

ENVIRONMENT HEALTH & SAFETY INSTRUCTIONS FOR CHILLERS AND HEAT PUMPS

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1 - Introduction

This safety manual applies for all types of chillers & heat pumps. It refers, when necessary, to information included in the installation, operation and maintenance (IOM) manual of your unit. The IOM is either provided with the unit or available on line.

Prior to the initial start-up of the chiller, people involved in the storage, transportation, handling, on-site installation, start-up, operation, and maintenance of this unit should read, understand and be thoroughly familiar with these instructions, the installation, operation and maintenance manual and the specific project data for the installation site.

Units are designed to cool/heat water for the air conditioning of buildings and industrial processes.

Units are designed to provide a very high level of safety during installation, start-up, operation and maintenance. They will provide safe and reliable service when operated within their application range.

Units are designed for a theoretical operating duration of 15 years. Beyond this operating period, the manufacturer recommends to perform a periodic requalification of the refrigerant circuit according to applicable local regulations. Except in case of a most restrictive local regulation, the manufacturer then recommends a 5 years periodicity requalification.

It is user's responsibility to ensure that the final installation respects all local, national and international regulations.

This manual provides the necessary information to safely do all operations on the equipment from installation to dismantling.

2 - General safety considerations

The unit must be installed in a place that is not accessible to the public or protected against access by non-authorized persons.

Do not modify or bypass any of the safety guards or switched in the system.

The main working place for the operator of the unit is in front of the control panel.

All operations on the unit must be carried out by authorized, qualified and trained people to do it using appropriate tools.

All persons who have to work with the equipment must wear personal protective equipment adapted to the intervention on the unit:

- Safety shoes
- Safety gloves or specific hand protection (cut resistant gloves, chemical gloves, thermic gloves, ...)
- Head protection
- Ears protection
- Eyes or face protection (safety glasses, goggles, facial shed)
- A2L detector if A2L gas in the chiller

Additional equipment may be required, depending on the risk analysis that must be done prior to any intervention.

No combustible matter should be placed within 6.5m of the unit.

The units are intended to be stored and operate in an environment where the ambient temperature must not be less than the lowest allowable temperature indicated on the nameplate.

RISK OF FALLING:



No part of the unit must be used as a walk-way, rack or support. Periodically check and repair or if necessary replace any component or piping that shows signs of damage.

The refrigerant lines can break under the weight and release refrigerant, causing personal injury.

Use a platform, or staging to work at higher levels.

RISK IN CASE OF LEAK:

Ensure good ventilation, as accumulation of refrigerant in an enclosed space can displace oxygen and cause asphyxiation or explosions.

Inhalation of high concentrations of vapor is harmful and may cause heart irregularities, unconsciousness, or death. Vapor is heavier than air and reduces the amount of oxygen available for breathing. These products cause eye and skin irritation. Decomposition products are hazardous.

Avoid contact with liquid refrigerant. Wash any spills from the skin with soap and water. If liquid refrigerant enters the eyes, immediately and abundantly flush the eyes with water and consult a doctor.

The accidental releases of the refrigerant, due to small leaks or significant discharges following the rupture of a pipe or an unexpected release from a relief valve, can cause frostbites and burns to personnel exposed. Do not ignore such injuries. Installers, owners and especially service engineers for these units must:

- Seek medical attention before treating such injuries.
- Have access to a first-aid kit, especially for treating eye injuries.

Never apply an open flame or live steam to a refrigerant container. Dangerous overpressure can result.

In case of combustion of refrigerant, do not clean combustion by-products with water, the mixture is highly corrosive.

RISK OF FLAMMABILITY:



If the unit contains A2L refrigerant, always use an A2L refrigerant detector when near the unit.

Default atex zone is 0.6m around the unit. for more details on your A2L unit zone, please refer to the dedicated instruction, operation & maintenance (IOM) instruction.

RISK OF EXPLOSION:



Never exceed the specified maximum operating pressures.

Verify the allowable maximum high-side and low-side test pressures by checking the instructions in this manual and the pressures given on the unit name plate.

3 - Storage safety considerations

The units are intended to be stored in an environment where the ambient temperature must not be less than the lowest allowable temperature indicated on the nameplate.

Never cover any protective device.

This applies to any relief valves (if used) in the refrigerant or heat transfer medium circuits and the pressure switches.

Do not obstruct any protective device.

This applies to any rupture disks and valves fitted on the refrigerant or heat transfer fluid circuits.

4 - Transportation safety considerations

The units are intended to be stored in an environment where the ambient temperature must not be less than the lowest allowable temperature indicated on the nameplate.

Never cover any protective device.

This applies to any relief valves (if used) in the refrigerant or heat transfer medium circuits and the pressure switches.

Do not obstruct any protective device.

This applies to any rupture disks and valves fitted on the refrigerant or heat transfer fluid circuits.

5 - Handling/Installation on site safety considerations

Do not remove the skid or the packaging until the unit is in its final position.

Do not throw away lifting instruction present on the tarpaulin.

The manufacturer strongly recommends employing a specialized company to load or unload the machine.

Lift the unit using the lifting instruction provided.

Unit's weight is indicated on the nameplate.

Units can be moved with a fork lift truck, as long as the forks are positioned in the correct place and direction on the unit.

The units can also be lifted with slings, using only the designated lifting points marked on the unit according the lifting instructions on the certified drawings supplied with the unit. These drawings can also be found in the installation, operation and maintenance (IOM) manual of the unit. Use slings or lifting beams with the correct capacity that have been tested and certified.

Do not tilt the unit more than 15°.

The unit must be placed on hard ground or concrete.

6 - Operation user safety considerations

The unit must be installed in a place that is not accessible to the public or protected against access by non-authorized persons.

Ensure you read and understood this instruction before accessing the unit.

7 - Start-up safety considerations

After the unit has been received, when it is ready to be installed or reinstalled, and before it is started up, it must be inspected for damage:

- Check that the refrigerant circuit(s) is (are) intact, especially that no components or pipes have shifted (e.g. following a shock).
- If in doubt, carry out a leak tightness check and verify with the manufacturer that the circuit integrity has not been impaired.
- If damage is detected upon receipt, immediately fill a claim with the shipping company.

Check that the protective devices are well installed and not covered before operating the unit.

The unit complies with the european pressure equipment directive. the list of pressure equipment integrated in the unit is given in the EU declaration of conformity.

NOTE: Pressure equipment for the hydraulic side (optional) are delivered as separate items. their integration in the complete hydraulic installation remain under the user's responsibility.

In accordance with above regulation:

- The high pressure safety loop are the safety accessories.
- The relief valves are not safety accessories but damage limitation accessories in case of an external fire.

SAFETY DEVICES CLASSIFICATION		
	Safety accessories ⁽¹⁾	Over pressure protection in case of an external fire ⁽²⁾
Refrigerant side		
High-pressure switch	X	
External relief valve ⁽³⁾		X
Rupture disk		X
Fusible plug		X
Heat transfer fluid side		
External relief valve	(4)	(4)

(1) Classified for protection in normal service situations.

(2) Classified for protection in abnormal service situations. These accessories are sized for fires with a thermal flow of 10kW/m².

(3) The instantaneous over-pressure limitation of 10% of the operating pressure does not apply to this abnormal service situation (see EN 764-7 §7.2 / Guideline E-02).

(4) The selection of these discharge valves must be made by the personnel responsible for completing the hydraulic installation.

NEVER COVER ANY PROTECTIVE DEVICE.

This applies to any relief valves (if used) in the refrigerant or heat transfer medium circuit and the pressure switches.

DO NOT OBSTRUCT ANY PROTECTIVE DEVICE.

This applies to any rupture disks and valves fitted on the refrigerant or heat transfer fluid circuits.

Check whether the original protection plugs are still present at the valve outlets. These plugs are generally made of plastic and should not be used. If there are still present, please remove them.

Fit devices at the valve or discharge piping outlets to prevent the penetration of foreign bodies and atmospheric agents.

These devices, as well as the discharge piping, must not impair operation or lead to a pressure drop that is higher than 10% of the set pressure.

If the relief valves are installed on a change-over valve, this is equipped with a relief valve on each of the two outlets. Only one of the two relief valves is in operation, the other one is isolated.

Never leave the change-over valve in the intermediate position, i.e. with both ways open bring the actuator in abutment, front or back according to the outlet to isolate.

If a relief valve is removed for checking or replacement, ensure that there is always an active relief valve on each of the change-over valves installed in the unit.

All factory installed relief valves are lead-sealed to prevent any calibration change.

The external relief valves must always be vented to outside if the units are installed in a closed space.

Refer to the installation regulations, for example those of European standard EN 378-3 and EN 13136.

These pipes must be installed in a way that ensures that people and property are not exposed to vented refrigerant. As the fluids can be diffused in the air, ensure that refrigerant is discharged away from building air intakes, or they must be discharged in a quantity that is appropriate for a suitably absorbing environment.

It is recommended to install an indicating device to show if part of the refrigerant has leaked from the valve. The presence of oil at the outlet orifice is a useful indicator that refrigerant has leaked.

Keep this orifice clean to ensure that any leaks are obvious.

Provide a drain in the discharge circuit, close to each relief valve, to avoid an accumulation of condensate or rain water.

Relief valves must be checked periodically.

See the installation, operation and maintenance manual of the chiller to do it.

When the unit is subjected to fire, safety devices prevent rupture due to over-pressure by releasing refrigerant. The fluid may then be decomposed into toxic residues when subjected to the flame:

- Stay away from the unit
- Set up warnings and recommendations for personnel in charge to stop the fire.
- Fire extinguishers appropriate to the system and the refrigerant type must be easily accessible.
- Do not clean combustion by-products with water, the mixture is highly corrosive.
- Do not restart the unit after it has been submitted to a fire. Material may have been seriously damaged by the heat.
- Restart may only be possible after detailed verification by a competent personnel in order to insure that the unit has not suffered any damage.

8 - Maintenance and repair safety considerations

Never work on a unit that is still energized.

All installation parts must be maintained by the personnel in charge, in order to avoid material deterioration and injuries to people.

Faults and leaks must be repaired immediately. The authorized technician must have the responsibility to repair the fault immediately. Each time repairs have been carried out to the unit, the operation of the protection devices must be re-checked.

All maintenance and repair operation must be done in compliance with regulations and IOM.

Only use original replacement parts for any repair or component replacement.

Consult the list of replacement parts that corresponds to the specification of the original equipment.

The manufacturer recommends the following drafting for a logbook (the table below should not be considered as reference and does not involve the manufacturer responsibility):

Intervention		Name of the commissioning engineer	Applicable national regulations	Verification Organism
Date	Nature ⁽¹⁾			

(1) Maintenance, repairs, regular verifications (See EN 378), leakage, etc.

Engineers working on the electric or refrigeration components must be authorized, trained and fully qualified to do so.

All refrigerant circuit repairs must be carried out by a trained person, fully qualified to work on these units.

He must have been trained and be familiar with the equipment and the installation.

All welding operations must be carried out by qualified specialists.

The insulation must be removed and heat generation must be limited by using a wet cloth.

Any manipulation (opening or closing) of a shut-off valve must be carried out by a qualified and authorized engineer. These procedures must be carried out with the unit shut-down.

Never work on any of the electrical components, until all the power supplies have been isolated using the disconnect switch(is) in the control box(is), locked and tagged out.

If any maintenance operations are carried out on the unit, lock the power supply circuit in the open position ahead of the machine.

If the work is interrupted, always ensure that all circuits are still deenergized before resuming the work.

ATTENTION: Even if the unit has been switched off, the power circuit remains energized, unless the unit or circuit disconnect switch is open.

For example the variable frequency drives (VFD) which take twenty (20) minutes to discharge. Refer to the wiring diagram for further details.

IMPORTANT INFORMATION REGARDING THE REFRIGERANT USED:

This product contains fluorinated greenhouse gas covered by the Kyoto protocol. For the fluid type refer to the name plate.

1. Any intervention on the refrigerant circuit of this product should be performed in accordance with the applicable legislation. In the EU, the regulation is called F-Gas, N°517/2014.
2. Ensure that the refrigerant is never released to the atmosphere during installation, maintenance or equipment disposal.
3. The deliberate gas release into the atmosphere is not allowed.
4. If a refrigerant leak is detected, ensure that it is stopped and repaired as quickly as possible.
5. Only a qualified and certified personnel can perform installation operations, maintenance, refrigerant circuit leak test as well as the equipment disposal and the refrigerant recovering.
6. The gas recovery for recycling, regeneration or destruction is at customer charge.
7. Periodic leak tests have to be carried out by the customer or by third parties. The EU regulation set the periodicity here after:

System WITHOUT leakage detection		No Check	12 Months	6 Months	3 Months
System WITH leakage detection		No Check	24 Months	12 Months	6 Months
Refrigerant charge/ circuit (CO ₂ equivalent)		< 5 Tons	5 ≤ Charge < 50 Tons	50 ≤ Charge < 500 Tons	Charge > 500 Tons ⁽¹⁾
Refrigerant charge/ Circuit (kg)	R32 (GWP 675)	Charge < 7,4 kg	2,4 ≤ charge < 74,1 kg	74,1 ≤ charge < 740,8 kg	Charge > 740,8 kg
	R134A (GWP 1430)	Charge < 3,5 kg	3,5 ≤ Charge < 34,9 kg	34,9 ≤ Charge < 349,7 kg	Charge > 349,7 kg
	R407C (GWP 1774)	Charge < 2,8 kg	2,8 ≤ Charge < 28,2 kg	28,2 ≤ Charge < 281,9 kg	Charge > 281,9 kg
	R410A (GWP 2088)	Charge < 2,4 kg	2,4 ≤ Charge < 23,9 kg	23,9 ≤ Charge < 239,5 kg	Charge > 239,5 kg
	HFO's: R1234ze	No requirement			

(1) From 01/01/2017, units must be equipped with a leakage detection system

8. A logbook must be established for equipment subject to periodic leak tests. It should contain the quantity and the type of fluid present within the installation (added and recovered), the quantity of recycled fluid, regenerated or destroyed, the date and output of the leak test, the designation of the operator and its belonging company, etc.
9. Contact your local dealer or installer if you have any questions.

If a leak occurs or if the refrigerant becomes contaminated (e.g. by a short circuit in a motor) remove the complete charge using a recovery unit and store the refrigerant in mobile certified containers.

Repair the leak detected and recharge the circuit with the total refrigerant charge, as indicated on the unit name plate. Some parts of the circuit can be isolated. Only charge liquid refrigerant at the liquid line.

Ensure that you are using the correct refrigerant type before recharging the unit.

Charging any refrigerant other than the original charge type will impair machine operation and can even lead to a destruction of the compressors. The compressors are lubricated with a synthetic polyolester oil.

Periodic inspections of the safety devices and external overpressure devices (external relief valves) must be carried out in accordance with national regulations.

The safety device shall be tested at least once a year to verify good operation and cut out value.

The company or organization that conducts a pressure switch test shall establish and implement a detailed procedure to fix:

- Safety measures
- Measuring equipment calibration
- Validating operation of protective devices
- Test protocols
- Recommissioning of the equipment.

An example of test procedure without removing the pressure switch is given in the installation operation and maintenance manual of the Chiller. Consult the manufacturer Service for this type of test.

CAUTION: If the test leads to replacing the pressure switch, it is necessary to recover the refrigerant charge, these pressure switches are not installed on automatic valves (Schraöder type).

At least once a year thoroughly inspect the protection devices (valves). If the machine operates in a corrosive environment, inspect the protection devices more frequently.

Ensure regularly that the vibration levels remain acceptable and close to those at the initial unit start-up.

Before opening a refrigerant circuit, purge, consult the pressure gauges and ensure that the circuit has been purged

Change the refrigerant when there are equipment failures, carry out a refrigerant analysis in a specialist laboratory.

If the refrigerant circuit remains open for longer than a day after an intervention (such as a component replacement), the openings must be plugged and the circuit must be charged with oxygen free nitrogen (inertia principle). The objective is to prevent penetration of atmospheric humidity and the resulting corrosion on the internal walls and on non-protected steel surfaces.

If work on the evaporator is required, ensure that the piping from the compressor is no longer pressurized (as the valve is not leak tight in the compressor direction.)

Any refrigerant transfer and recovery operations must be carried out using a transfer unit. A 3/8" SAE connector on the manual liquid line valve is supplied with all units for connection to the transfer station. The units must never be modified to add refrigerant and oil charging, removal and purging devices. All these devices are provided with the units. Please refer to the installation, operation and maintenance manual of the unit.

Do not re-use disposable (non-returnable) cylinders or attempt to refill them. It is dangerous and illegal. When cylinders are empty, evacuate the remaining gas pressure, and move the cylinders to a place designated for their recovery. Do not incinerate.

Do not use oxygen to purge lines or to pressurize a machine for any purpose. Oxygen gas reacts violently with oil, grease, and other common substances.

Never exceed the specified maximum operating pressures.

Verify the allowable maximum high-side and low-side test pressures by checking the instructions in this manual and the pressures given on the unit name plate.

Do not use air for leak testing. Use only oxygen free nitrogen.

Do not unweld or flamecut the refrigerant lines or any refrigerant circuit component until all refrigerant (liquid and vapor) has been removed from chiller. Traces of vapor should be displaced with oxygen free nitrogen. Refrigerant in contact with an open flame produces toxic gases.

The necessary protection equipment must be available, and appropriate fire extinguishers for the system and the refrigerant type used must be within easy reach.

Do not clean the unit with hot water or steam. This may cause the refrigerant pressure to rise.

HIGH PRESSURE SAFETY LOOP (SRMCR):

Each circuits of the unit is equipped with a high pressure safety loop, also known as safety related measurement control and regulation system (SRMCR), consisting of:

- High pressure switches (HPS) located on the high pressure side of compressor. PZHH (manual) or PSH (automatic) type, depending on the compressor technology
- A control relay on the compressor board.
- Compressor(s) main contactor(s)

See the wiring diagram and bill of material of the unit for details of identification and references.

This safety loop is designed to be reliable for the whole life of the chiller providing adequate annual testing is performed.

FUNCTION DESCRIPTION AND RESET:

Switches and compressor contactors are closed during normal operation. A pressure above the set value opens the switch(es) which open the compressor(s) contactor(s) stopping the power supply to compressors.

Shortly after compressor shutdown, the pressure in the system comes back to equilibrium.

Restart after high pressure detection.

After safety loop activation:

- reset manually the triggered pressure switch (screw type compressors only).
- Clear the alarm on the unit control panel. This has to be done physically on the panel, not remotely.

CHECKS IN CASE OF APPARENT FAILURE OF THE SAFETY ACCESSORY:

If the operating pressure of the unit appears to have been exceeded (for example: after opening of the relief valves), the unit must be stopped immediately. The unit and the safety loop must pass periodic testing procedure successfully before any possible restart.

If the test reveals any malfunctions that could have led to exceed the maximum allowable pressure (PS) of the device, a complete check of all pressure equipment must be performed to verify their mechanical integrity.

In order to verify the full integrity of the safety loop, the following checks have to be performed periodically:

- High pressure safety loop periodic test
- Contactors check
- Complete loop operation check

POWER CONTACTOR CHECK PROCEDURE:

This procedure shall be applied for each compressor of the unit.

1. Switch off the power of the electrical equipment.
2. Measure the resistance between upstream and downstream terminals of the main power contactors for each phase.

Note: calibrated Ohmmeter shall be used for this task.

3. Confirm resistance is more than 1.0 MOhm.

A resistance lower than 1.0 MOhm might indicate that contactor is defective: further investigations are required.

COMPLETE SAFETY LOOP TEST:

The purpose of this periodic test is to verify the proper functioning and setting of the high-pressure safety loop of a refrigerant circuit.

In order to reach the triggering pressure of the loop, the pressure and temperature thresholds activating the discharge of the compressor by the regulation system are raised.

This procedure must be repeated for each circuit of the unit:

1. Set up a calibrated pressure gauge on the high pressure part of the circuit (compressor discharge)
2. Clear all activated alarms
3. Activate the HP test mode for the corresponding circuit via the control interface.

Enable Quick Test Mode (Quick Test Menu> [QCK_TEST] parameter active)

Activate the high pressure test for the desired circuit (Menu Quick Test> parameter [HP_TEST] to 0 for circuit A or 1 for the B circuit. The corresponding circuit starts to perform the HP test.

4. Start the unit
5. For water-cooled units, stop the circulation of the secondary circuit to the condenser in order to stop the condensation and cause the increase in pressure (this operation is managed by the control on air-cooled machines)
6. Record the trigger value
7. Check if the trigger values are correct

The release values should be between -1.5 /+0 bars of nominal values indicated on the unit.

8. Reset all alarms

For screw type compressors, this procedure should be repeated if only one of the pressure switch has triggered. The triggered pressure switch shall then be substituted with a mean of stopping the system or a pressure switch with a higher triggering value.

Note:

Access to the maintenance functions can be protected by a password. Contact your dealer or the manufacturer's service department for more information.

The type of connector must be WAGO 231-302 or equivalent.

9 - Dismantling safety considerations

Comply with local environmental laws and guidelines.

Never work on a unit that is still energized.

Refrigerant and oil must be removed from the machine before dismantling operations

Only a qualified and certified personnel can remove the refrigerant from the equipment

The refrigerant, the oil and e-cards must be recycled in suitable industries.

all other materials are recyclable

