALVES.

[1] Check the compressor power connection.

[2] Check the compressor fittings.

[3] Check the compressor oil level and filter.

[4] Check the compressor pressure gauge shows between 6 and 8 bar.

[5] Check the pneumatic circuit from the compressor to the pilot assembly cabinet and each of the directional valves for each risk.

[6] In wet or mixed installations, drain the piping section that goes from the discharge manifold outlet valve to the directional valves. This must be carried out through the system's drain valve and never through the equipment.

[7] Repeatedly activate and reset each of the fire detection, fire extinguishing panel valves, etc. checking that they work properly and the correspondence of the risk triggered by the opening of the directional valve associated with that risk is also correct.

[8] After verifying the activation of each of the directional valves, make sure they are all closed and are well-labelled.

[9] In the pilot assembly control circuits, check:

a) The pneumatic circuit pressure confirmation switch (if incorporated), closing the outlet valve of the compressor and causing a loss of pressure in the circuit, disconnecting the air from the pilot assembly of one of the directional valves, and activating the trigger circuit from the fire system (see 8.2). The DL1 LED should go out. Once this test is complete, reconnect the pneumatic circuit tube and open the compressor valve.

b) Service signal (see 8.2): the DL4 LED should be off when the electrical panel is not operational, e.g. with the switches turned to position "0".

c) Check all other internal indicators (see 8.2) by setting the input and output lines of each of the risks.

12.5.- SYSTEM RESOURCES.

[1] Check the fixings for the piping sections, retightening them where applicable.

[2] Check all drain and test valves, opening and closing them several times and ensuring there are no problems. Once done, ensure they are closed.

[3] Check that the diffusers installed are not blocked in any way and have not accumulated any dirt.

[4] Check the status of the diffuser filter with a random sampling. If an accumulation of dirt, rust, etc. is observed, there should be a general 100% cleaning of them.

12.6.- PERFORMANCE TESTING.

[1] Perform specific tests for each type of system as listed in Chapter 11 Instructions for start-up.

[2] During the maintenance tests, the equipment will remain working in recirculation (test valve) with the tank inlet open:

a) For 15 minutes at 0 bar pressure, to oxygenate the water if the tank has not been emptied.
b) For 30 minutes at the working pressure.
c) Overpressure test. With all the pumps in operation at the working pressure, the test valve will be closed slowly to see if an emergency stop is produced due to overpressure.
d) Close the deposit's "inlet" access.

12.7.- CLEANING.

[1] If applicable, clean the inside of electrical panel (maximise all security measures). This will always be done without the presence of voltage, disconnecting the low-voltage mains protection circuits (MSBs) and the main switch cabinet.

[2] Clean the internal ventilation grid filters.

[3] After cleaning inside the electrical panel, reconnect the mains protection circuitry and the main switch (IG1).

[4] Clean the exterior of the equipment using appropriate products for each resource and taking care not to use abrasive products when cleaning the network analyser display, the pressure transducer display, and the control panel vinyl.

12.8.- TESTING SUMMARY.

1 Month.	ü ü ü	Visual inspection of the pump room. Visual inspection of the equipment, electrical panel, controls and signs. Visual inspection of the pilot assembly.
3 Months	ü ü ü	Inspection of the fire detection system trigger circuits. Check the pneumatic circuits (directional valves, risks). Check the Jockey pump start counter.
6 Months	ü ü ü ü ü ü	Clean the resources that make up the pump assembly. Clean the filters, water container inlet, intake manifold and pumps where included. Manual start-up of equipment in circulation at 0 bar pressure for 10'. Manual start-up of equipment in circulation at working pressure for 10'. Automatic system operation test. Repeatedly perform the process of opening and closing each of the ball valves.
1 Year.	ü	Complete maintenance protocol.
2 Years.	ü	Retighten the electric circuit switching and signalling connections.
5 Years.	ü	Check the PLC battery.

A copy of the reports regarding any hydraulic testing, implementation, preventive and corrective maintenance, etc. carried out will be included in the equipment maintenance record.

13 Troubleshooting

13.1.- HYDRAULIC CIRCUIT.

Nº	FAILURE	POSSIBLE CAUSE	MEASURES
1	Water is not reaching the tank.	Water supply failure. Inlet valve closed. Faulty float valve.	Check previous valves. Open valve. Replace valve.
2	When purging the discharge circuit, there is no water coming out.	No water in the tank. Tank outlet valve closed. Intake manifold return valve installed backwards.	Fill the tank. Open valve. Install the valve correctly.
4	When performing a pump circulation operation test, there is no water going from the return manifold to the tank. The discharge valve is closed.	There is no water in the discharge manifold. The surge pump is turning backwards. The pump or delivery manifold is not purged.	Check for water in the tank and outlet valve. Contact Aguilera. Purge the system to remove air from the manifold or pump.
5	When activating a pump test (circulation), it seems to stutter.	Air in the intake circuit.	Purge the intake manifold or revise the section of the inlet pipeline.
6	In an open system, the trigger circuit is activated. The systems starts up but does not pressurise.	Test valve open.	Close test valve
7	When a risk is activated, the directional valve opens but the equipment does not start.	No confirmation signal at the end of the terminal (open) of the directional valve. If no terminal is installed, the status check circuit is open.	Check the valve confirmation wiring in the pilot assembly. Bridge the open input valve confirmation circuit in the corresponding pilot assembly.
8	The Jockey pump will not pressurise the system.	The test valve is not properly closed. There are leaks in the system circuits. Other.	Close the test valve properly. Check the system layout and correct leaks. Contact Aguilera.
9	With all pumps running, the system does not reach the working pressure.	The test valve is not properly closed. The regulating valve is malfunctioning. Excessive demand.	Close the test valve properly. Do not handle. Contact Aguilera. Check the working pressure in the project notes and contact Aguilera.
10	With the discharge and test valves closed, the Jockey Pump starts too frequently.	Pressure loss in the delivery manifold.	Check the test, discharge, pump return and regulating valves. Transducer connecting tube, pressure gauge or pulse damper. Contact Aguilera.

13.2.- ELECTRICAL CIRCUIT.

Nº	FAILURE	POSSIBLE CAUSE	MEASURES
1	When turning on the main switch, the cabinet does not activate.	Lack of voltage. Fuses blown.	Check supply. Check fuses, F1 - F10.
2	When activating the general switch, the network analyser display AR1 is not lit up, though the relay PTR1 is.	Failure in the power circuit.	Check fuses F9 and F10.
3	When turning on the main switch, the network analyser AR1 display turns on, but the relay PTR1 does not.	Fault in the measurement protection circuit.	Check fuses F5 - F8.
4	The cabinet fan does not work.	Fuse blown. Failure in the thermostat. Failure fan	Check fuse F11. Check thermostat. Check voltage 230Vac.
5	No output voltage to power the compressor.	Lack of power supply on the A2 circuit.	Activate A2 magneto-thermal circuit.
6	The cabinet indicates an emergency stop but the emergency stop button is reset.	PLC operating failure. The priming pump is not operational. Low water level. Intake and/or discharge valves are closed.	Check RP1 relay, active OK. Activate breaker DBC1. Fill the water tank. Check the valves are open.
7	The control panel has no signs but the display does.	Pressure transducer disconnected. Lack of power supply to circuit A1. Faulty power supply FA1.	Insert into connector. Activate magneto-thermal circuit A1. Check input and output 230Vac / 24Vdc source.
8	The centrifugal surge pump is turning backwards.	Inverted phase	Do not handle. Check PTR1 and consult Aguilera.
9	All pump modules have the protection trigger signs lit up.	Protection breaker set to position 0-OFF.	Set DBx breakers to I-ON.
10	The main pump module indicates a protection trigger and the breaker is in position I-ON	Failure in the auxiliary contacts of the corresponding circuit breaker DBx.	Check the insertion of the auxiliary contacts in the breaker. If correct, order a spare from Aguilera.
11	The main pump 1 fails to start manually or automatically. It indicates the presence of voltage but has a start-up failure.	Faulty connection. Fault in the inverter (if installed) or the smooth starter system.	Check the connection to the pump. If it includes a drive, check the error code on the display and consult in both cases.
12	When activating the main switch IG1, the Jockey pump will not start. There is no protection trigger signage.	Delivery manifold pressure> 40 bar.	Reduce discharge manifold pressure, range 35-40 Bar.
13	The Jockey pump module signals a protection trigger. The breaker is in position I-ON.	Failure in the auxiliary contacts of circuit breaker DBJ1. Triggering of thermal relay (motor protector).	Check the insertion of the auxiliary contacts in the breaker. Reset the contact and check consumption.
14	A pump SB switch does not work.	Fault in auxiliary contacts. Fault in the control circuit.	Check the contacts are inserted properly and consult Aguilera.

13.2.- PNEUMATIC CIRCUIT.

Nº	FAILUR	POSSIBLE CAUSE	MEASUR
1	The compressor does not start with a pressure <6 bar.	Failure in the power circuit. The compressor is defective.	Check voltage at inlet. Magneto-thermal protection circuit A2. Do not handle. Contact Aguilera.
2	The compressor indicates a pressure of 8 bar but there is no pressure in the pilot assembly pneumatic circuit.	The compressor's outlet valve is closed.	Open the compressor outlet valve.
3	The compressor will not stop running.	Broken or disconnected pneumatic circuit pipe from the compressor to the pilot assembly.	Review the installation and repair the break or connect the pipe if it has been disconnected.
4	When a risk is activated, another directional valve opens.	Error in correspondence for the electric or pneumatic circuit.	Review correspondence for the electric or pneumatic circuit.
5	When a risk is activated, the directional valve will not opened.	If the solenoid is activated, the air outlet tube is broken or disconnected. The hydraulic valve is stuck. The pneumatic valve is defective.	Review the installation and repair the break or connect the pipe if it has been disconnected. Replace directional valve. Replace directional valve.
6	A directional valve cannot be manually reset.	The pneumatic solenoid is activated by the fire system.	Reset the fire panel.

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