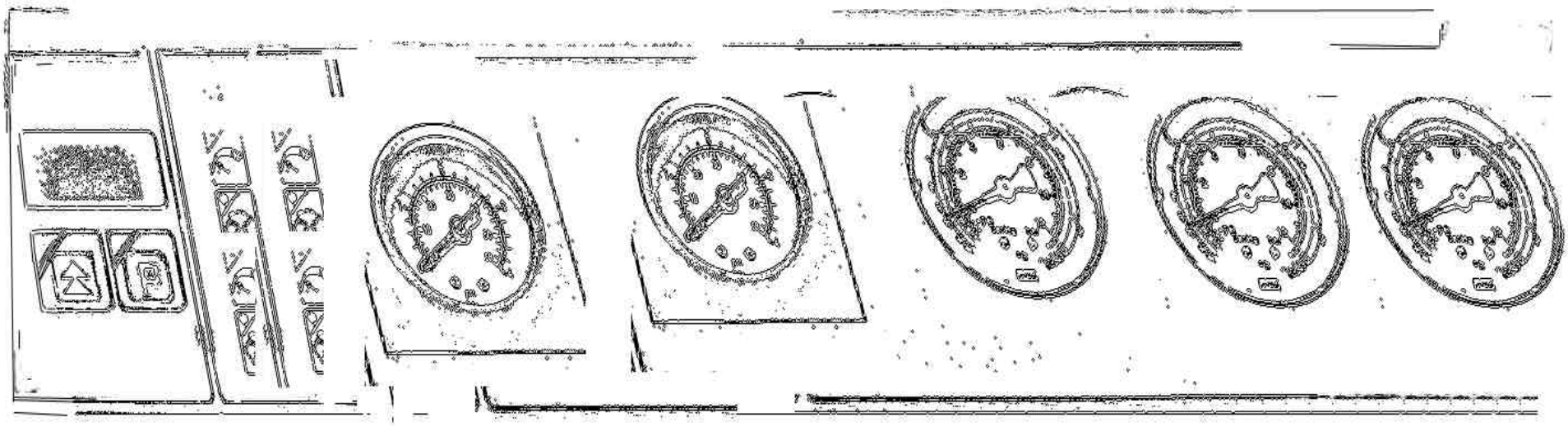
Refrigeratori d'acqua

Water Chillers

TAE / TAS / TWE / TWS 202- 252 - 302

TAE / TAS 402 - 502 - 602



Manuale di istruzione e manutenzione

Maintenance and operating manual

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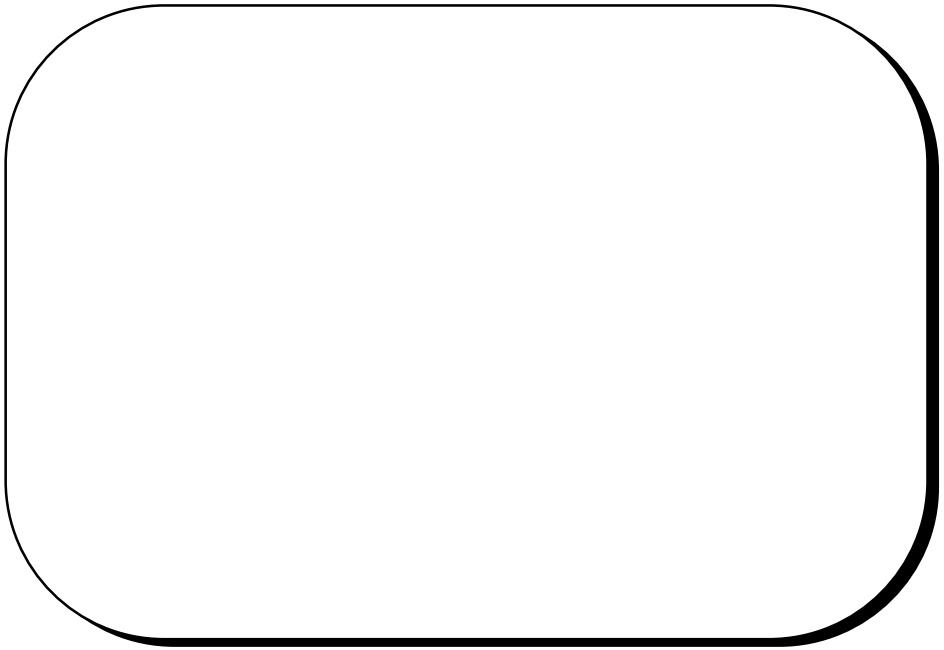
Refrigeratori acqua

Water chillers



Manuale di istruzione e manutenzione

Maintenance and operating manual

QUICK REFERENCE GUIDE "STAGE 3"

The machines have an electronic control panel programmed by buttons. This control panel controls the operation of refrigerant circuits basing on the measured control parameters.

- **P2** ON/OFF button with associated led
- **P3** leds and display button
- **P4** button to adjust parameters
- **P5** programming button (See Below)

CONTROL PARAMETERS

- **Cooling water outlet temperature (B1):** Temperature normally displayed.
- **Evaporator water outlet temperature (B2):** To display B2, when B1 is displayed, it is necessary to push P4. This temperature is used as an antifreeze thermostat.

WORKING PRINCIPLE:

The unit chill the water until its temperature (B1) reach the fixed value (SEt). The compressor stops; it restarts when B1 is higher than the fixed value which is called delta (d IF).

SET POINT (SEt)	DIFFERENTIAL (d IF)	STOP 1ST step	START 1ST step	STOP 2ND step	START 2ND step
9 °C	2 °C	SEt - d IF = 7°C	SEt = 9 °C	SEt = 9 °C	SEt + d IF = 11 °C

NOTE: If SEt - d IF are set at a value <7°C, the water circuit must appropriately be protected with antifreeze fluid (see instructions in the manual).

CHANGE THE (B1) WATER OUTLET TEMPERATURE SET POINT (SEt) AND THE DIFFERENTIAL (d IF)

1) The display must show temperature B1;
2) Push P5 for 5 seconds: the set point value will flash;
3) Change the value by using P4 button;
4) Push P5, the differential value flashes, adjust by using P4 button;
5) Push P5, the control board saves the new instructions (after the Sto inscription, the display returns to value B1).

ALARMS

The display shows the following flashing alarm codes:

CODES		LED	DESCRIPTION
SA1	(1)		B1 sensor in open circuit (T< -40°C)
SC1	(1)		B1 sensor in short circuit (T> +90°C)
LA1	(5)		low cooling water outlet temperature
HA1	(3)		high cooling water outlet temperature
SA2	(1)		B2 sensor in open circuit (T< -40°C)
SC2	(1)		B2 sensor in short circuit (T> +90°C)
LA2	(5)		evaporator low water outlet temperature
HA2	(3)		evaporator high water outlet temperature
AAA	(1)	+ I°	high pressure switch - circuit 1 (HP1)
AAA	(1)	+ II°	high pressure switch - circuit 2 (HP2)
AAA	(1)	+ I°	low pressure switch - circuit 1 (LP1)
AAA	(1)	+ II°	low pressure switch - circuit 2 (LP2)
AAA	(2)		low water level
AAA	(4)		pump overload
AAA	(4)	⚠A	only TAE/TWE: spare alarm intervention "I°" delayed as requested by SET-UP procedure IAd parameter
AAA	(4)	⚠A+I°+PI	only TAS/TWS: Complete protection (PI) - circuit 1 - alarm intervention, delayed as requested by SET-UP procedure, IAd parameter
AAA	(4)	⚠A+II°+PI	only TAS/TWS: Complete protection (PI) - circuit 2 - alarm intervention, delayed as requested by SET-UP procedure, IAd parameter
AAA	(4)	⚠A+I°+PO	only TAS/TWS: Oil pressure switch (PO) - circuit 1 - alarm intervention delayed as requested by SET-UP procedure, IAd parameter
AAA	(4)	⚠A+II°+PO	only TAS/TWS: Oil pressure switch (PO) - circuit 2 - alarm intervention delayed as requested by SET-UP procedure, IAd parameter
EEA			see description below
EEE			see description below

(1): Stopping alarms with manual reset which don't interrupt the pump operation.
(2): Stopping alarms automatic reset which interrupt the pump operation.
(3): Non stopping alarms with automatic reset.
(4): Stopping alarms with manual reset which interrupt the pump operation.
(5): Stopping alarms with automatic reset which don't interrupt the pump operation.

INDEX

ANNEXES

GENERAL INFORMATION

The machines described in this manual are called "WATER REFRIGERATORS" or simply "REFRIGERATORS".

This manual is written for those responsible for the installation, use and maintenance of the refrigerator.

These refrigerators have been designed to cool a liquid flow.

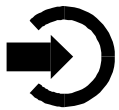
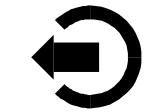
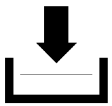
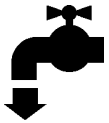
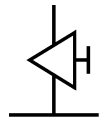
In most applications, the liquid to be cooled is water and the term "WATER" will be used even if the liquid to be cooled is different from water (e.g. a mixture of water and glycol).

The liquid to be cooled must be compatible with the materials used. This analysis must be made before purchasing or installing the refrigerator.

Here below the term "pressure" will be used to indicate the gauge pressure.

All parts of the text which are important for the SAFETY of persons and property are written in bold face and highlighted by the symbol shown here on the right. This symbol is also printed near the title of sections or paragraphs concerning safety.

The following symbols are shown on the stickers on the unit as well as on the overall dimension drawing and refrigeration circuits in this manual. Their meaning is the following:

	Cooled water inlet		Cooled water outlet
	Water inlet (for water cooled units)		Water outlet (for water cooled units)
	Heat recovery device water inlet (for special units only)		Heat recovery device water outlet (for special units only)
	Indications for lifting the unit		Water drainage point from the machine
	Water filling point		Cooling air flow (for air-cooled units)
	Direction of the refrigerant gas flow		Direction of fan rotation (for air cooled units)
	Electric shock risk		Air vent

How to interpret the MODEL

MODEL	DESCRIPTION
T • • X X 2	
	refrigerator with two refrigerating circuits indicative power of the refrigerator compressor in hp
	E = hermetic type compressor S = semi-hermetic type compressor
	A = condenser cooled by ambient air W = condenser cooled by water
	T = “tank”; refrigerator with accumulator tank.

How to interpret the CODE

CODE	
/P0	with pump type P0: with a working head of about 2.5-3 bar
/P1	with pump type P1: with a working head of about 4.5-5 bar
/P2	with pump type P2: with a working head of about 0.6-1 bar
/P15	with pump type P15 with a working head of about 1.5 bar +/- 0.3
/C	with centrifugal fans
/M	with high and low pressure gauges for refrigerant pressure
/BV	with low-speed axial fans
/NP	without pressostatic water valve
/NF	tank in stainless steel, non-ferrous materials in contact with cooled water
/KA	with automatic filling kit already installed for operation with tank under pressure
/KT	with can kit installed for operation with tank at atmospheric pressure
/KG	with kit installed for filling the water-glycol mixture
/PQ	with distribution board protection installed

This manual provides the user, installer and maintenance technician with all the technical information required for installation, operation and carrying out routine maintenance operations to ensure long life.
If spare parts are required, this must be original. Requests for SPARE PARTS and for any INFORMATION concerning the unit must be sent to the distributor or to the nearest service centre, providing the MODEL and MACHINE NUMBER shown on the machine data plate and on the first page of this manual.

A - SAFETY

This machinery was designed to be safe in the use for which it was planned provided that it is installed, started up and maintained in accordance with the instructions contained in this manual.
The manual must therefore be studied by all those who want to install, use or maintain the machinery.
The machine contains electrical components which operate at the line voltage, and also moving parts.
It must therefore be isolated from the electricity supply network before being opened.
All maintenance operations which require access to the machinery must be carried out by expert or appropriately trained persons who have a perfect knowledge of the necessary precautions.

GENERAL

When handling or maintaining the unit and all auxiliary equipment, the personnel must operate with care observing all instructions concerning health and safety at installation site.
Most accidents which occur during the operation and maintenance of the machinery are a result of failure to observe basic safety rules or precautions. An accident can often be avoided by recognising a situation that is potentially hazardous.
The user should make sure that all personnel concerned with operation and maintenance of the unit and all auxiliary equipment have **read** and **understood** all warnings, cautions, prohibitions and notes written in this manual as well as on the unit.
Improper operation or maintenance of the unit and auxiliary equipment could be dangerous and result in an accident causing injury or death.
Do not operate the unit and auxiliary equipment until the instructions in the Operating section of this manual are understood by all personnel concerned.
Do not carry out any servicing, repair or maintenance work on the unit and auxiliary equipment until the instructions in the relevant sections of this manual are clearly understood by all personnel concerned.
We cannot anticipate every possible circumstance which might represent a potential hazard. The warnings in this manual are therefore not all-inclusive. If the user employs an operating procedure, an item of equipment or a method of working which is not specifically recommended, he must ensure that the unit and auxiliary equipment will not be damaged or made unsafe and that there is no risk to persons or property.

GENERAL PRECAUTIONS

Liquids to be cooled

The liquids to be cooled must be compatible with the materials used.
These can be water or mixtures of water and glycol, for example.
In case of distilled or demineralized water, pay attention to the compatibility with the materials and to the minimum conductivity that lever sensor may relieve **(80 µS).**
The addition of anti-corrosive chemical additives and operating in a pH range between 7 and 8 is recommended.
Even in the case of glycol mixtures, the use of appropriate chemical additives (consult the glycol supplier) is very important to protect the refrigerator materials from possible corrosion caused by the chemical degradation to which glycol is subject.
The use of chemical additives is necessary when any part of the hydraulic circuit the refrigerator is part of is open to the atmosphere. In this case, in fact, the continuous supply of oxygen facilitates possible corrosive reactions inside the refrigerator.
The liquids to be cooled must not be flammable.
If the liquids to be cooled or heated contains dangerous substances (e.g. ethylene glycol) is very important to collect any liquid which leaks because it could cause damages to the ambient.
Furthermore, when the refrigerator is no longer used, dangerous liquids must be disposed of by firms specialised and authorised for treating them.

Lifting and carriage precautions

Avoid injury by using a hoist to lift heavy loads. Check all chains, hooks, shackles and slings are in good condition and are of the correct capacity. They must be tested and approved according to local safety regulations. Cables, chains or ropes must never be applied directly to lifting eyes. Always use an appropriate shackle or hook properly positioned. Arrange lifting cables so that there are no sharp bends.
Use a spreader bar to avoid side loads on hooks, eyes and shackles. When a load is on a hoist stay clear of the danger area beneath and around it. Keep lifting acceleration and speed within safe limits and never leave a load hanging on a hoist for longer than is necessary.
Handling the refrigerators using fork-lift trucks must be carried out in accordance with the drawings in annexes **A-003**.

Installation precautions

For the connection to the electrical net see chapter D- INSTALLATION.

Precautions during operation

Operation must be carried out by competent personnel under a qualified supervisor.
All the cooled water or cooling water piping must be painted or clearly marked in accordance with local safety regulations in the place of installation.
Never remove or tamper with the safety devices, guards or insulation materials fitted to the unit or auxiliary equipment.
All electrical connections must comply with local codes. The unit and auxiliary equipment must be earthen and protected by fuses against short-circuits and overloading.
When mains power is switched on, lethal voltages are present in the electrical circuits and extreme caution must be exercised whenever it is necessary to carry out any work on the electrical system.
Do not open any electrical panels or cabinets or touch any electrical components or associated equipment while voltage is applied unless it is necessary for measurements, tests or adjustments. Such work should be carried out only by a qualified electrician equipped with the proper tools and wearing appropriate body protection against electrical hazards.

Maintenance precautions

Maintenance, overhaul and repair work must be carried out by competent personnel under a qualified supervisor.
When disposing of parts and waste material of any kind make sure that there is no pollution of any drain or natural water-course and that no burning of waste takes place which could cause pollution of the air. Protect the environment by using only approved methods of disposal.
If replacement parts are needed use only original spares.
Keep a written record of all maintenance and repair work carried out on the unit and auxiliary equipment. The frequency and the nature of the work required over a period can reveal adverse operating conditions which should be corrected.
Use only refrigerant gas specified on the specification plate of the unit.
Make sure that all instructions concerning operation and maintenance are strictly followed and that the complete unit, with all accessories and safety devices, is kept in good working order.
The accuracy of pressure and temperature gauges must be regularly checked. They must be renewed when acceptable tolerances are exceeded.
Keep the machine clean at all times. Protect components and exposed openings by covering them, for example, with clean cloth or tape during maintenance and repair work.
Do not weld or carry out any operation which produces heat near a system which contains oil or flammable liquids. The systems which may contain oil or flammable liquids must be completely drained and cleaned (with steam, for example), before carrying out these operations. Never weld, nor modify in any way, a vessel which may be put under pressure.
To prevent an increase in working temperature, inspect and clean heat transfer surfaces (i.e. condenser cooler fins) regularly. For every unit establish a suitable time schedule for cleaning operations.
Avoid damage to safety valves and other pressure relief devices. Avoid plugging by paint, oil or dirt accumulation.

Precautions must be taken when carrying out welding or any repair operation which generates heat, flames or sparks. The adjacent components must always be screened with non-flammable material and if the operation is to be carried out near any part of the lubrication system, or close to a component which may contain oil, the system must first be thoroughly purged, preferably by steam cleaning.
Never use a light source with an open flame to inspect any part of the machine.
Before dismantling any part of the unit ensure that all heavy movable parts are secured.
When a repair has been completed, make sure no tools, loose parts or rags are left in, or on the machine. Check the direction of rotation of electric motors when starting up the unit initially and after any work on the electrical connections or switch gear.
All guards must be reinstated after carrying out repair or maintenance work.
Do not use flammable liquid to clean any component during operation. If chlorinated hydrocarbon non-flammable fluids are used for cleaning, safety precautions must be taken against any toxic vapours which may be released.

Before removing any panels or dismantling any part of the unit, carry out the following operations:

Isolate the dryer unit from the main electrical power supply by disconnecting the cable from the electrical power source.
Lock the isolator in the "OFF" position with a lock.
Attach a warning label to the main isolator switch conveying: “WORK IN PROGRESS - DON NOT APPLY VOLTAGE”. Do not switch on electrical power or attempt to start the unit if a warning label is attached.

REFRIGERANT GASES

R22, R134a and R407C are used as refrigerants in these units.
Never attempt to mix refrigerant gases.
To clean out a very heavily contaminated refrigerant system, e.g. after a refrigerant compressor burnout, a qualified refrigeration engineer must be consulted to carry out the task.
The manufacturer's instructions and local safety regulations should always be observed when handling and storing high pressure gas cylinders.

B - TECHNICAL DATA

MEANING OF ABBREVIATIONS

The main technical data are given on the machine data plate.

MODEL and CODE	The model number and the code identify the size of the unit (see chapter GENERAL INFORMATION) and the type of construction.
MANUAL	This is the code number of the manual.
SERIAL NUMBER	This is the construction number of the unit.
MANUFACTURING YEAR	This is the year of the final test of the unit.

VOLTAGE/PHASE/FREQUENCY	Electric alimentation characteristics.
MAX. CONSUMPTION I_{MAX}	This is electrical current consumed by the unit during the limit working conditions (refrigerant condensing temperature is 65°C = 149°F; refrigerant evaporating temperature is 10°C = 50°F).
INSTALLED POWER P_{MAX}	It is the power absorbed by the unit during the limit working conditions (refrigerant condensing temperature is 65°C = 149°F; refrigerant evaporating temperature is 10°C = 50°F).
PROTECTION	As defined by the EN 60529 European standard.

REFRIGERANT	This is the refrigerant fluid in the unit.
REFRIGERANT QUANTITY	This is the quantity of refrigerant fluid contained in the unit.
MAX. COOLING PRESSURE	This is the design pressure of the refrigeration circuit.
MAX. COOLING TEMPERATURE	This is the design temperature of the refrigeration circuit.

USER CIRCUIT FLUID	Fluid cooled by the unit (normally water).
MAX. COOLING PRESSURE	Max. design pressure of the user circuit.
MAX. TEMPERATURE	Design temperature of the user circuit; this should not be confused with the maximum working temperature which is established when the offer is made.

CONDENSER COOLING FLUID	Fluid used by the unit to cool the condenser (this data is not present if the unit is air cooled condensed).
MAX. COOLING PRESSURE	Max. design pressure of the condenser cooling circuit (this data is not present if the unit is air cooled condensed).
MAX. TEMPERATURE	Max. design temperature of the condenser cooling circuit (this data is not present if the unit is) air cooled condensed).

SOUND PRESSURE LEVEL	Sound pressure level in free field in hemispheric irradiation conditions (open field) at a distance of 1m from the unit, condenser side, and at a distance of 1.2 m from the ground.
AMBIENT TEMPERATURE	Min. and max. cooling air temperature value.
WEIGHT	This is the approximate weight of the unit before packing.

On the wiring diagram you will find the following abbreviations(see the first column in the table above) :

I_M = max. electric current;
P_M = max. power;
I_{LR} = electric current with rotor stopped;
I_n = nominal electric current;
I_{cn} = nominal failure current;

The performance of the refrigerant depends principally on the flow rate and temperature of the refrigerated water and on the temperature of the condenser cooling fluid (ambient temperature or water input temperature respectively, depending on whether the condenser is air or water-cooled). These data are defined in the offer and it is to these that reference should be made.

Other data relative to the standard machine.

MODEL TAE/TWE/TAS/TWS			202	252	302	TAE/TAS 402	TAE/TAS 502	TAE/TAS 602
TANK CAPACITY		[litres]	400	400	400	600	600	600
PUMP P0	water flow rate	[m3/H]	7.6/18	9.8/18	11.3/30	14.8/42	18.5/72	22.3/72
	available head	[bar]	2.8/1.7	2.7/1.7	2.2/0.8	3.7/2.1	3.15/1.23	3.10/1.20
	absorbed power	[kW]	1.85	1.85	1.85	4	5.5	5.5
PUMP P1	water flow rate	[m3/h]	7.6/30	9.8/30	11.3/30	14.8/33	18.5/54	22.3/54
	available head	[bar]	4.7/2.2	4.6/2.2	4.5/2.2	6.3/4.4	5.8/2.3	5.9/2.3
	absorbed power	[kW]	3.7	3.7	3.7	9.2	11	11
PUMP P2	water flow rate	[m3/h]	7.9/22.3	9.8/22.3	11.3/22.3	14.8/42	18.5/42	23.2/42
	available head	[bar]	0.97/0.18	0.91/0.18	0.85/0.2	1.16/0.2	1.1/0.2	1.0/0.2
	absorbed power	[kW]	0.81	0.81	0.81	1.47	1.47	1.47
PUMP P15	water flow rate	[m3/h]	7.6/17	9.8/17	11.3/24	14.8/36	18.5/36	23.2/36
	available head	[bar]	1.6/0.9	1.5/0.9	1.5/0.7	1.38/0.78	1.35/0.78	1.27/0.78
	absorbed power	[kW]	0.75	0.75	1.1	1.5	1.5	1.5
CENTRIFUGAL FANS	number	[n.]	3	3	3	2	2	2
	available head	[Pa]	274/315	83/215	84/244	40/213	54/213	54/190

Notes:

- the head is the head available to the user;
- it is possible for the pump installed to be different from the standard. In this case reference should be made to the data in the offer;
- two numbers are given for the flow rate and the head of each pump; the first number refers to the nominal conditions while the second refer to the maximum conditions. E.g.: for model TAE 202 with pump P0, the nominal flow rate is 7.6 m3/h corresponding to an available head of 2.8 bar while the maximum flow rate which must not be exceeded is 18 m3/h corresponding to an available head of 1.7 bar.

Choking:
All models can be 50% choked.

C - DESCRIPTION

OPERATING PRINCIPLE

All the refrigerators described in this manual work on the basis of the same principle. A cooling circuit cools the finned surface of an evaporator enclosed in a tank through which the liquid to be cooled passes.
The cooling compressor is controlled by an electronic control unit which controls the output temperature of the water from the refrigerator to maintain it within the preset limits.

MATERIALS

The data relating to the materials refer to standard machines. To meet particular requirements it is possible for materials different from the standard ones to be used. In this case it is necessary to refer to the data on the offer.

Casing:

Built with galvanised panels and painted with epoxy resins.

Materials in contact with the liquid to be cooled:

The materials in contact with the liquid to be cooled can belong to two different groups:

T • • X X X refrigerators: carbon steel, copper, aluminium, zinc, brass, stainless steel and plastics in particular:
- evaporator with copper tubes, aluminium fins and shoulders in galvanised steel;
- tank in carbon steel;

T • • X X X /NF refrigerators: stainless steel (AISI 304), copper, brass and plastics in particular:
- evaporator with tubes and fins in copper and brass shoulders;
- tank in AISI 304 stainless steel; if coupled with stainless steel pumps, the fittings and piping will also be in non-ferrous materials (stainless steel and/or brass and/or plastics).

Condenser:

air-cooled (models T A • X X X): consisting of a fin-pack battery with aluminium fins and copper tubes and axial or centrifugal power fans.

water-cooled (models T W • X X X): trombone type with copper tubes and the rest in carbon steel.

Fan/s (models T A • X X X) :

The refrigerator can have one of the following types of fan:
1. axial;
2. low-speed axial (/BV); the dimensions and number of fans are the same in the axial versions but the number of fan revolutions is lower to reduce noise.
3. centrifugal (/C); up to model 302 the impeller is directly keyed to the shaft of the electric motor. From model 402 and above, motion is transmitted by means of a belt.

Pump:

Version / P0: - in stainless steel from 202 to 302;
- in cast iron/carbon steel from model 402 to 602.

Version / P1: - in stainless steel from model 202 to 302;
- in cast iron/carbon steel from model 402 to 602.

Version / P2: - The parts in contact with water are in cast iron/carbon steel for all models.

Version / P15: in stainless steel from 202 to 302;
- in cast iron/carbon steel from model 402 to 602

OVERALL DIMENSIONS

See enclosure RAD xxx

INDOOR INSTALLATION: MINIMUM DISTANCES FROM WALLS

See enclosure RAD xxx

WATER AND COOLING CIRCUITS

See enclosures RAF xxx

Water circuit

The water circuit consists of a tank inside which is a fin-pack heat exchanger. The water passes through the pack, remaining in contact with the fins and is cooled by the refrigerant fluid which evaporates inside the tubes. The cooled water is sucked by a centrifugal pump if installed, which sends it directly to the user.
The pump delivery is connected to the tank input by by-pass piping which guarantees a minimum water flow through the pump should a pipe at any point of the hydraulic circuit be closed by mistake.
A water pressure gauge is connected to the pump output and is located on the machine control panel and indicates the water pressure at the plant output.

Cooling circuit

There are two distinct cooling circuits. The refrigerant is pumped by the refrigerator compressor to a condenser.
The compressors can be hermetic (T • E X X X) o semi-hermetic (T • S X X X).

Air-cooled condenser (T A • X X X)

The condenser is a fin-pack type condenser and is cooled by an air-flow produced by one or more power fans. The power fan(s) is/are controlled by a pressure switch which stops it when the condensation pressure drops below a determined value.
Refrigerators fitted with two or three centrifugal fans have two pressure switches:
- a pressure switch which controls 1 or 2 fans;
- a pressure switch (of the variable setting type) which controls one fan only (the furthest one from the distribution board).

Water-cooled Condenser (T W • X X X and only up to model .....302)
(See annexes)

The condenser is a tube-in-tube heat exchanger (copper tubes inside a carbon steel outer tube) in which the water flows inside the exchanger tubes. The cooling water enters the rear of the unit and flows through a water regulating valve before entering the condenser. The water regulating valve controls the cooling water flow to ensure that the condensing pressure, measured by the pressure gauge does not fall below a preset value.

The liquid refrigerant then passes through a filter-unit a flow indicator and a thermostatic valve.

The refrigerant then enters the evaporator which can be one of two types:

models up to T 3 0 2: here it consists of a single fin pack in which the refrigerant flows inside tubes in perfect counter-flow with respect to the cooled water;

models from T 4 0 2 to T 6 0 2: here it consists of two fin packs connected in series with the same frontal surface. The flow of the refrigerant which evaporates is in perfect counter-flow with respect to the water flow. The water first passes through the evaporator of circuit 2 and then the evaporator of circuit 1.
For this reason, the evaporator section of circuit 2 is smaller than the evaporator section of circuit 1 and when the refrigerator is capacity controlled works always the circuit 1.

When it leaves the evaporator, the refrigerant is once more drawn by the compressor and the cycle is repeated.

ELECTRICAL CIRCUIT

See the enclosed electrical diagrams.

D - INSTALLATION

⚠ **Before carrying out the installation or operating on this machine, ensure that all the personnel has read and understood the SAFETY chapter in this manual.**

INSPECTION

Immediately after uncrating, inspect the unit.

POSITIONING

1. The refrigerator may be installed both outdoors and indoors.
2. If installed indoors, the room must be well ventilated. In some cases it may be necessary to install fans or extractors to limit the temperature of the room.
3. The ambient air must be clean and not contain flammable gas or solvents. The minimum and maximum working ambient temperature are specified on the unit data plate. In extreme temperature conditions, the protection devices may trip.
4. The machine can be positioned on any flat surface capable of supporting its weight.
5. Leave at least one metre around the unit to permit access during service operations (see chapter C: OVERALL DIMENSIONS).
6. If the refrigerator is air-cooled, do not obstruct or disturb the condenser's flow of cooling air. Position the refrigerator in such a way that the cooling air cannot recirculate in the intake grilles. Ensure that the refrigerator is not subject to warm air from the cooling systems of other machines.

ANTIFREEZE PROTECTION

Even if the minimum working ambient temperature is above 0°C it is possible for the refrigerator - during stoppages in the cold seasons - to find itself in an environment with a temperature below 0°C. In these cases, if the refrigerator is not emptied, antifreeze (ethylene glycol) must be added in the following percentages to prevent the formation of ice:

min. ambient temp. [°C]	**ethylene glycol [% in volume]**
<0	10
-5	15
-10	20
-15	30
-20	35

Depending on the cooled water outlet temperature, antifreeze (ethylene glycol) must be added in the following percentages to prevent the formation of ice:

min. ambient temp. [°C]	**ethylene glycol [% in volume]**
<5	10
0	15
-5	20
-10	30
-15	35
-19.9	40

PLUMBING CONNECTIONS

1) Connect the refrigerator to the water piping.
2) Provide two cocks (inlet and outlet) to by-pass the machine for maintenance purposes without having to empty the water circuit of the user.
3) Fill the water container with water using:
   - a remote filling system.
     in this case it is necessary to vent the air from the tank manually by means of the manual valve [24] (*).
     If there is frequent infiltration of air into the water circuit, installing an automatic air valve is recommended.
   - the filling unit /expansion tank kit (optional).
     Connect the kit as illustrated in the drawing provided with it (*).
   - the can kit for operation at atmospheric pressure (optional).
     Connect the kit as illustrated in the drawing provided with it.
4) If the refrigerator is not fitted with a pump, ensure that the intake of pump installed by the user is directly connected to the refrigerator in such a way that the pressure in its tank is not too high (about 0.5 bar is suggested).

(*): Make sure (by checking the reading on the tank's pressure gauge with the pump stopped) that the pressure in the water circuit is about 0.5 bar so that the pump operation will not create a vacuum in the tank, thereby leading to air intake and, in any case, impeding the use of vent systems, manual or automatic.

EXPANSION TANK

If the plumbing circuit is closed, an expansion tank must be installed.

The expansion tank is always connected to the pump intake.

To calculate the minimum volume of the expansion tank required for a given installation, the formula below cab be used and is valid if the pressure is less than or equal to 0.5 bar when the pump is stopped and the maximum working pressure of the expansion tank is greater than or equal to 4 bar.

The volume of the expansion tank V in litres is given by the formula: $V = 2 \bullet V_t \bullet (P_{tmin} - P_{tmax})$
where:

V_t = total volume of the circuit in litres
P_{tmin} = specific weight at the minimum
P_{tmax} = specific weight at the maximum temperature obtainable over the year in °C (even with the plant stopped)

Example of calculation:

V_t = 200 litres
percentage of ethylene glycol in volume = 30 %
tmin = 5 °C → from the table P_{tmin} = (1.0450+1.0414)/2 = 1.0432
tmax = 40 °C → from the table P_{tmax} = 1.0282
V = 2 · 200 · (1.0432 - 1.0282) = **5.92 litres**

Table of specific weights P

	Temperature [°C]									
% Glycol	**-20**	**-10**	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**
0 %	1,0036	1,0024	1,0008	0,9988	0,9964	0,9936	0,9905	0,9869	0,9830	0,9786
10 %	1,0195	1,0177	1,0155	1,0130	1,0101	1,0067	1,0030	0,9989	0,9945	0,9896
20 %	1,0353	1,0330	1,0303	1,0272	1,0237	1,0199	1,0156	1,0110	1,0060	1,0005
30 %	1,0511	1,0483	1,0450	1,0414	1,0374	1,0330	1,0282	1,0230	1,0175	1,0115
40 %	1,0669	1,0635	1,0598	1,0556	1,0510	1,0461	1,0408	1,0351	1,0290	1,0225

ELECTRICAL CONNECTIONS

Check that the power supply voltage and frequency match the requirements of the dryer as shown on the dryer data plate and they are within the tolerances given in the wiring diagram.
Ensure that the electrical installation complies with local wiring and safety regulations.
In the event of single-phase supply, check that there is a neutral line in the electrical installation and it is earthen in the transformer cabin (TN system in compliance with IEC 364 - HD 384 - CEI 64-8) or that this is done by the electricity supply company (TT system).
The electrical supply cable must be connected to the electrical installation and pay attention to connect the neutral wire of the unit (as described in the attached electrical wiring diagrams) to the neutral wire of the installation.
The electrical supply cable must be the one supplied with the unit and/or indicated in the electrical wiring diagrams.
At the beginning of the electrical supply cable

1. must be guaranteed a protection against direct contacts with a protection degree of IP2X or IPXXB at least;
2. must be installed protection devices that:
   - 2.1. protect against overcurrents, the power supply cable and the cables not protected by the electrical plant of the machine; (see information in the electrical wiring)
   - 2.2. limit the 15 kA peak short circuit current to its own nominal cut-off power when the short circuit current at the operation point is higher than 10 kA effective;
   - 2.3. protect against indirect contacts on the unit, (such as short-circuiting between the phase and protection circuit) by cutting off the supply automatically (see IEC 364 - HD 384, CEI 64-8); Use a differential switch (normally with operation nominal differential current of 0.03 A)
   - 2.4. protect against phase failures where the electrical supply is three-phase.

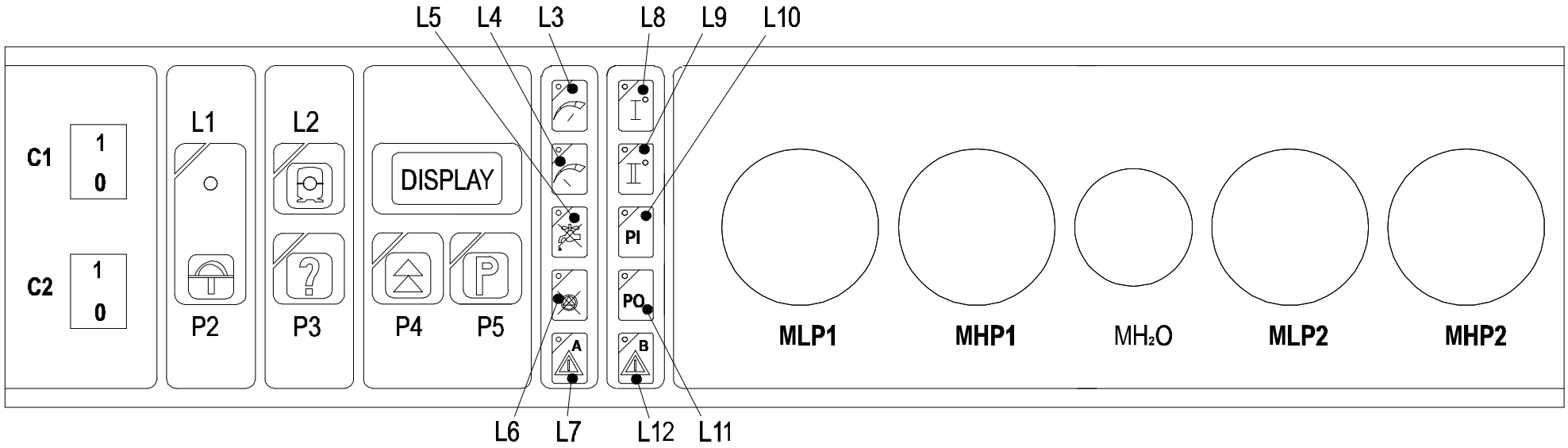
For protection circuit dimensions, please refer to the data specified in the wiring diagrams attached (max. absorption, pickup currents, cables section).

E - START UP

⚠ **Before starting up or operating these units be sure that all personnel have read and understood the SAFETY section of this manual.**

1) Check that the machine's on/off valves are open.
2) Check that the tank is completely full of water and properly vented.
3) • If the plumbing circuit is of the closed type:
   • Check that an expansion tank of adequate capacity is installed.
   • Check that the pressure reading on the pressure gauge on the machine panel is about 0.5 bar.
4) Models with air-cooled condenser:
   • Check that the ambient temperature is within the limits indicated on the machine data plate.
5) Models with water-cooled condenser:
   • Open water inlet valve to the refrigerator.
   • Open the water outlet valve from the refrigerator.
   • Check the available head for the refrigerator (difference in cooling water pressure between the refrigerator inlet and outlet) is at least 1-1.5 bar.
   If the refrigerator is not fitted with a monastic valve, check that the cooling water temperature of the condenser is over 20 °C.
6) Check that the main switch is in the OFF position (“O”).
7) Check that the power supply voltage is correct.
8) Power the machine by means of the supply line protection device.
9) Turn the machine main switch ON (“I”). LED L1 indicates that the machine is powered (see chapter F).
10) Push ON/OFF button on the electronic control unit. **The pump, if installed, will start immediately**. After **2 minutes** (delay set on the electronic control unit) **the compressor will start**.
11) Check that the pump rotates in the correct direction. If necessary invert two phases to reverse the rotation direction.
12) Models with air-cooled condenser:
Check that the fan rotates in the correct direction (if there is a pump and it rotates in the correct direction, then so will the fan). The cooling air must enter the refrigerator through the grille next to the condenser. If necessary invert two phases to reverse the rotation direction.
13) Models with water-cooled condenser:
Check that the cooling water temperature is within the limits given on the machine data plate.
Set the monastic valve as described in the MONASTIC VALVE section of chap. **G.**
14) Models with pump (/P0 or /P1 or /P2 or P/15):
Check that the difference in pressure between the reading on the pressure gauge on the machine control panel with the pump running and the pump stopped is greater than the available head with maximum pump delivery (see chapter B). If this difference is lower it means that the water flow rate is greater than the permitted maximum. **To avoid damaging the pump it is necessary to increase the pressure drop in the hydraulic circuit: e.g. partially closing a pump output cock**.
15) Models with centrifugal fans (/C):
Check that the output of the centrifugal fans is correctly ducted and that the pressure drop of the ducting system is about equal to the available head (see Chap. B). if the pressure drops are:
Greater this means that there is a reduction in the flow of cooling air with a consequent drop in machine performance and the possibility of protection devices tripping even at relatively low ambient temperatures.
Lower this means that the air flow may be too high for the fan and this could be dangerous for the centrifugal fan motor.
16) **If with the first start-up**, there is a high ambient temperature and the temperature of the water in the hydraulic circuit is much higher than the working value **(e.g. 25-30°C)** this means that the refrigerator starts up overloaded with the consequence of possible tripping of **the protection devices. To reduce this overload, a refrigerator outlet valve can be gradually** (but not totally!) **closed to reduce the flow of water passing through it.** Open the valve as the water temperature in the hydraulic circuit reaches the working value.
The refrigerator is now ready to work. If the thermal load is lower than that produced by the refrigerator, the temperature of the water drops until it reaches the set point value (SEt) set by means of the B1 PROG procedure (see chapter F). When the set point has been reached, the thermostat which controls the water outlet temperature stops a circuit. If the water outlet temperature continues to drop and reaches the value of SEt-dIF, then the thermostat stops the other circuit. The water pump, however, continues to run.

F - STAGE 3 ELECTRONIC CONTROL



BUTTONS AND LEDS

BUTTONS

C1 = ON/OFF switch, circuit n°1;
C2 = ON/OFF switch, circuit n°2;
P1 = main switch (it is located on the distribution cover panel);
P2 = ON/OFF button;
P3 = LEDs/display segment control button;
P4 = button for increasing the adjustable parameters;
P5 = button for accessing parameter programming.

LEDs

L1 = indicates the machine status (green);
L2 = indicates the compressor status (green);
L3 = high pressure HP alarm LED (red);
L4 = low pressure LP alarm LED (red);
L5 = low water level in tank alarm LED (red);
L6 = pump heat alarm LED (red);
L7 = available alarm LED “I°” (red);
L8 = alarm in circuit n°1 LED (red);
L9 = alarm in circuit n°2 LED (red);
L10 = integral protection alarm LED “PI” used only with semi-hermetic compressors (red);
L11 = oil pressure switch alarm LED “PO” used only with semi-hermetic compressors (red);
L12 = available alarm LED “II°” (red).

PRESSURE GAUGES

MLP1 = indicates the intake pressure of the compressor/s in circuit n°1;
MHP1 = indicates the output pressure of the compressors in circuit n°1;
MLP2 = indicates the intake pressure of the compressor/s in circuit n°2;
MHP2 = indicates the output pressure of the compressors in circuit n°2;
MH2O = indicates the pressure of the pump water output with the pump running or the pressure in the hydraulic circuit wit the pump stopped.

The three-figure display has a resolution of 0.1°C or 0.1°F.

FIRST START-UP

When the machine is turned on by means of the isolator P1 or whenever the power fails and returns, the following will be displayed for a few seconds:

1) the program code "A02";
2) the code "C" if the temperature measurement unit is °C or "F" if °F.

⚠ **If the program code is not A02 call a specialised service centre.**

TEMPERATURES

The control unit is provided with two temperature sensors of the NTC type with the following resistance values:

	B1 water outlet	B2 evaporator outlet
0 °C	27.28 KΩ	
20 °C	12.00 KΩ	
25 °C	10.00 KΩ	
30 °C	8.31 KΩ	

(Attention: replace with original spare parts only)

The display normally shows the water outlet temperature.
The temperature measurement unit can be °C or °F. The unit of measurement used is displayed for a few seconds when the machine is turned on.

Water outlet temperature (B1) (positioned on the tube)

This is the temperature of the water coming out of the refrigerator. It is normally shown on the display when no key is pressed. To display B1 when some parameter is being programmed, it is necessary to exit the PROG procedure and wait for 30" without pressing any key.

Temperature of water at the evaporator outlet (B2) (positioned on the evaporator)

This is used as an **antifreeze function**: that is, to prevent the water temperature drops to dangerous levels from the ice formation point of view. To display the temperature measured by this probe, press P4 ⏫ when B1 is being displayed and keep it pressed: B2 will be displayed continuously for as long as P4 ⏫ is pressed.

ALARMS

When an alarm is triggered, a flashing code alternates on the display with the temperature from probe B1. Where applicable, one of the red LEDs associated with the alarm goes on.
Up to three alarm messages can be displayed alternatively at the same time.

Message	Leds	Set point (6)	Description
SA1 (1)		-40°C	B1 probe open (T < -40 °C)
SC1 (1)		+90°C	B1 probe in short circuit (T > +90 °C)
LA1 (5)		B1 PROG	low cooled water outlet temperature
HA1 (3)		B1 PROG	high cooled water outlet temperature
SA2 (1)		-40°C	B2 probe open (T < -40 °C)
SC2 (1)		+90°C	B2 probe in short circuit (T > +90 °C)
LA2 (5)		B2 PROG	low evaporator water outlet temperature
HA2 (3)		B2 PROG	high evaporator water outlet temperature
AAA (1)	L3+L8	§G	high pressure switch operation circuit 1 (HP1)
AAA (1)	L3+L9	§G	high pressure switch operation circuit 2 (HP2)
AAA (1)	L4+L8	§G	low pressure switch operation circuit 1 (LP1) trips after the set delay (parameter LPd in SET-UP procedure - default value = 0 min.) from compressor start
AAA (1)	L4+L9	§G	low pressure switch operation circuit 2 (LP2) trips after the set delay (parameter LPd in SET-UP procedure - default value = 0 min.) from compressor start
AAA (2)	L5	< 80 µSiemens	low water level in tank
AAA (4)	L6	see wiring plan	pump thermal protection device operation
AAA (4)	L7		TAE/TWE only: available alarm "I°" operation (delayed as parameter IAd in SET-UP procedure)
AAA (4)	L7+L8+L10	see wiring plan	TAS/TWS only: integral protection alarm PI operation circuit n°1 (delayed as parameter IAD in SET-UP procedure)
AAA (4)	L7+L9+L10	see wiring plan	TAS/TWS only: integral protection alarm PI operation circuit n°2 (visualisation delayed as parameter IAD in SET-UP procedure)
AAA (4)	L7+L8+L11	§G	TAS/TWS only: oil pressure switch alarm PO operation circuit n°1 (visualisation delayed as parameter IAD in SET-UP procedure)
AAA (4)	L7+L9+L11	§G	TAS/TWS only: oil pressure switch alarm PO operation circuit n°2 (visualisation delayed as parameter IAD in SET-UP procedure)
EEA			see description below
EEE			see description below

(1): Manually reset machine stop alarms without stopping pump.
(2): Automatically reset machine stop alarms with stopping of pump.
(3): Automatically reset alarms which do not stop the machine.
(4): Manually reset machine stop alarms which stop pump.
(5): Automatically reset machine stop alarms without stopping the pump.
(6): With variable set point the PROG procedure with which it was set is indicated. In the case of pressure switches, the paragraph giving the set points is indicated (§G).

- The integral protection alarms PO and oil pressure switch alarms PI are only fitted in models with semi-hermetic compressor (TAS).
  The level alarm "AAA" + "LS " acts with the logic described below (see paragraph CIRCULATION PUMP).
- In case of injury on one of the circuits, the damaged one not be electrically supplied, to permit the other circuit work.

General alarm

Any alarm condition trips the general alarm relay.
If the parameter rLA=On (standard version) this means that the general alarm relay is normally energized (no alarm) and is de-energized when there is any alarm.
Its specifications are : 8A/AC1 250V.
The general alarm relay is normally energized: it is de-energized in any alarm condition. On the board there is a "clean" contact, that is, one without voltage so that the status of this relay can be repeated in remote:

Terminal no.	Description
- "9"	common
- "10"	normally closed
- "NO"	normally open

For remote alarm indication, connect to terminals "**9**" and "**NO**".

Machine stop alarms

With a machine stop alarm, the compressor stops and LED L1 flashes. If it is a manually reset alarm and the alarm condition has been eliminated, press the On/OFF button P2 ☎ to restart the compressor.
Not all the alarms also stop the pump.

Available alarm "I" (AAA+L7)

Models TAE or TWE: an alarm signal from outside the unit can be connected to terminal n°15 on the board (see wiring plan). This is generally used for connecting a flow switch. In models TAS or TWS it is used to signal an integral protection or semi-hermetic compressor oil pressure switch alarm condition.
Triggering of this alarm is delayed by 10" (IAd parameter in SET-UP procedure).

"EEA" Alarm

The code "EEA" is displayed if there is a microprocessor initialisation problem. In this case the microprocessor must be initialised again and a specialised service centre must be called for this purpose.

"EEE" Alarm

If, for any reason, the microprocessor loses the programmed data, the unit is stopped (the relays de-energise except for the general alarm one) and the code "EEE" appears on the display. In this case the microprocessor must be initialised again and a specialised service centre must be called for this purpose.

PROGRAMMING: NOTES COMMON TO THE PROG AND SET-UP PROCEDURES

Up to 16 parameters can be programmed.
The most important for the user are:

Parameter	See procedure	Description
SEt	B1 PROG	water outlet temperature thermostat set point
d IF	B1 PROG	thermostat differential

⚠ **The thermostat set point and differential can be modified only after carefully reading the recommendations given in the B1 PROG procedure.**

The programmable parameters are adjustable by means of the PROG and SETUP procedures.

⚠ **The "SET-UP" procedure parameters can only be adjusted by specialised personnel in very special cases. Tampering, for example, may lead to breakdown of the evaporator or of the refrigerator compressor, or to a water outlet pressure which is too high.**

Adjusting a parameter

A code is assigned to each parameter (e.g. "LPd" for low pressure switch delay).The parameter is displayed by alternating its code with its set point value in the digital display so that it is clear to which parameter the value refers. Key P4 ⏫ must be depressed to change the value (its value is increased until it reaches the top of its programmable range and then restarts from the lowest possible value).
As long as key P4 ⏫ remains depressed, the value of the parameter that is being changed is displayed continuously.

Selecting a parameter

Enter the PROG or SET-UP procedure as described below in order to display the first parameter on the list. To pass on to successive parameters press P5 (P). Once the list of parameters has been completed, pressing P5 (P) once more will display the code "SEt" to indicate that the card is storing the programmed data.
However, if no button is depressed within 30 seconds of the last key being depressed the procedure is ended, all the previous data are restored and the display reverts to dew-point temperature.
When the procedure is properly terminated the display passes to the value of the temperature measured by the sensor B1 and then to normal operation.

Second function parameters (II°F)

Some parameters are partially protected and are called "second function" parameters (II°F) to distinguish them from others called "first function" (I°F).
To access a "second function" parameter, it is first necessary to display the "first function" with which it is associated and press P5 (P) for 8 seconds.
When the list of "second function" parameters which are associated with a given "first function" parameter has been terminated, the next "first function" parameter envisaged in the list will be displayed by pressing P5 (P) again.

SET-UP PROCEDURE

⚠ **"SETUP" parameters must only be modified by qualified personnel and only in specific circumstances.**

To enter the SET-UP procedure:

1) press P4 ⏫ and P5 🅿 together;
2) energise the control card by switching on the main switch P1;
3) release P4 ⏫ and P5 🅿: the first "dES" parameter on the list enters the display.

Parameters	Description	Range	Default value
dES	delay between successive compressor starts	0/10 min	5
dAS	compressor start delay after last stop	0/10 min	2
LPd	low pressure switch LP trip delay	0/10 min	0
IAd	delay in intervention of the available alarm	0/120 s	10 s
rLA	status of the alarm relay	On or OFF	On
SE2 (*)	On = sensor B2 present	On or OFF	On
At2 (*)	On = stop alarm LA2 (only if SE2=On)	On or OFF	On
ASC (**)	compressors rotation	On or OFF	OFF
dEG	temperature measurement unit selection	°C or °F	°C
Adr	board identifier (used in computer control of several machines)	01/16	01

(*): SE2=OFF means that the probe B2 is not installed and is for preventing intervention of the alarm "SA2". At2 = OFF means that alarm LA2 is not a machine stop alarm. At2 is displayed only if SE2=On.

(**): if ASC=On then:
- if the two circuits are running, the one that started first will stop;
- if the two circuits are stopped, the one that stopped first will start.

⚠ **The ASC parameter can be set On in models 202, 252, 302 only.**

B1 PROG PROCEDURE (WATER OUTLET TEMPERATURE)

⚠ **Before modifying the SEt make sure that it is neither too low nor too high:**

- **a setting which is too low may cause ice formation so that antifreeze must be added (see Chapter D - INSTALLATION). Before reducing the SEt it may be necessary to reduce the LSL value.**
- **a value which is too high may cause machine overloading with consequent intervention of the protection devices and deterioration of the compressor.**

The d IF value must not be too low; a value of 1.5 ÷ 2°C is normal. If the differential value is too low compressor starting and stopping (and hence the temperature of the cooled water) depends, with partial loads, on the dES and dAS delays set using the SET-UP procedure, rather than on the thermostat.

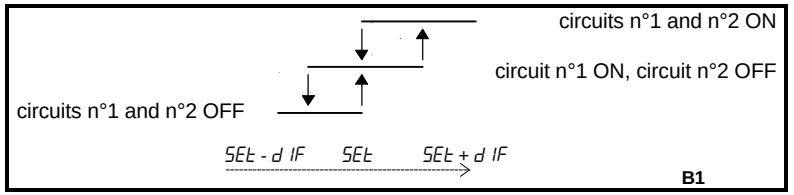
To enter the B1 PROG procedure, it is necessary:

1) for the value measured by probe B1 to be displayed;
2) to press P5 🅿 for 5 seconds to display the SEt parameter.

B1 PROG procedure parameters (code A02)

Parameters		Description	Range		Default value	
I°F	II°F					
SEt		thermostat set point	LSL/65 °C	LSL/149 °F	9 °C	48.2 °F
	HA I	high temperature alarm	-19.9/65 °C	-4/149 °F	60 °C	140 °F
	LA I	low temperature alarm	-19.9/65 °C	-4/149 °F	-19.9 °C	-4 °F
d IF		thermostat differential	0/8°C	0/14.4 °F	2 °C	3.6 °F
	LSL	lower SEt limit	-19.9/65°C	-4/149 °F	7 °C	44.6 °F

The operating logic of the thermostat function is:



(*): If the thermostat function calls for the two steps at the same time, there will be a delay of **5 seconds** between the two starts. The dES and dAS delays are applied to each single step.

B2 PROG PROCEDURE (EVAPORATOR WATER OUTLET TEMPERATURE)

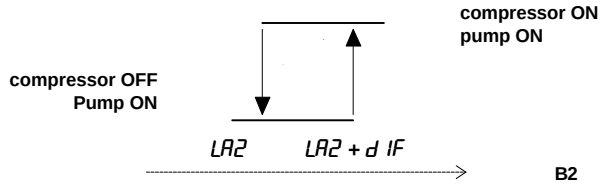
To enter the B2 PROG procedure it is necessary:

1) for the value measured by the probe B2 to be displayed (keep P4 ⏫ pressed);
2) keeping P4 ⏫ pressed, press P5 🅿 at the same time for 5 seconds to display the first HA2 parameter.

B2 parameter PROG procedure

Parameters		Description	Range		Default value	
I°F	II°F					
HA2		high temperature alarm	-19.9/65 °C	-4/149 °F	60 °C	140 °F
LA2		low temperature alarm	-19.9/65 °C	-4/149 °F	3 °C	37.4 °F
	d IF	low temperature differential alarm	1/10 °C	1/18 °F	4 °C	7.2 °F

The antifreeze operating logic is:



CIRCULATION PUMP

When the machine is turned on by means of button P2 ☎, LED L1 goes on and the pump controlled by rL3 starts and continues to run until the machine is not turned OFF by means of button P2 ☎.
If the compressor is also enabled to start, the pump always starts 3 seconds before it.
The pump only stops with the following alarms:
- level alarm;
- pump thermal alarm;
- available alarm.

When the level alarm is triggered, the corresponding alarm is displayed and the machine is stopped.
When the level probe is wet once again, and therefore detects the presence of water, the following are possible:

- two minutes after the probe detects the level again, and without any operation on the machine, the alarm disappears and the machine returns to normal operation;
- press button P2 ☎, before two minutes have passed, to start normal machine operation again.

AUTOMATIC RE-START

After a loss of power, the unit will re-start automatically if it was On, but not if it was OFF before the loss of power.

G - SETTING THE COMPONENTS

PRESSURE SWITCHES

The refrigerators are fitted with the following pressure switches:

1. **fan pressure switch (PV)**
   This monitors the condensing pressure.
   It is only fitted to air cooled units. It controls the fan motor to keep the condenser pressure within the design limits.
   Refrigerators with two or three centrifugal fans have two pressure switches:
   - a pressure switch which controls one or two fans;
   - a pressure switch (again of the variable setting type) which controls one fan only (the furthest one from the distribution board).
2. **low pressure switch (LP)**
   This monitors refrigerant compressor intake pressure and will trip to protect the compressor if it should fall to too low a value.
   To prevent temporary fluctuations from causing this pressure switch to trip, a short time delay can be incorporated to avoid false alarms (LPd parameter in SET-UP procedure).
   It is of an "automatic reset" type. Its operation sends an alarm signal to Stage 3; after a time set by the parameter lpd, Stage 3 stops the compressor (not the pump). When the intake pressure increases, and allows the unit to restart, it restores power to the safety thermostat(s) and operates the in-built start delay timer which then switches on the compressor after the preset time.
   If the cause of low pressure trip switch operation is not remedied this condition will be continually repeated.
3. **high pressure switch (HP)**
   This monitors the refrigerant compressor discharge pressure and prevents it increasing to levels dangerous to the operation of the unit and people within the vicinity.
   It is of an "automatic reset" type. When it trips, it opens the compressor supply circuit (see wiring plan). When the compressor output pressure drops below the reset point it is reset. The electronic board starts the compressor after the delay set by means of the dAS parameter of the SET-UP procedure.
4. **oil differential pressure switch (PO))**
   This is only fitted on models with the semi-hermetic compressor (TAS and TWS).
   It is of the “fixed setting” - “manual reset” type.
   It controls the pressure difference between the compressor oil lubrication pump intake and output. It trips when this difference remains below 0.8 bar for 60-120 seconds.

   ⚠ **When the oil differential pressure switch trips, it is necessary to remove the cause, because it could trip again and again. This possibility will seriously damage the compressor.**

   When the cause has been removed, press the P2 ☎ button to start the unit.
5. **integral compressor protection (PI)**
   This protection is composed by three thermistor probes placed in the electric motor phase windings and connected in series.
   It protects against the most part of the problems causing the motor burning out.
   When the PI trips it is necessary to verify and remove the cause. When the cause has been removed, press the P2 ☎ button to start the unit.

The pressure switches PV, LP and HP are screwed to the cooling circuit piping with SCHRAEDER valve (with needle) which prevent leakage during replacement.
The TRIP and RESET values of the above three pressure switches depend upon the refrigerant gas used and are listed in the table below:

COMPONENT	REFRIGERANT	TRIP			RESET		
		bar	°C	°F	bar	°C	°F
Fan pressure switch PV	R22	18	49	120.2	13.5	38	100.4
	R134a	11.7	49	120.2	8.6	38	100.4
	R407c	18	46.4	115.5	13.5	35.7	96.2
Low pressure switch LP	R22	1.5	-19.5	-3	3	-6.5	20
	R134a	0.3	-20.5	-5	1.6	-3	26
	R407c	1.5	-19.3	-2.7	3	-6.7	19.9
High pressure switch HP	R22	25	63	145	18	49	120.2
	R134a	17.2	63	145	12.2	50	122
	R407c	25	59.8	139.6	18	46.4	115.5

WATER VALVE

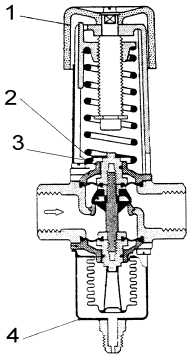
(only TWE/TWS)

The water regulating valve must be set by means of the knob [1] to operate with the following values as read on the pressure gauge [16].

Refrigerant	Pressure [bar]	Temperature [°C]	Temperature [°F]
R22	14.3	40	104
R134a	10.1	40	104
R407c	14.3	37.7	100

principal components

1 Knob
2 Cup spring
3 O-Ring
4 Bellows sensor



The water regulating valve, on models with water cooled condenser, needs to be checked regularly because impurities in the water could cause it to malfunction.
This valve is equipped with a knob [1] to permit adjustment of the set point.

operating principle

The pressure signal arrives at the bellows [4] which, via the main valve rod, causes the valve to open and close. The resistance of the spring opposing the operation of the bellows, can be regulated by means of the knob [1]. In this way the differential pressure necessary for the opening of the valve is adjusted.

H - OPERATION AND MAINTENANCE

OPERATION

The machine operates in completely automatic mode.
There is no need to turn it off when there is no thermal load as it turns off automatically when the preset water output temperature has been reached.

MAINTENANCE

⚠ **Before proceeding with the maintenance of these units be sure that all personnel concerned have read and understood the SAFETY section of this manual.**

These units will give many years of trouble-free service if they are properly maintained and serviced.

Unit access

To access the components of the cooling circuit, remove the front panel.
To remove the front panel, it is first necessary to unscrew the two screws which hold it to the base and then release the two hooks which hold it to the side panels using a screwdriver.
To access the components of the distribution board, remove the two screws which fix the horizontal panel to the side panels.

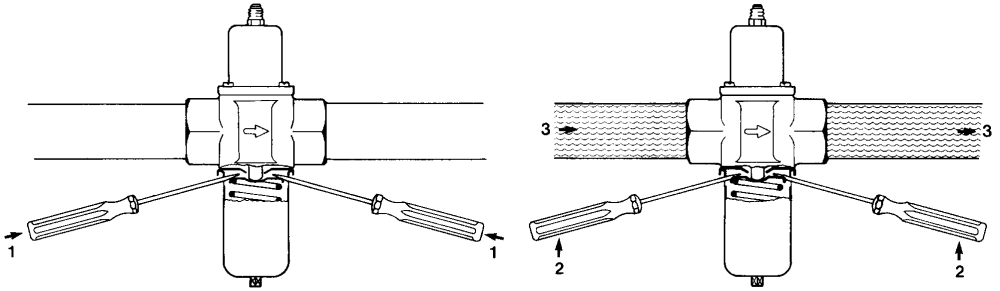
Water regulating valve maintenance

(only for water cooled condenser models)

see section G - WATER REGULATING VALVE

The valve may retain impurities. To remove them proceed as follows:

- set the knob [1] to the minimum pressure value ("1" on the scale);
- ensure that the bellows unit [4] is not under pressure;
- put a screwdriver through the opening and remove the retaining cup spring [2] from its seat;



- open the valve;
- rinse dirty parts;
- replace worn O-rings [3], if necessary;
- grease the cylindrical surface with non acidic grease;
- lubricate screws and tie-rods before reassembling the valve.

⚠ **The bellows unit must not be dismantled when the system is under pressure, as it could cause permanent deformation.**

I - TROUBLE SHOOTING

PROBLEM	CAUSE	SYMPTOM	REMEDY
A. Water outlet temperature B1 greater than the expected value.	A1. Thermal load too high (water flow) x (input temperature - water outlet) = Thermal load.	A1.1 • Temperature B1 greater than expected value; • alarm *HA 1* trips (if the *HA 1* parameter of B1 PROG has been modified) as well as the general alarm relay.	Restore the thermal load to within the preset limits.
	A2. Air-cooled models: ambient temperature too high.	See A1.1.	Restore the ambient temperature to within the preset limits.
	A3. Air-cooled models: cooling water temperature too high (low water flow).	See A1.1.	Restore the water intake temperature to within the preset limits (increase the water flow).
	A4. Air-cooled models: condenser fins dirty.	See A1.1.	Clean the condenser fins.
	A5. Air-cooled models: front surface of the condenser obstructed.	See A1.1.	Free the front surface of the condenser.
	A6. Air-cooled models: the fan rotates in the wrong direction.	See A1.1.	Invert the position of 2 of the 3 power supply phases.
	A7. (1) Water-cooled models: surface of exchanger tubes dirty.	See A1.1.	Clean the surfaces of the tubes by running a solution which dissolves carbonates but is not aggressive for steel and copper.
	A8. No refrigerant fluid in the plant.	A8.1 • See A1.1; • low evaporation pressure; • a lot of bubbles in the liquid indicator.	Get a refrigerator technician to check for leaks and eliminate them. Fill the plant.
B. Excessive pressure drop in the cooled water.	B1. Water flow too high.	B1.1. • Possible increase in the outlet temperature B1 (see A1.1); • with pump installed on the machine: pressure difference, read on the machine pressure gauge, too low with pump stopped and pump running.	Bring the flow within the preset values.
	B2. Before ice obstructs the whole machine, there is an increase in the pressure drop.	B2.1 See point C.	See point C.
	B3. Finned surface obstructed by dirt carried by the water to be cooled.	B3.1 High water temperature difference between input and outlet.	Depending on the type of dirt: • clean the evaporator by running a detergent solution which is not aggressive for steel, aluminium and copper; • run a high water flow against the stream. Install a filter upstream from the refrigerator.
C. The refrigerator is obstructed and the water does not flow.	C1. B1 PROG set point too low so that the water freezes.	C1.1. • Water does not pass; • the alarm "*AAA* + L4 + L9" of the low pressure switch trips; • intake pressure too low.	Choose between: • raise the set point; • add an appropriate % of ethylene glycol (antifreeze) (see chapter D).
D. High pressure switch HP1 or HP2 tripped. Alarm displayed: *AAA+L3+L8* or *AAA+L3+L9*	D1. Fan motor does not work.	D1.1 • Refrigerant compressor stops; • L1 led flashes; • L3 led lights up; • the code "*AAA*" is displayed alternately with the dew-point value; • main alarm relay tripped.	Repair or replace the fan motor. Where fitted, check the thermal protection switch of the motor. Press P2 ☎ button to run the unit (*L 1* goes on).
	D2. Air cooled units: Ambient air temperature too high.	D2.1 • Air ambient temperature higher than maximum permitted value; • see D1.1.	Reduce ambient temperature within design limits, for example by increasing local ventilation. Press P2 ☎ button to run the unit (*L 1* goes on).

PROBLEM	CAUSE	SYMPTOM	REMEDY
	D3. Air cooled units: recirculation of warm air due to incorrect installation location.	D3.1 • Cooling air temperature higher than the permitted value; • see D1.1.	Change the position of the unit or the position of any adjacent obstructions to avoid recirculation. Push P2 button to run the unit (L1 goes on).
	D4. Air cooled units: see A4.	See D1.1.	Clean the condenser fins. Push P2 button to run the unit (L1 goes on).
	D5. Air cooled units: see A5.	See D1.1.	Remove obstruction from condenser intake. Push P2 button to run the unit (L1 goes on).
	D6. Air-cooled units: Ambient temperature high combined with incorrect fan rotation (on three phase supply units).	D6.1 • The fan blows air across the condenser coil instead of drawing it across; • refrigerant compressor stops; • main alarm relay tripped.	Reverse the connections of 2 of the 3 phases.
	D7. Water cooled units: water inlet temperature too high.	See D1.1.	Reduce the water temperature to the design values. Push P2 button to run the unit (L1 goes on).
	D8. Water cooled units: water flow too low.	See D1.1.	Increase the available head pressure at the unit to increase the water flow. Push P2 button to run the unit (L1 goes on).
	D9. (1) Water cooled units: dirty surface of exchanger tubes.	See D1.1.	Clean the inside of the heat exchanger tubes with mild descaling agent that dissolves carbonates but is suitable for steel and copper. Push P2 button to light up L1.
	D10. Thermal load too high (water flow) x (input temperature - water outlet) = thermal load.	D10.1 • Temperature B1 higher than expected value; • refrigerant compressor stops; • main alarm relay tripped.	Reduce the thermal load to design figures. Push P2 button to light up L1.

PROBLEM	CAUSE	SYMPTOM	REMEDY
E. Low pressure switch LP1 or LP2 tripped. Alarm displayed: AAA+L4+L8 or AAA+L4+L9.	E1. Lack of refrigerant (see also A10).	E1.1 • Refrigerant compressor stops; • L1 LED flashes; • L4 LED light up; • the message "AAA" alternates on the display with the value of B1; • alarm relay tripped.	Call a qualified refrigeration engineer to check for leaks and replenish refrigerant charge.
F. The compressor protection device trips. (only TAE/TWE)	F1. Thermal load = (water flow) x (water input - output temperature) too high in combination with high ambient temperature.	F1.1 • The head of the refrigerant compressor is very hot; • the compressor stops and tries to restart after a short time (even a few seconds).	Stop the machine and restore the load to the preset limits. Wait for few minutes before restarting the unit.
	F2. Thermal load = (water flow) x (water input - output temperature) too high combined with a shortage of refrigerant (also see A10.).	See F1.1.	Call a qualified refrigeration engineer to check for leaks and replenish refrigerant charge.
	F3. See points D1 to D8.	See F1.1.	See points D1 to D8.
G. Digital display and all LEDs off although P1 main switch On ("I").	G1. Control board fuse blown. Power supply fluctuations or 'spikes'.	G1.1 Despite presence of power at the input terminals, the digital display and all LEDs remain unlit.	Replace the fuse. Provide cleaner power supply to the unit.
	G2. Abnormal power consumption by one or more of the control board components.	See G1.1.	Replace the fuse. Provide cleaner power supply to the unit.
H. SA1 or SA2 alarm displayed.	H1. B1 or B2 sensors in open circuit.	H1.1 • See problem; • main alarm relay tripped.	Check that the temperature sensor is correctly connected to the control board terminals and that the cable is undamaged. If necessary replace the temperature sensor.

PROBLEM	CAUSE	SYMPTOM	REMEDY
I. SC 1 or SC2 alarm displayed.	I1. B1 or B2 sensor in short circuit.	I1.1 • See problem; • main alarm relay tripped.	See point H.
J. LA 1 alarm displayed.	J1. Set point value of LA 1, as stored under the PROG B1 procedure, is higher than value measured by the B1 sensor.	J1.1 • See problem; • main alarm relay trip.	Identify and remove the cause. If necessary, adjust LA 1 temperature set point to a value lower than that measured by the B1 sensor.
K. HA 1 alarm displayed.	K1. Set point value of HA 1, as stored under the PROG B1 procedure, is lower than the value measured by the B1 sensor.	K1.1 • See problem; • main alarm relay tripped.	Identify and remove the cause. If necessary, adjust HA 1 temperature set point to a value higher than that measured by the B1 sensor.
L. LA2 alarm displayed.	L1. Set point value of LA2, as stored under the PROG B2 procedure, is higher than the value measured by the B2 sensor.	L1.1 • See problem; • main alarm relay trip.	Identify and remove the cause. If necessary, adjust LA2 temperature set point to a value lower than that measured by the B2 sensor.
	L2. Water flow too low.	L1.1 • See problem; • the compressor stops and restarts when the LA2+d IF 1 value is exceed; • the general alarm relay trips.	Increase the water flow.
M. HA2 alarm displayed.	M1. Set point value of HA2, as stored under the PROG B2 procedure, is lower than the value measured by the B2 sensor.	M1.1 • See problem; • main alarm relay trip.	Identify and remove the cause. If necessary, adjust HA2 temperature set point to a value higher than that measured by the B2 sensor.
N. Alarm displayed: AAA+L7 (only TAE/TWE).	N1. The alarm, sent to the 0V & 15 terminals, is activated and triggers alarm on STAGE 3 control board (see attached wiring plan).	N1.1 • See problem; • main alarm relay tripped; • refrigerant compressor stops; • L1 LED flashes.	Identify and remove the cause of the remote alarm.
O. Alarm displayed: AAA+L5 lack of water in tank.	O1. The water level in the tank is lower than the level sensor insertion point.	O1.1 • See problem; • general alarm relay tripped; • the compressor and pump stop; • LED L1 flashes.	Check the hydraulic circuit for water leaks. Add water to fill the tank, checking that air no longer comes out of the vent.

PROBLEM	CAUSE	SYMPTOM	REMEDY
P. Alarm displayed: AAA+L6 pump thermal switch.	P1. The pump's thermal protection device has tripped because the water flow is too high.	P1.1 • See problem; • general alarm relay tripped; • the compressor and pump stop; • LED L1 flashes; • the pressure difference read on the machine gauge with the pump stopped and pump running is lower than the available head with maximum pump flow (see chapter B).	Reset the thermal protection device. Increase the pressure drop in the hydraulic circuit, for example by partially closing the pump output valve.
	P2. The grille through which the pump cooling air passes is obstructed.	P2.1 • See problem; • general alarm relay tripped; • the compressor and pump stop; • LED L1 flashes.	Reset the thermal protection device. Free the grille.
	P3. The pump is defective.	P3.1 • See problem; • general alarm relay tripped; • the compressor and pump stop; • LED L1 flashes; • the current absorbed by the pump is greater than the nominal rating; • the pump may be noisy.	Reset the thermal protection device. Replace the pump.
Q. Integral protection P11 or P12 tripped. Alarm displayed: AAA+L10+L8 or AAA+L10+L9	Q1. The compressor operates in extreme conditions (e.g. high condensation pressure with excessive overheating of the gas drawn in).	Q1.1 • See problem; • general alarm relay tripped; • the compressor stops; • LED L1 flashes.	Check that the temperature of the cooled water and of the cooling fluid of the condenser are with any the limits envisaged.

PROBLEM	CAUSE	SYMPTOM	REMEDY
R. Oil pressure switch PO1 or PO2 tripped. Alarm displayed: AAA+L11+L8 or AAA+L11+L9	R1. Low oil in compressor casing.	R1.1 • See problem; • general alarm relay tripped; • the compressor stops; • LED L1 flashes.	Check that no improper operation has been carried out: e.g. compressor start without flow of cooled water. Have the plant checked by a refrigeration engineer and top up oil in the compressor until oil is seen in the indicator. ATTENTION: The oil must be the same as the oil already present.
S. EEA alarm displayed.	S1. Microprocessor initialising error.	S1.1 EEA flashing on display.	Turn off and turn on the unit. If this does not solve the problem, contact the nearest service centre.
T. EEE alarm displayed.	T1. Microprocessor mistake in reading datas.	T1.1 EEE flashing on display.	Turn off and turn on the unit. If this does not solve the problem, contact the nearest service centre.

(1): If the cooling circuit uses disposable water or is an open circuit with cooling towers it is possible for the concentration of calcium and magnesium carbonates to cause encrustation on the warm walls of the exchanger tubes (the greater the condenser outlet temperature, the greater the possibility of the formation of encrustation).

Safety schedule

Denomination:	chlorodifluoromethane **(R22)**	1,1,1,2 - tetrafluoroethane **(R134a)**	23% Difluoromethane (R32); 25% Pentafluoroethane (R125); (**R407C)** 52 % R134a
INDICATION OF THE DANGERS			
Major dangers:	Asphyxia		
Specific dangers:	unknown	unknown	rapid evaporation can cause freezing.
FIRST AID MEASURES			
General information:	Do not give anything to unconscious persons.		
Inhalation:	Take the person outdoors. Use oxygen or artificial respiration if necessary. Do not administer adrenaline or similar substances.		
Contact with the eyes:	Thoroughly wash with plenty of water for at least 15 minutes and call a doctor.		
Contact with the skin:	Wash immediately with plenty of water. Remove contaminated clothing immediately.		
FIRE-FIGHTING MEASURES			
Means of extinction:	any means.		
Specific dangers:	pressure increase.		
Specific methods:	cool the containers with water sprays.		
MEASURES IN THE EVENT OF ACCIDENTAL LEAKAGE			
Individual precautions:	Evacuate personnel to safe areas. Provide adequate ventilation. Use means of personal protection.		
Environmental precautions:	evaporates.		
Cleaning methods:	evaporates.		
HANDLING AND STORAGE			
<u>Handling:</u> technical measures/ precautions:	only use in well-aired premises.	only use in well-aired premises.	ensure sufficient air change and/or extraction in the work areas.
recommendations for safe use:		tightness test. Do not carry out any pressure tests with air/R134a mixtures. It can form a combustible mixture with the air at pressures above atmospheric pressure when the ratio in volume exceeds 60%.	Do not inhale vapours or aerosols.
<u>Storage:</u>	close properly and store in a cool, dry well-ventilated place.	Close properly and store in a cool, dry well-ventilated place.	Close properly and store in a cool, dry well-ventilated place. Store in its original containers. Incompatible products: explosives, flammable materials, organic peroxide
CONTROL OF EXPOSURE/INDIVIDUAL PROTECTION			
Control parameters:	1000 ppm v/v or ml/m3 = 3540 mg/m3 as weighted average over 8 hours.	1000 ppm v/v or ml/m3 = 3540 mg/m3 as weighted average over 8 hours.	AEL (8-h e 12-h TWA) = 1000 ml/m^3 for each of the three components.
Respiratory protection:	For rescue and maintenance work in tanks, use autonomous breathing apparatus. The vapours are heavier than air and can cause suffocation, reducing the oxygen available for breathing.		
Protection of the eyes:	safety goggles.		
Protection of the hands:	rubber gloves.		
Hygiene measures:	do not smoke.		

Denomination:	chlorodifluoromethane **(R22)**	1,1,1,2 - tetrafluoroethane **(R134a)**	23% Difluoromethane (R32); 25% Pentafluoroethane (R125); (**R407C)** 52 % R134a
PHYSICAL AND CHEMICAL PROPERTIES			
Colour:	colourless		
Odour:	similar to ether		
Boiling point:	-40.8 °C at atm. press.	-26.5 °C at atm. press.	-43.9 °C at atm. press.
Flammability point:	non flammable		
Relative density:	1.194 kg/l at 25 °C.	1.21 kg/l at 25 °C.	1.138 kg/l at 25 °C
Solubility in water:	3 g/l at 25 °C at atm. press.	0,15% in weight (25 °C - atm. press.)	negligible
STABILITY AND REACTIVITY			
Stability:	no reactivity if used with the relative instructions.		
Materials to avoid:	alkaline metal, earthy alkaline metals, granulated metals salts, Al, Zn, Be, etc. in powder.		
Hazardous decomposition products:	halogen acids, traces of carbonyl halides.		
TOXICOLOGICAL INFORMATION			
Acute toxicity:	LC50/inhalation/4 hours/lab. rats = 220 ml/l.	ALC/inhalation /4 hours/lab. rats = 567 ml/l.	(R32) LC50/inhalation/4 hours/lab. rats >760 ml/l (R125) LC50/inhalation/4 hours/lab. rats >3480 mg/l (R134a) ALC/inhalation/4 hours/lab. rats = 567 ml/l.
Local effects:	concentrations substantially above 1000 ppm v/v can cause narcotic effects. Inhalation of products in decomposition can lead to respiratory difficulty (pulmonary oedema).		concentrations substantially above the TLV can cause narcotic effects. Inhalation of products in decomposition can lead to respiratory difficulty (pulmonary oedema).
Long-term toxicity:	has not shown any cancerogenic, teratogenic or mutagenic effects in experiments on animals.		
ECOLOGICAL INFORMATION			
Global warming potential HGWP (R11=1):	0.098	0.28	R125: 0.84 - R134a: 0.28
Ozone depletion potential ODP (R11=1):	0.05	0	0
CONSIDERATIONS ON DISPOSAL	usable with reconditioning.		

Maintenance Schedule

OPERATION	1 day	1 month	6 months	annually
Check control panel display for any alarm signals.	■			
Check that the water output temperature is within the envisaged range.	■			
Check that the water intake temperature is lower than the value used for selecting the refrigerator.		■		
Check that the pressure in the tank (with pump stopped) is about 0.5 bar if the hydraulic circuit is of the closed type.		■		
Check that the difference between the pump output pressure (if installed) and intake pressure (measured by a pressure gauge with the pump stopped) is within the limits envisaged and, in particular, is not lower than the value corresponding to the maximum flow.		■		
Check that the liquid indicator is full or with a small stream of bubbles when the compressor is running.			■	
Check that the unit current absorption is with the value on the data plate.			■	
Carry out visual inspection of refrigerant circuit, looking out for any deterioration of the piping or any traces of oil which might indicate a refrigerant leak.			■	
Check the condition and security of piping connections.			■	
Check the condition and security of wiring and electrical connections.			■	
Using a spanner, check that the connections to the refrigerant compressor have not slackened. (IMPORTANT)			■	

Air cooled units:

Check that the ambient air temperature is lower than the value used for selecting the refrigerator (normally 30-35°C 77-86°F). Check that the environment is well ventilated.		■		
Check that fan operation is not noisy. Thoroughly clean the fins of the condenser with soft brush and/or jet of clean compressed air. Check that the grilles of the unit are free from dirt and any other obstructions.			■	
Clean condenser fins with a mild detergent.				■

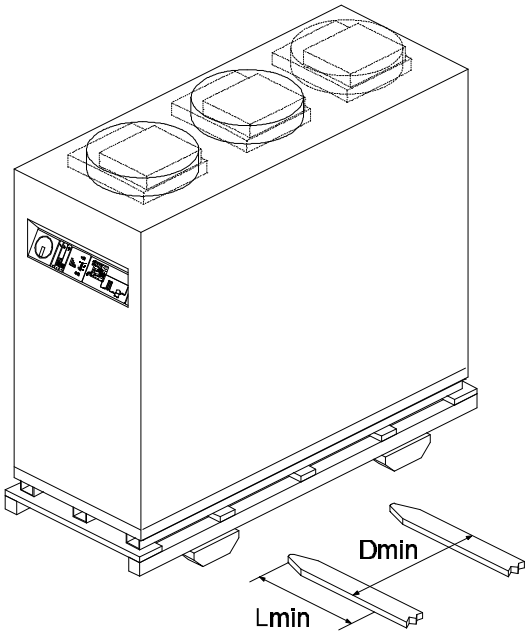
Water cooled units:

Check that the cooling water temperature is lower than the value used for selecting the refrigerator (normally 30-35°C 77-86°F).		■		
Check that the head available for the refrigerator (difference in the cooling water pressure between the refrigerator intake and output) is at least 1-1.5 bar.			■	
When the cooling water is very hard (high concentration of carbonates, calcium and magnesium salts as in the case of circuits with cooling towers) descale the internal surface of the condenser (water side) with a suitable chemical ensuring it does not react with copper and carbon steel.				■

IMPORTANT:

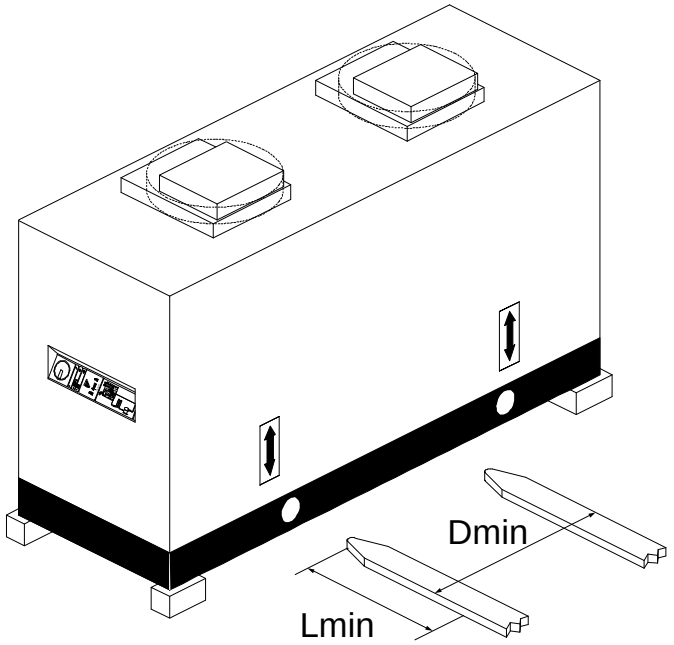
- This plan is based on an average working situation.
- In some installations it may be necessary to increase the frequency of maintenance.

TAE/TAS/TWE/TWS 202 - 302



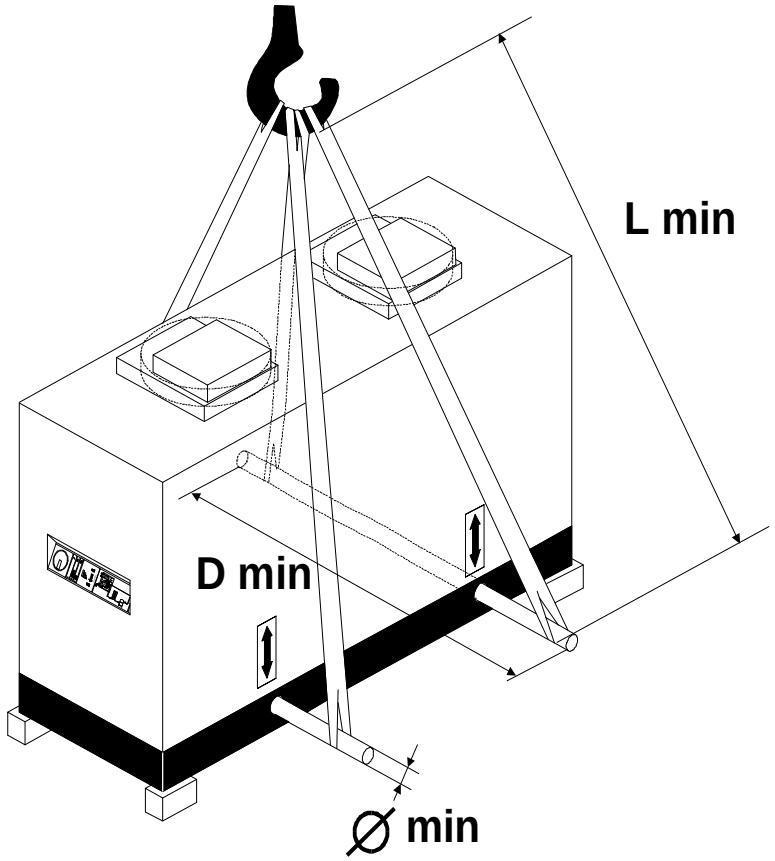
		D min	L min	KG
TAE/TAS/TWE/TWS	202	900	1000	801
	252	900	1000	850
	302	900	1000	870

TAE/TAS 402 - 602



		D min	L min	KG
TAE/TAS	402	900	1250	1385
	502	900	1250	1440
	602	900	1250	1510

TAE/TAS 402 - 602



		D min	ϕ min	L min	KG
TAE/TAS	402	1450	50	4000	1385
	502	1450	50	4000	1440
	602	1450	50	4000	1510