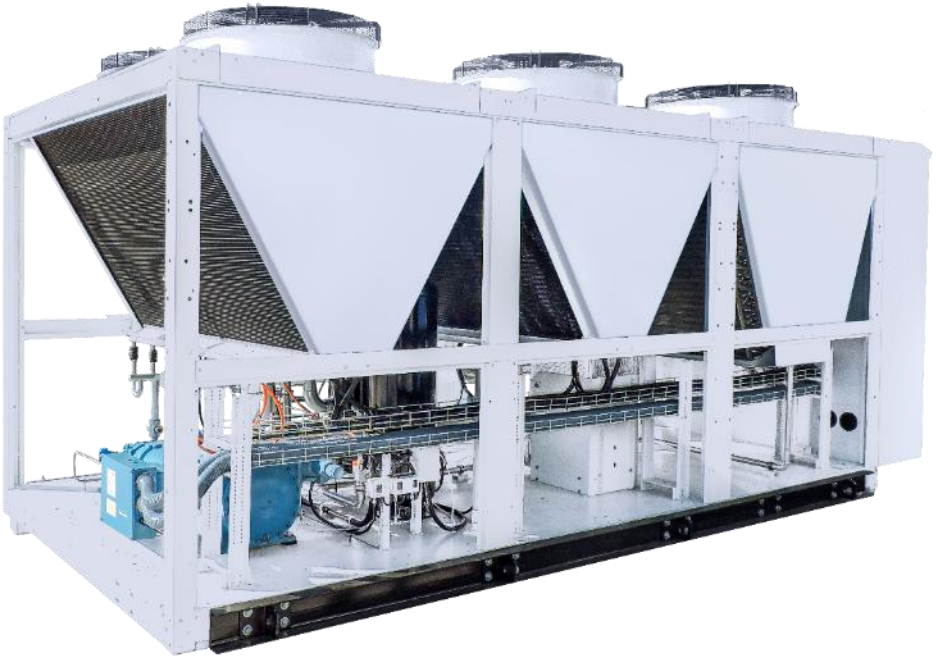
# Installation
# Operation
# Maintenance

**RTDF** Air-Cooled Ammonia Chillers
R-717 Refrigerant



**RTDF**

ISO 9001

v 3.7

**Store near the unit**
**Subject to technical changes**

## Table of contents

# 1 User Guide

All important information for operation and installation is summarised in this "Installation and Operation Manual".

Read the installation and operating instructions and use the product only after you have understood the installation and operating instructions.

If you have any questions, please contact your manufacturer specialist dealer. The current address is available on the last page.

## 1.1 Structure of the installation and operation manual

### 1.1.1 Warnings

**Structure of warnings**

The warnings are structured as follows:

| | |
|---|---|
| ⚠ SIGNAL! | **The source of the danger!**<br>Consequences of non-compliance.<br>► Measure to avoid danger. |

**Classification of warnings**

Warnings are differentiated according to the type of hazard as follows:

| | |
|---|---|
| ⚠ DANGER! | Warns of an imminent threat of danger, which will result in death or serious injury if not avoided. |
| ⚠ WARNING! | Warns of a potentially hazardous situation, which will result in death or serious injury if not avoided. |
| ⚠ CAUTION! | Warns of a potentially hazardous situation, which will result in moderate or minor injury if not avoided. |
| **NOTE** | Warns of a potentially hazardous situation, which will result in damage to property or the environment if not avoided. |

**Tips, notes and recommendations**

ⓘ *Provides the user with advice, notes or recommendations on the efficient use of the product.*

### 1.1.2 Additional symbols

**Handling instructions**

Handling instructions call for an operation or a work step to be carried out. Handling instructions must always be carried out individually and in the specified sequence.

Structure of the handling instructions:

➲ Instructions for an operation.

*Results if needed.*

## 1.2 Staff requirements

➲ Ensure that only authorised and trained persons operate, maintain or repair the unit.

➲ Ensure that all persons using, maintaining or repairing the unit are of the specified minimum age.

➲ Ensure that staff training includes theoretical information (technology and safety) and practical training on the unit.

➲ Ensure that personnel have read and understood the instruction manual and documentation provided.

➲ Ensure that personnel to be trained, taught, instructed or generally trained work in the unit only under the constant supervision of an experienced person.

➲ Regularly check that staff are working with safety and risk in mind.

➲ Clearly define staff responsibilities for operation, overhaul, maintenance and repair.

## 1.3 Target groups

These instructions are intended for authorised specialists only:

➲ Electrical work may only be carried out by qualified electricians.

➲ The initial start-up must be carried out exclusively by the manufacturer or by a specialist appointed and authorised by the manufacturer.

➲ Repair should be carried out by a qualified refrigeration specialist, qualified for flammable refrigerants where applicable.

## 1.4 Related documents

➲ For safe and correct use of the unit, please observe the additionally supplied documents and the relevant standards and laws.

Documents to be observed:

- Safety data sheets of the units and consumables used.
  - R-717 (ammonia: $NH_3$).
  - Oil: PAG.

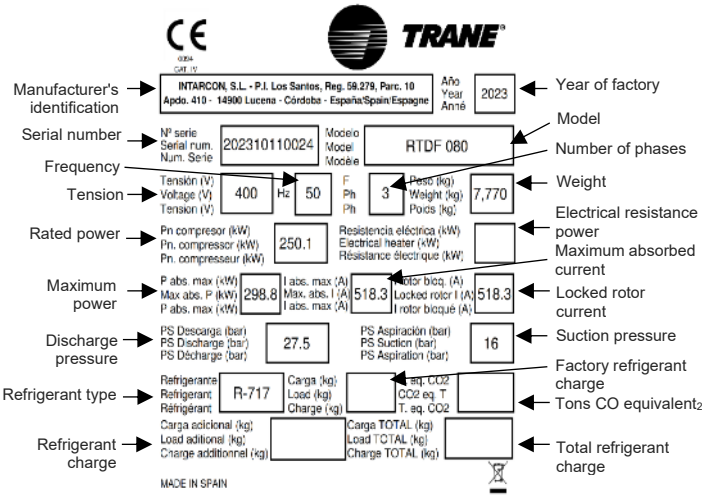
## 1.5 Documents safekeeping

➲ Keep the installation and operating instructions close to the unit.

## 1.6 Symbols on the product

### 1.6.1 Type plate

Each unit carries a plate that unmistakably identifies it, with the following indications:




ⓘ *Any communication with the manufacturer shall require the serial number of the unit.*

### 1.6.2 Warnings

- Warns of the risk of fire.

- Warns against electric shock.

- Indicates that the power must be switched off before opening the body.

- Requires reading the installation and maintenance manual.

## 2 Safety and Dangers

| ⚠ DANGER! | **Risk of electric shock!** |
|---|---|
| | Before starting any work on the unit, disconnect the power supply and ensure that it cannot be switched on again. |
| | ► Observe country-specific regulations and guidelines before working with electrical equipment. |

| ⚠ DANGER! | **Risk of burns to eyes or skin due to leaking refrigerant!** |
|---|---|
| | Wear safety goggles and gloves when working on the refrigerant circuit. |

| NOTE | **Damage due to impermissible repair!** |
|---|---|
| | ► Do not use objects or tools that are not permitted. |

| NOTE | **Damage due to inadmissible support load!** |
|---|---|
| | ► Prevent additional force from being exerted. |
| | ► Do not step on the roof surface. |

| NOTE | **Incorrect installation!** |
|---|---|
| | Observe local installation requirements for refrigerant systems with R-717 (ammonia). |

➲ Follow the installation and operating instructions.

➲ Installation, maintenance, cleaning and repair work may only be carried out by authorised qualified personnel who are familiar with the applicable national regulations.

## 2.1 Safety recommendations for R-717

**Recommended personal protective equipment:**

**Respiratory protection:** High concentrations may cause asphyxiation and intoxication and exposure is not recommended. If necessary use a properly fitted air-supplied or air-purifying respirator complying with approved standards.

**Hand protection:** Wear work gloves for any activity where the unit is to be handled. Gloves with chemical resistance according to EN 374 must be used.

**Eye and face protection:** It is recommended to wear flame retardant clothing and to have a product resistant anti-acid suit for use in case of emergency.

ⓘ *See section "3 Personal Protective Equipment".*

**Safety precautions when working with R-717:**

➲ Ensure that the work area is well ventilated with no source of ignition within 3 m of the system and associated equipment.

➲ Eye wash facilities, such as eye wash bottles, shall be available.

➲ Before handling the electrical connections of the unit, make sure that the unit is disconnected from the power supply.

➲ For maintenance work, use tools and utensils suitable for working with R-717.

**Suitable fire extinguishing media:**

- Appropriate media may include water spray, dry chemical powder, water fog or foam.
- Do not apply water directly on liquid ammonia to avoid heating and evaporation.
- The mixture of ammonia and air, in open spaces, is unlikely to be within the flammable limits, therefore the risk of fire or explosion is negligible.
- In enclosed spaces there may be a risk of explosion if the mixture meets a source of ignition, therefore installation in an area away from sources of ignition is recommended.

- Remove fumes/vapours/mist with a water spray.
- Always act from a position with your back to the wind.
- Avoid any contact with contaminated water.
- Once the fire has been extinguished, quickly clean surfaces that have been exposed to fumes to minimise damage to the unit.

**Handling and storage of the refrigerant:**

- Protect the refrigerant bottles from physical damage, do not throw, roll or drop them.
- Temperatures in storage areas should not exceed 50°C.
- The refrigerant may only be handled by experienced and properly trained persons.
- Purge the system with a dry inert gas (helium or nitrogen) before charging the refrigerant and with the system out of service.
- Keep the refrigerant away from sources of ignition, including static discharge.
- Use spark-free tools.
- Ensure that the system has been checked before use for leaks.
- For the handling of the bottles, suitable transport trolleys must be used.
- Ensure that containers are always upright and with valves closed when not in use.
- Do not use direct flame or electrical equipment to increase vessel pressure.
- Store away from oxidising gases and other oxidising materials.
- If you have any questions regarding the handling or storage of the refrigerant, please refer to the manufacturer's safety data sheet or contact the supplier.

### 2.2 Safety recommendations in case of emergency

| ⚠ DANGER! | **Risk of asphyxiation, narcotic effect, or cardiac arrhythmia due to inhalation of refrigerant!** |
|---|---|
| | ► Ensure that the working area is well ventilated. |

**Refrigerant leaks can cause:**

- Asphyxiation due to displacement of oxygen from the air, and narcotising effect or cardiac arrhythmia due to inhalation of the refrigerant.
- Eye irritation and burns from splashing or skin contact.
- Dizziness, salivation, nausea, vomiting and loss of mobility or consciousness.

**In case of eye injuries due to splashes of refrigerant:**

➲ Never rub your eyes. If contact lenses are worn, they should be removed.

➲ Hold eyelids open and rinse with plenty of water.

➲ Transfer the victim to a specialist doctor (ophthalmologist) or to an emergency department.

**In case of burns by skin contact:**

➲ Wash the affected area with plenty of water and remove clothing while applying water.

➲ Never cover the affected parts with cloth, bandages, or oil.

**In case of inhalation of refrigerant:**

➲ Move the victim to a place where he can breathe fresh air. The victim should remain lying down or on his side.

➲ Call emergency medical services if necessary.

| ⚠ DANGER! | **Risk of cutting due to sharp ends!** |
|---|---|
| | ► Wear safety gloves when working on the unit. |

| NOTE | **Damage due to incorrect temperature range!** |
|---|---|
| | ► Ensure that the unit is operated exclusively within the set temperature range. |

| NOTE | **Damage due to lack of training!** |
|---|---|
| | ► Ensure that only qualified personnel carry out work on the unit. |

| NOTE | **Damage due to defective device!** |
|---|---|
| | ► Ensure that only qualified personnel carry out work on the unit.<br>Use the unit only in its original condition, without unauthorised modifications and in perfect technical condition. |

➲ Follow the instructions in the installation and operation manual.

➲ Have maintenance, cleaning and repair work carried out only by specialists who are familiar with the applicable national standards.

## 3 Personal Protective Equipment

Assembly personnel, electricians, maintenance personnel and auxiliary personnel are responsible for the following:

- Use of personal protective equipment.
- Regular cleaning and care of protective equipment.
- Immediate replacement of damaged parts of protective equipment.

Components of protective equipment:

- Safety helmet
- Protective goggles
- Hearing protectors
- Face mask
- Protective gloves
- High-visibility clothing (reflective, high-visibility colour)
- Safety shoes
- Special protective clothing
  - against burns
  - against hypothermia
  - against chemical burns
  - against punctures and cuts

## 4 Description

RTDF chillers are state-of-the-art chillers of silent construction. They combine the latest ammonia technology for the reduction of the refrigerant charge. It is a critical charge system with low charge components, such as dry expansion evaporators or microchannel condensers, reducing the specific charge to 70 g per kW refrigerant. The lubrication system is based on a miscible oil, requiring only a gravity separation stage. The part of the lubricant not separated in the primary system, although it may be small, is returned through the suction gases.

RTDF chillers have the highest energy efficiency, manufactured with energy-saving components. Designed in a very compact construction and for outdoor installation, assembled on a galvanised sheet steel frame and body with polyester paint, equipped with semi-hermetic screw compressors and aluminium microchannel coils.

All these features result in a better seasonal energy performance factor (SEPR) in accordance with the European Ecodesign Directive.

The ammonia RTDF series consists of air-cooled refrigeration units for high temperature (water inlet/outlet 12 °C/ 7 °C), medium temperature (glycol water inlet/outlet -2 °C/ -8 °C) and low temperature (glycol water inlet/outlet -19 °C/ -25 °C) refrigeration.

This series consists of 22 models covering the nominal cooling capacity range from 180 to 782 kW in high temperature, from 116 to 738 kW in medium temperature and from 120 to 365 kW in low temperature. They are available in a wide range of compressor power ratings from 96 hp to 2x 180 hp, in one or two cooling circuits.

Once installed, the unit can be fully managed from the electronic controller. This has the functions and features described in the regulation and control manual.

## 5 Operation

Ammolite process chillers are vapour compression refrigeration machines designed to operate at constant flow rates in primary hydraulic circuits.

| ⚠ WARNING! | **¡ Constant flow in primary circuit!** |
|---|---|
| | ► Chiller designed to operate exclusively with constant flow in the primary circuit, ensuring that the nominal flow required by the unit is always maintained. |
| | ► Failure to comply with these conditions may result in serious damage and void the warranty. |

### 5.1 Operating Limits

RTDF chillers with R-717 are designed to operate continuously within the temperature limits indicated in the following table. The unit should only be operated outside these limits on a one-off basis and only during start-up of the installation:

| | Water / glycol outlet temp. | | Recovery water inlet temp. of oil circuit | | Recovery water inlet temp. of condensation circuit | | Ambient temperature | |
|---|---|---|---|---|---|---|---|---|
| | Min | Max | Min | Max | Min | Max | Min | Max |
| High temp. | 0 °C | 15 °C | 20 °C | 50 °C | 20 °C | 40 °C | -15 °C * | 45 °C |
| Medium temp. | -15 °C | 0 °C | | | | | | |
| Low temp. | -30 °C | -15 °C | | | | | | |

* For operation at outdoor temperatures below -15 °C, the optional OCBT low outdoor temperature kit must be included.

ⓘ *If it is necessary to work outside the specified limits, please consult the manufacturer.*

## 6 Foreseeable Misuse

Use the unit only within the operating conditions approved by the manufacturer (see section "25 Technical Data").

The units are designed and tested to use as secondary fluid, exclusively water or propylene glycol/ethylene glycol in the minimum concentrations as specified in section 13.4.2.

| ⚠ WARNING! | **Inappropriate secondary fluid!** |
|---|---|
| | The use of secondary fluids other than the above requires the manufacturer's approval. |

## 7 Composition

The units are built on a steel profile frame, with a painted galvanised sheet steel body.

They consist of the following elements:

**Cooling and air circuits**

- Semi-hermetic screw compressor, with variable speed permanent magnet motor, suction and discharge service valves and electronic protection module.
- Compact V-shaped condenser(s) with microchannel coils in aluminium-magnesium alloy with Polyester Powder Coating treatment.
- Compact V-shaped condenser(s) with microchannel coils in stainless steel alloy and aluminium (optional).
- Compact V-shaped condenser(s) with microchannel coils in stainless steel and aluminium alloy with polyurethane anti-corrosion paint (optional).
- Variable speed electronic axial fans.
- Evaporator of welded stainless-steel plates welded with stainless steel.
- Proportional electronic expansion valve with control driver.
- Refrigeration circuits made of stainless-steel tube with welded connections, vertical oil separators with heating elements, oil filters, filter drier, sight glass for liquid and oil, high- and low-pressure switches, shut-off and service valves, pressure transducers and temperature probes.
- Single-stage vertical oil separator.
- Oil drain valves.
- Double safety valve for refrigerant discharge to protect against overpressure in the high- and low-pressure sectors.
- Liquid container.
- Oil circuit flow switch.
- Air-cooled oil cooler in V-shaped module with aluminium finned coils and stainless-steel tube with variable speed electronic axial motor fans.
- Liquid injection system for discharge temperature control with electronic expansion valve.
- Economizer for liquid subcooling and vapour injection (low temperature models only).
- Condenser heat recovery (optional).
- Heat recovery in the oil circuit (optional).

**Integrated hydraulic circuit**

- Hydraulic circuit made of stainless-steel tube.
- Flow switch.
- Pressure gauges and pressure and return thermometers.
- Air bleeder.
- Drain valve.
- Service valves.
- Flanged hydraulic connections.
- Mesh filter (only with pump set).
- Expansion vessel (only with pump set).
- Safety valve (only with pump set).
- Buffer tank (optional with pump set).
- Circulator pump (only with pump set).
- Variable displacement circulating pump (optional with pump set).
- Back-up pump (optional with pump set).

**Electronic controller**

- Control panel for power control and operation with forced ventilation.
- Differential, circuit breaker and thermal protection for compressors, fans and pumps.
- Electronic controller with intarNH3 software specifically designed to optimise the operation of the equipment.
- Fan speed control with proportional control of the condensing pressure.
- Timing and sequencing of compressors and rotation of circulator pumps balancing operating times.
- Protection of the condenser head pressure against extreme outside temperatures by progressive modulation of the compression stages.
- Digital readout of system temperatures and pressures with operating indicators.
- Alarm management with internal memorisation.
- External communication module with Modbus protocol and RS485 connection.

| | |
|---|---|
| **NOTE** | Refer to the Regulation Manual for the rest of the features of the electronic controller. |

## 7.1 Optional table

| Code | Name | Description | Advantages |
|---|---|---|---|
| **OAR3** ① | **General electrical network analyser** | Mains analyser on the unit's electrical supply | Allows the measurement of active and reactive energy, as well as the transmission of electrical variables in the electrical supply to supervision systems. |
| **OAR3C** ① | **Compressor power analyser** | Compressor independent power analyser | It allows the measurement of active and reactive energy, as well as the transmission of electrical variables of each compressor to supervision systems. |
| **OAR3P** ① | **Electrical network analyser prevention** | Mains analyser on the unit's electrical supply for prevention | Allows to limit the consumption of the unit |
| **OBIA** ② | **Condenser stainless steel - aluminium** | Condenser with stainless steel tube coils and aluminium fins | Increases the service life of condenser coils |
| **OBIAP** ② | **Condenser stainless steel - aluminium + polyurethane** | Condenser with stainless steel tubular coils and aluminium fins with anti-corrosion treatment based on polyurethane coating | Increases the service life of condenser coils |
| **OEPA** | **Epoxy coating oil chiller** | V-shaped 1-module air-cooled oil cooler with coils made of stainless-steel tube and aluminium fin with epoxy-coated anti-corrosion treatment, and electronic axial variable-speed motor fans | Increases the service life of condenser coils |
| **OCBT** | **Low-temperature condenser head pressure control** | Condenser pressure control for operation below -15 °C ambient temperature, this option includes: two ICS valves per circuit for minimum pressure control and for differential pressure control; two check valves per circuit; heating element integrated in the control panel and oil separator heater | Facilitates the creation of the necessary differential pressure between the condenser and evaporator without forcing suction vacuum operation and consequent overheating of the compressor windings. |
| **ORCA** | **Oil heat recovery 20%** | Oil heat recovery unit for hot water production (water inlet/outlet temperature: 40/50 °C) by means of waste heat recovery, consisting of stainless-steel plate heat exchanger welded in stainless steel, hydraulic circuit in stainless steel pipework and service taps | |
| **ORC080** | **Total heat recovery 80%** | Condenser for hot water production (water inlet/outlet temperature: 30/40 °C) by means of total condensation heat recovery, consisting of stainless-steel plate heat exchanger, hydraulic circuit in stainless steel pipe, service valves and threaded connections | |
| **OAXIT** | **AxiTop® Diffusers** | AxiTop® diffusers on condenser fans, for increased efficiency and reduced fan noise level | |
| **ASLB** | **Silentblock kit** | Kit consisting of rubber-metal anti-vibration suspensions with high rigidity and horizontal stability, including fasteners. | Dampens the vibrations of the unit |
| **OAACS** | **Acoustic insulation compressor and oil separator** | Acoustic insulation box assembled on the compressor, built in galvanised steel sheet with epoxy paint and internally coated with TCB-2 insulation, with built-in leak detector and extraction fan. Includes TCB-2 sound insulation enclosure for the oil separator. | Achieves acoustic attenuation of the sound level of compressors and oil separators |
| **OAACSP** | **Acoustic insulation compressor, oil separator and perimeter** | Perimeter acoustic insulation built in 20 mm thick natural cotton fibre felt bound with fireproof phenolic resin. It includes a acoustic insulation box assembled on the compressor, built in galvanised steel sheet with epoxy paint and internally coated with TCB-2 insulation, with a built-in leak detector and extraction fan; as well as a TCB-2 soundproofing enclosure for the oil separator. | Achieves acoustic attenuation of the sound level of compressors, oil separators and the perimeter of the refrigeration circuit. |
| **OPAR** | **Rodent protection panelling** | Perimeter panelling of the compressor compartment with rodent protection function, made of aluminium sheet with polyester paint coating, with a grid in the lower part of the panel. | Protects the compressor compartment against rodent entry |
| **ORAP** | **Anti-bird grid** | Grid kit with bird protection function for the condenser coils, made of aluminium with polyester paint coating. | Protects the condenser coils against the entrance of birds |
| **ARER** | **Spare electronic regulation** | Spare iPro intarChiller controller | Programmed iPro intarChiller electronic controller, supplied as spare part, for replacement in case of emergency |

① Optional incompatible with each other

② Optional incompatible with each other

## 8 Trials and Tests

All units have been previously tested and tested in the factory according to the following test protocol:

- Pressure test.
- Dielectric test.
- Leakage test by means of helium tracing in the refrigeration circuit. A leakage certificate is available on request.
- Refrigerant charge.
- Functional test, including cooling cycle check.
- Checking of safety devices; verifying their proper installation, compliance with regulations, and operation of pressure switches, as well as the leak detector.

## 9 Safety Devices

Units incorporate the following security measures:

- Incorporation of protection against abnormal refrigerant pressure levels for both high- and low-pressure sections.
- Dual safety valves to protect against high refrigerant pressure levels for both high- and low-pressure sections.
- Incorporation of automatic reset thermal protections in the compressor and motor fans that protect the motor windings.
- Protection circuit breakers.
- General earth connection of the control panel.
- Leak detector for R-717 (optional).
- Anti-freeze protection system, which will be activated in case of low glycol outlet temperature, low refrigerant temperature or low evaporating pressure.
- Flow switch in the hydraulic circuit to protect the installation in the event of a lack of flow.
- Expansion vessel (optional hydraulic circuit) to protect the system against water volume variations due to temperature variations.
- Safety valve (optional hydraulic circuit) to protect against abnormal pressure levels in the hydraulic circuit.

## 10 Emergency System

The electronic regulation of the units incorporates emergency control and alarm systems for the following reasons:

- Failure of temperature sensors.
- High and low temperature of the hydraulic circuit.
- High and low refrigerant pressure.
- Electronic board failure.
- In the event of a fault, the external alarm signal is activated and the unit enters safe operating mode.

## 11 Transport

### 11.1 Scope of delivery

Delivery includes:

- Chiller plant.
- Unit documentation.
- Electronic controller and driver for replacement electronic expansion valve (optional).

### 11.2 Transport conditions

Transport the unit as follows:

➲ Transport only in an upright position.

➲ Do not tilt the unit.

➲ Observe the symbols on the packaging.

➲ Lift and transport the unit exclusively on its pallet.

➲ Do not remove the packaging until its final location.

➲ Ensure that the condenser is not damaged.

➲ Never stack the units during transport.

➲ Use a pallet truck, forklift, or crane to move the unit.

### 11.3 Road transport

The transport of ammonia chillers may be subject to restrictions on the transport of dangerous goods under the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR 2019).

### 11.4 Goods inspection

| ⚠ WARNING! | **Damage due to tilting of the unit!** |
|---|---|
| | ▶ Ensure that the unit is not tilted. |

➲ Check the unit for transport damage by visual inspection.

➲ Document defects (e.g. with photos) and report them to the manufacturer, specifying manufacturing information and model designation. Pay attention to loose parts, dents and scratches as well as visible oil leakage.

➲ Ensure that the condenser is not damaged.

➲ Lift the unit from its base as described in section "11.5 Lifting the unit".

### 11.5 Lifting the unit

| ⚠ DANGER! | **Risk of damage!** |
|---|---|
| | ▶ Wear necessary personal protective equipment such as gloves, helmet and safety goggles. |

### Lifting by forklift truck

For lifting and handling of the units, follow the instructions below:

- ➲ Do not remove the pallet or packaging until the unit has been placed in its final location.
- ➲ Use a pallet truck or forklift.
- ➲ See lifting diagrams in section "29.1.1 Lifting by forklift truck".

| ⚠ DANGER! | **Risk of falling!** |
|---|---|
| | ► Ensure that the forklift or pallet truck shovels go all the way through the pallet. |

### Lifting by crane

For lifting and handling of the units, follow the instructions below:

- ➲ Do not remove the packaging until the unit has been placed in its final location.
- ➲ For lifting or handling the unit, use an outrigger crane or H-frame with slings to be attached to the transport anchorages provided at the base of the unit.
- ➲ Use slings of equal length to connect the unit to the H-frame.
- ➲ See lifting diagrams in section "29.1.2 Lifting by crane".

| ⚠ DANGER! | **Risk of deformation!** |
|---|---|
| | Use lifting beams for lifting the unit to avoid deformation of the unit's longitudinal members. |

- ➲ Remove the transport brackets and install the shock absorbers before placing the unit in the final location.

| **NOTE** | If shock absorber supports are installed, they shall be installed on the unit before final positioning, for more information about the location of the shock absorbers see section "29.3 Supports". |
|---|---|

## 11.6 Unpacking

Before and during unpacking:

- ➲ Comply with safety and environmental regulations at the installation site.
- ➲ Lift the unit from its base as described in section "11.5 Lifting the unit".
- ➲ Dispose of packaging material in an environmentally friendly manner in accordance with local regulations.

## 11.7 Storing unit

| **NOTE** | Store the unit in a dry place protected from the outside. |
|---|---|

Follow the instructions below if the unit is to be stored:

- ➲ Check that there are no leaks in the refrigerant circuit.
- ➲ Check that the hydraulic circuits are free of water.
- ➲ Keep the unit on the pallet until final installation is decided.
- ➲ Check that the electrical panels are closed.
- ➲ Keep the plastic film wrapped around the unit for protection.
- ➲ If you receive several units, never stack them on top of each other and store them in their upright position.

# 12 Pre-Installation

## 12.1 Preliminary considerations

- ➲ Refer to the dimensional drawings, see section "27 Dimensions".
- ➲ Observe the recommended minimum installation distances, see section "29.2 Minimum distances for installation and maintenance".
- ➲ Respect the discharge area of the safety valves to allow proper dissipation of ammonia in case of leakage, see section "29.2 Minimum distances for installation and maintenance ".

## 12.2 Unit location

As ammonia chiller plants are indirect systems (with refrigerant with toxicity category B and flammability category 2L), they are designed for installation in type 3 (according to EN378:2016) outdoor locations and can be installed in any type of premises according to EN378:2016:

| Category of premises | A. Public access | B. Supervised access | C. Restricted access |
|---|---|---|---|
| **$NH_3$ chiller** | ✓ | ✓ | ✓ |

* To consult the loads per circuit, see section "25 Technical Data".

## 12.3 Installation conditions

| ⚠ WARNING! | **Risk of structure collapse!** |
|---|---|
| | Check beforehand that the chosen surface is strong enough to support the weight of the unit, as well as the vibrations and stresses it may transmit, guaranteeing the integrity and safety of the installation. |

### Installation requirements

- ➲ Ensure that the ambient temperature is within the limits defined in section "5.1 Operating limits".
- ➲ Maintain 2500 mm from the sides of the unit to ensure adequate airflow and access.
- ➲ Maintain 1500 mm from the control panel side to ensure adequate access.
- ➲ Avoid direct heat radiation.
- ➲ Avoid installation in areas with magnetic interference pulses that have an impact on the operation of the unit.
- ➲ Avoid installation in an explosive environment.

➲ Avoid installation in commercial premises subject to potential fire hazards (consult applicable national standards and local regulations).

➲ Comply with local regulations for installation, operation, maintenance, and removal of the unit.

### 12.4 Support and weight sharing

➲ For the distribution of support and distribution of weights, see section "29.3.1 Support position and weight distribution".

### 12.5 Silentblocks

➲ It is recommended that the unit be installed on silent blocks suitable for the weight to be supported.

➲ For installation see section "29.3.2 Silentblocks installation".

## 13 Assembly

| | |
|---|---|
| ⚠ CAUTION! | **Risk of injury due to lack of protective equipment!**<br>► Use personal protective equipment.<br>► Ensure that personal protective equipment is properly worn and that tools are used correctly. |

### 13.1 Installing unit

The final location of the units will largely condition their proper operation. For optimum performance, follow the recommendations below:

➲ On receipt of the unit, check that no damage has occurred to the unit or its components.

➲ Install the unit outdoors.

➲ Clear the air intake spaces of the units to facilitate air intake and exhaust and avoid air recirculation as far as possible.

### 13.2 Fixing the unit

ⓘ *To ensure proper operation of the unit and to allow access for maintenance, respect the recommended minimum distances. See section "29.2 Minimum distances for installation and maintenance".*

➲ Remove the transport blocks from the unit and install the shock absorbers once the unit is in its final location.

➲ Install the unit in place on the shock absorbers respecting the minimum recommended distances.

➲ For the installation of shock absorbers, see section "29.3 Supports".

### 13.3 Safety valves

The safety valves are routed to the outside of the equipment through the chassis, with the aid of a discharge manifold at the top of the equipment of the "gooseneck" type.

➲ See section "29.2 Minimum distances for installation and maintenance ".

### 13.4 Hydraulic installation

RTDF chiller plants feature flanged connections.

#### 13.4.1 Hydraulic connections

**Hydraulic installation**

The hydraulic installation must be designed in accordance with the regulations in force and be equipped with the appropriate safety features.

The following are a few points that must be considered in a hydraulic installation:

- The circulator pump(s) shall be sized to ensure the nominal flow rate given on the nameplate and to overcome the internal pressure drop of the heat exchanger and other hydraulic elements (filter, valves, etc.).
- A mesh filter shall be provided in the hydraulic circuit downstream of the chiller with a clearance ≤ 1 mm.
- In case the volume of fluid recirculated in the installation in the case of minimum demand and for the smallest power stage is not sufficient to ensure a hysteresis of at least 5 minutes, a buffer or buffer tank must be provided to increase the volume of fluid in the installation. Generally, the minimum required fluid volume expressed in litres can be estimated from the minimum cooling capacity expressed in kW as follows:

$$V_{L\,min}[\mathrm{l}] \simeq 8 \times P_{min}[\mathrm{kW}]$$

- The hydraulic installation shall have bleeders at the highest points of the circuit, as well as drain cocks at all low points to allow draining of the entire circuit.
- The expansion vessel must be sized to compensate for the expansion and contraction of the fluid volume of the system from its minimum working temperature to the maximum system rest temperature, and as a function of the filling pressures and the set point of the safety valve. As a rule, the size required for the expansion vessel can be estimated from the total volume of fluid contained in the installation as follows:

$$V_e \simeq 0{,}03 \times V_T$$

- The system must be flushed with water to trap the impurities generated during installation of the system in the sediment filter. After flushing, the sediment filter must be removed and cleaned.
- Properly insulate pipes (after leakage tests) to reduce heat losses, prevent condensers and prevent damage due to freezing.

**Layout and dimensioning of hydraulic pipelines**

The layout and support of the piping has an important effect on the reliability of the operation and maintenance of the unit. Follow the recommendations below:

- ➲ Install hydraulic lines with the shortest and straightest possible route, avoiding unnecessary elbows and joints, and away from heat sources. Avoid chokes in the pipe and use bending radii greater than 3.5 times the diameter of the pipe.
- ➲ Avoid laying hydraulic pipes in passageways, such as lobbies and stairwells, or lift shafts. If a lobby is to be crossed, install the pipe no less than 2.2 m above the floor, in a joint-free section and protect the pipe with a rigid metal pipe or conduit.
- ➲ Pipes passing through fire resistant walls and ceilings shall be sealed in accordance with the classification of the relevant faces in the fire regulations.
- ➲ Generally, water loop pipes do not require insulation. Only in case of combined installations with chiller plants or in internal pipe runs where low outside temperatures may occur, the piping should be insulated to prevent surface condensation.
- ➲ Fix the pipes to a fixed support by installing clamps, taking care not to damage the insulation.

### 13.4.2 Secondary fluid charge and drain

| ⚠ WARNING! | **Risk of damage to hydraulic pump!** |
|---|---|
| | Do not use the hydraulic pump of the chiller to charge the hydraulic fluid or to vent the air. |
| | Do not use the hydraulic pump when idle, it requires hydraulic fluid for cooling. |

- ➲ Make a homogeneous mixture of water and glycol based on the concentration recommended in the following table according to the working temperature. This mixture must be made before being introduced into the hydraulic circuit.

| Fluid | % | T | ρ | $c_p$ | μ |
|---|---|---|---|---|---|
| **Water** | | 7 | 1000 | 4,21 | 1,4 |
| **Propylene glycol** | 15% | 5 | 1015 | 4,04 | 2,9 |
| | 25% | 0 | 1026 | 3,91 | 5,6 |
| | 30% | -5 | 1033 | 3,84 | 9,1 |
| | 35% | -10 | 1040 | 3,76 | 16 |
| | 40% | -15 | 1047 | 3,68 | 28 |
| | 45% | -20 | 1055 | 3,59 | 54 |
| | 50% | -25 | 1062 | 3,51 | 110 |
| | 55% | -30 | 1070 | 3,41 | 239 |
| | 60% | -40 | 1079 | 3,30 | 969 |
| **Ethylene glycol** | 10% | 5 | 1018 | 4,02 | 2,1 |
| | 20% | 0 | 1036 | 3,82 | 3,4 |
| | 30% | -5 | 1056 | 3,62 | 5,8 |
| | 35% | -10 | 1066 | 3,51 | 8,6 |
| | 40% | -15 | 1077 | 3,39 | 13 |
| | 45% | -20 | 1088 | 3,27 | 21 |
| | 50% | -25 | 1100 | 3,15 | 34 |
| | 55% | -30 | 1112 | 3,01 | 57 |

- T Temperature of the fluid (ºC)
- P Density (kg/m$^3$)
- $c_p$ Specific heat (kJ / kg·K)
- μ Dynamic viscosity (mPa·s)

- ➲ Bleed all the air out of the hydraulic circuit.
- ➲ Introduce the water/glycol mixture with the aid of an auxiliary pump at the lowest point of the installation.

### 13.4.3 Secondary fluid handling and risks

| **NOTE** | **Before the start-up:** |
|---|---|
| | Check that the heat transfer fluid is compatible with the materials present in the hydraulic circuit. |
| | In case of using additives and other fluids than propylene glycol or ethylene glycol, ensure that they are not considered as gases and belong to equipment 2 as defined in directive 2014/68/EU. |

The water used must be analysed, and the hydraulic circuit must include the necessary elements for its treatment: filters, additives, intermediate exchangers, purge valves, sacrificial anode, etc. to avoid corrosion, fouling and deterioration of the circuit.

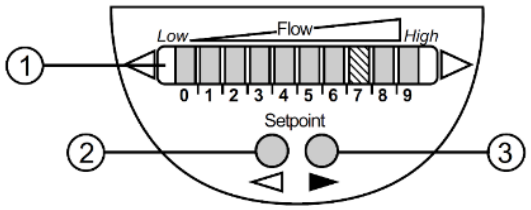
**Recommendations for water quality parameters:**

- pH neutral at 20 ÷ 25 °C (7,5 < pH < 9).
- Electrical conductivity 10 ÷ 600 μS/cm.
- Water hardness > 0.5 mmol/l. Recommended values are between 1,0 and 2,5 mmol/l. The formation of a scale layer can limit the corrosion of the copper, but too high values can lead to blockage of the pipes.
- Dissolved oxygen: avoid changes in water oxygenation, as this can lead to instability of copper hydroxides and increase particle size.
- Absence of ammonium ions $NH_4^+$ in water as it causes strong corrosion on copper.
- Values below 10 mg/l of chlorine ions $Cl^-$ due to the risk of perforation by corrosion or puncture.
- Values below 30 mg/l sulphate ions $SO_4^{-2}$ to avoid the risk of perforation corrosion.
- Absence of fluoride ions (< 0,1 mg/l).
- Absence of iron ions $Fe^{+1}$ and $Fe^{+2}$.
- Values < 0,1 mg/l dissolved silicon.

### 13.4.4 Flow switch

| ⚠ WARNING! | ¡ Do not alter, factory settings! |
|---|---|
| | ▶ Flow switch configured and verified at the factory.<br>▶ The flow switch settings must NOT be modified under any circumstances by the installer or end user.<br>▶ Any adjustments or interventions must only be carried out by INTARCON's Official Technical Support Service (SAT).<br>▶ Failure to comply with these conditions may result in serious damage and voiding of the warranty. |

**Operating and display elements**

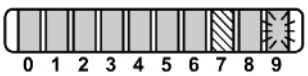



| 1 | **Operation display** |
|---|---|
| The green LEDs indicate the current flow (the LEDs 0 to 9 represent the range between no flow and maximum flow) | |
| A lighting LED indicates the position of the switch point (orange = output closed, red = output open) | |
| **2,3** | **Setting buttons for adjustment and configuration** |

**Operation**

After every power on all LEDs light and go out again step by step (during this time the output is closed if configured as normally open). The unit is then ready for operation.

In case of power failure or interruption all settings remain.

| **Operating indicators** | |
|---|---|
|   | Green LED bar: Current flow within the representation range.indication of the switch point (SP):<br>▪ LED orange: output closed<br>▪ LED red: output open |
|   | LED 9 flashes: current flow above the representation range. |
|   | LED 0 flashes: current flow far below the representation range. |
| **Interference indicators** | |
| Display OFF<br>(no LED lights): | Operating voltage too low (< 85 V AC) or failed.<br>Ensure a correct voltage supply. |

**Maintenance**

Recommended maintenance:

➲ Check the sensor tip for build-up from time to time

➲ Clean it using a soft cloth. Stubborn build-up (e.g. lime) can be removed using a common vinegar cleaning agent.

### 13.4.5 Heat recovery (optional)

| NOTE | **Freeze protection** |
|---|---|
| | The protection of the hydraulic circuit of the recovery water exchanger must be ensured for outside temperatures below 0 °C. |

This option allows the production of free hot water by heat recovery from the compressor discharge gases or from the oil cooling system of the unit.

- During installation of the unit, the heat recovery plate heat exchangers shall be insulated and protected against frost if necessary.
- For further details on the arrangement of the hydraulic connections, see sections "28 Hydraulic Connections and Electrical Supply".
- The hydraulic connection of the recuperators must not generate mechanical stress on the recuperators, if necessary, flexible connection sleeves must be installed.
- Refer to the principal diagram for the main components in section "26 Cooling Systems Diagrams".
- Install flow regulation and balancing valves at the outlet of the heat exchangers.
- The regulation and balancing of the flow rates can be done by reading the pressure drop of the exchangers.
- The volume of the recuperator water circuit should be as low as possible so that the temperature can rise quickly.
- The inlet temperature of the recovery water must be within the limits indicated in section "5.1 Operating Limits". It may be necessary to use a three-way valve with its regulator and probe to control the minimum inlet water temperature.
- The water circuit must include a volume-dependent expansion tank and a safety valve for pressure relief.

## 13.5 Power supply

| ⚠ DANGER! | **Risk of electric shock!** |
|---|---|
| | Any work on the electrical circuit must be carried out by qualified personnel. |
| | Before carrying out any work on the unit, ensure that it is de-energised. |

| **NOTE** | **Crankcase and oil tank heaters** |
|---|---|
| | The crankcase and oil tank heaters must be energised at least 24 hours before the unit is put into operation. |

Before making the electrical connection, check the state of the control panel and follow the recommendations below:

- ➲ Refer to the wiring diagram supplied by the manufacturer.
- ➲ Use electrical cables with the appropriate characteristics according to the consumption of the unit.
- ➲ Install the appropriate protection device, circuit breaker and differential, on the electrical supply line. When more than one equipment is installed, each line must be provided with its own protection system.
- ➲ The sizing of the cables is the responsibility of the installation company. To calculate the cross-section of the electrical supply wires, consider the electrical data on the nameplate, the length of the supply, type of wiring, etc.; comply with the regulations for electrical installations.

### 13.5.1 Basic electrical checks

- ➲ Check that the installed electrical elements have a short-circuit current of at least 25 kA in RTDF units.
- ➲ Check that the power supply complies with the specifications on the nameplate of the unit.
- ➲ Check that the power supply voltage is within the range specified in the electrical data table.

| **NOTE** | **Incorrect power supply voltage** |
|---|---|
| | Operating the unit with an incorrect power supply voltage is considered misuse and will invalidate the manufacturer's warranty. |
| | The voltage value between phases must be equal to that indicated on the nameplate of the unit, with an admissible tolerance of 5 %, otherwise contact the electricity company and do not start up the unit until the appropriate corrective measures have been taken. |

- ➲ Check that there is no excessive imbalance between phases.

| **NOTE** | **Excessive phase imbalance** |
|---|---|
| | Operation of the unit with excessive phase imbalance is considered misuse and will invalidate the manufacturer's warranty. |
| | If the phase-to-phase unbalance is greater than 2 % for voltage or 10 % for current, contact the utility company and do not start up the unit until corrective measures have been taken. |

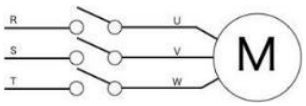
**Calculation of phase unbalance (%)**

$$Df\ (\%) = \frac{Maximum\ deviation\ from\ Taverage}{Taverage}\ x\ 100$$

Df = Phase imbalance (%)
Taverage = Average voltage between phases R, S and T.

**Example:** Power supply 400V 3 ~ 50Hz

**1.-** Measure the individual voltages in each of the phases:




$V_{RS}$ = 402 V $V_{RT}$ = 387 V $V_{ST}$ = 375 V

**2.-** Calculate the average voltage:

Taverage = ($V_{RS}$ + $V_{RT}$ + $V_{ST}$ ) / 3

Taverage = (402 + 387 + 375) / 3 = 388 V

**3.-** Check that the deviation of the average voltage with respect to the nominal voltage is less than 5 %:

Deviation (%) = [1 - (Taverage / Tnominal)] x 100

Deviation (%) = [1 - (388 / 400)] x 100 = 3% < 5

**4.-** Calculate the deviation of each phase with respect to the mean voltage:

$D_{RS}$ = 402 - 388 = 14 V

$D_{RT}$ = 388 - 387 = 1 V

$D_{ST}$ = 388 - 375 = 13 V

**5.-** Check that the voltage deviation of each of the phases with respect to the average voltage is less than 2 %:

In this case, the maximum deviation from the average voltage is 14 V, so the highest percentage of deviation is 14 V:

100 x 14 / 388 = 3.61 % > 2 %, therefore **NOT acceptable**.

**Conclusion:** The unit must not be operated under these conditions. Contact the power company for corrective action.

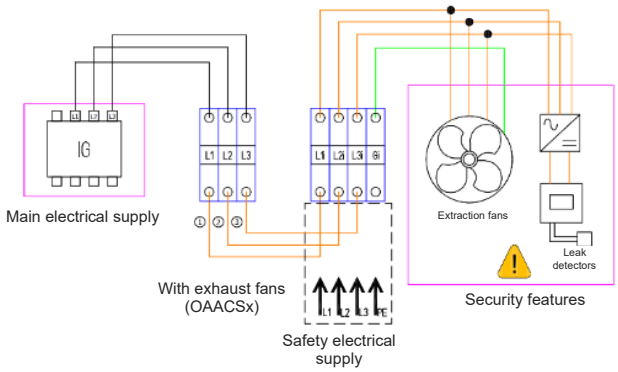
### 13.5.2 Electrical connections

Before making the electrical connection, check the state of the control panel and follow the recommendations below:

- ➲ Refer to the wiring diagram supplied by the manufacturer.
- ➲ All units have a three-phase power supply and have a 5-wire electrical supply, with the green-yellow wire always being the earth connection.
- ➲ Use electrical cables with the appropriate characteristics according to the consumption of the unit.
- ➲ Install the appropriate protection device, circuit breaker and differential, on the electrical supply line. When more than one unit is installed, each line must be provided with its own protection system.
- ➲ To calculate the cross-section of the electrical supply wires, the electrical data provided on the unit's nameplate and other factors such as the length of the electrical supply, the type of wiring used, etc., must be considered; in all cases respecting the current regulations for electrical installations.

### 13.5.3 Safety electrical supply

For added safety, the unit allows the possibility of using a separate electrical supply for exhaust fans and leak detector associated with the optional acoustic box (OAACSx). To make use of this configuration, proceed as follows:




- ➲ Disconnect jumpers 1, 2 and 3.
- ➲ Connect separate safety electrical supply (400V/460V 3 ~ 50Hz/60Hz, 3x 1.5mm2 + G) to terminals $L1_i$, $L2_i$, $L3_i$, $G_i$.

### 13.5.4 Modbus RTU communication

- ⓘ *The unit has three terminals +, - and gnd for connection to an RS-485 network for communication via Modbus RTU protocol.*
- ⓘ *Use twisted pair and shielded cable to avoid possible interferences.*
- ➲ Refer to the wiring diagram supplied.

## 14 Commissioning

| ⚠ DANGER! | **Risk of electric shock!** |
|---|---|
| | ▶ Ensure that start-up is carried out by qualified personnel only. |
| | ▶ Before power supplying the unit, ensure that nobody is working on the unit. |

### 14.1 Pre-commissioning actions

Before starting up the system, the complete installation must be checked. This requires the following checks to be carried out:

- ➲ Check that the unit has not been damaged in transit or storage.
- ➲ Check that all components correspond to the specifications.
- ➲ Check that all safety devices, documentation, and equipment required by the applicable standard are present.
- ➲ Check that pressure vessel documents, certificates, identification plates and instruction manuals are present.
- ➲ Check that the volume of the expansion vessel is sufficient.
- ➲ Check instructions and guidelines to prevent deliberate release of refrigerant into the environment.
- ➲ Check installation of fittings and valves.
- ➲ Check brackets and fixings.
- ➲ Check the quality of welds and other joints.
- ➲ Check protection against mechanical damage.
- ➲ Check accessibility for maintenance or repair, see section "29.2 Minimum distances for installation and maintenance".
- ➲ Check the quality of the thermal insulation.
- ➲ Check heat exchange surfaces for dirt.
- ➲ Check that the screws are securely fastened and the electrical connections are correctly installed. If work has been carried out inside the unit, check that no tools or foreign objects have been left inside, that there are no gas leaks and that both the assembly of the units and the hydraulic connections have been carried out properly.
- ➲ Prior to initial start-up or after a prolonged shut-down period, it is recommended to activate crankcase and oil tank heaters (if fitted) 24 hours in advance. If it is not possible to activate the heater sufficiently in advance, the compressor must be warmed up in a different way to ensure separation of the refrigerant and oil. This is particularly important during start-ups at low ambient temperatures.

Once these checks have been made, it will be necessary to carry out the relevant tests on the installation in accordance with the applicable national regulations, and

it is particularly recommended that appendix G of EN 378-2 be consulted. These tests must be recorded.

**Leakage tests**

The unit has been subjected to the relevant leakage tests during the manufacturing process (ask for a certificate if necessary), so it will not be necessary to repeat these tests during start up.

**Pressure testing of hydraulic system pipelines**

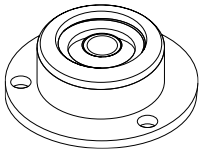
- ➲ Before testing, check that the pressure gauges are accurate by comparing them with a properly calibrated standard pressure gauge.
- ➲ The hydraulic system piping shall be hydraulically or pneumatically tested at a pressure of 1,3 times the maximum working pressure and maintained at this pressure for 4 hours.
- ➲ If leaks are found, they shall be repaired.
- ➲ Leaking brazed joints shall be reworked and shall not be repaired by soldering.
- ➲ Soft soldered joints containing leaks may be repaired by cleaning the leakage area, preparing the surface and re-soldering.
- ➲ Sections with defective welded joints shall be repaired and rewelded.
- ➲ After all repairs have been carried out, this pressure test shall be carried out again and the results recorded.

### 14.1.1 Levelling of compressors

**NOTE**

**Levelling check**

Before the start-up of the unit, the correct levelling of the compressors must be checked by observing the spirit level installed on the unit.



▶ Adjust the elevation of the unit supports if necessary.

### 14.1.2 Instructions to avoid overpressure

Before start-up, appropriate measures must be taken to ensure that the specified pressure and temperature limits are not exceeded.

Higher than recommended ambient temperatures can lead to a pressure increase in the heat transfer fluid, resulting in high pressure shutdown and in some cases to outgassing of the safety valves.

The following checks are necessary to prevent overpressure in the system:

- ➲ Avoid high ambient temperatures.
- ➲ Check that the air inlets and outlets of the condenser are free and that there is no air recirculation.
- ➲ Carry out a correct cleaning of the condenser coils.
- ➲ If the refrigeration system has been evacuated correctly, as the presence of air remains in the condenser and hinders condensation.
- ➲ Avoid overcharging the refrigerant, as this will reduce the condensing capacity.
- ➲ Check the correct opening of the water valve with the optional heat recovery to ensure the circulation of cooling water (condensation).

### 14.1.3 Precautions to prevent freezing of water

- ➲ Avoid the presence of water inside the hydraulic circuit when the unit is out of service and outside temperatures below freezing point may occur.
- ➲ Insulate all hydraulic lines after checking for leaks to reduce heat gains and prevent surface condensation.
- ➲ Protect the hydraulic circuit against possible freezing by using an anti-freeze solution (propylene glycol / ethylene glycol) in a suitable concentration depending on the minimum temperature that can be reached (see section "13.4.2 Secondary fluid charge and drain").

## 14.2 Commissioning

**NOTE**

Before starting up the system, it must be checked that the entire installation has been brought into compliance with the applicable national regulations and in accordance with EN 378.

All checks must be carried out under the responsibility of the refrigeration company and, where applicable, the competent refrigeration plant manager.

RTDF chiller plants are subjected to rigorous operating and performance tests at the factory to verify the correct operation of all the components of the refrigeration, hydraulic and electrical circuits. The chiller plants are supplied charged with refrigerant and tested in the factory. The following checks must be carried out for start-up:

**Unit**

- ➲ Check the location and recommended distances of the unit and control panels, respecting the indications given by the manufacturer. See section "29.2 Minimum distances for installation and maintenance".
- ➲ Check the direction of rotation of compressors and condenser fans.
- ➲ Check that the condenser is well ventilated. It must be ensured that there is no recirculation of the hot air generated in the condenser. To do this, the air intake temperature must be measured and compared with the ambient temperature.
- ➲ Check that there are no extraneous noises or vibrations.

**Hydraulic installation**

➲ Before the start-up of the hydraulic system, it must be checked that:

- The leakage test of the hydraulic circuit has been carried out.
- Water has been circulated through the hydraulic circuit to trap the impurities generated during the installation of the hydraulic system in the sediment filter.

➲ Check that the mesh filter is clean.

➲ Check with the refractometer that the glycol water is in the correct concentration for the operating temperature of the chiller.

➲ Ensure that the installation is completely vented. Check that the installation is correctly vented at the highest point of the installation and of the chiller plant.

➲ Check that the flow switch is working properly by switching off the power supply to the pump or by closing the return flow shut-off valve of the chiller plant. When the flow switch is activated due to lack of flow, the operation of the chiller plant (compressor(s) + pump(s)) is stopped, and an alarm is generated in the electronic regulation (see "Regulation and Control Manual").

➲ Check that the anti-freeze pressure switch (or probe) is set to a refrigerant evaporating pressure (temperature) value that ensures that the freezing point of the hydraulic fluid is not reached.

➲ Check that the anti-freeze temperature limit parameters at the outlet of the plate heat exchanger have adequate values to prevent freezing of the hydraulic fluid (see "Regulation and Control Manual").

➲ Check that the minimum evaporating pressure protection parameter has a value that ensures that the freezing point of the hydraulic fluid is not reached (see "Regulation and Control Manual").

➲ Partially close the water return valve to the chiller to increase the thermal gap between water inlet and water outlet and check the correct functioning of the frost protection.

➲ With the installation at operating temperature and at full compressor power, check that the thermal gap between the water inlet and outlet is as designed (usually 4K to 6K). If the thermal gap is higher, it is possible that the chiller plant has a low flow rate. If the thermal gap is lower, the chiller plant may have a high flow rate or the proportional control band parameter may need to be adjusted.

➲ Compare evaporating, condensing, water inlet and water outlet temperatures and/or pressures with design conditions.

➲ Check that the filling pressure of the hydraulic fluid is the design pressure (this value must be higher than 2 bar).

➲ Check the head losses of the installation by comparing the outlet pressure with the water inlet pressure.

➲ Check pressure and temperature at full and half load.

**Electrical installation**

➲ Connect the unit to a suitable socket outlet that is earthed and protected by a personal protective device (residual current circuit breaker) in accordance with the specifications on the rating plate.

➲ The power supply voltage at the individual control units and switchgear shall correspond to the nominal operating voltage of that unit or switchgear (see nameplate of the unit), with a tolerance of ± 5 %.

➲ The contracted power must be higher than the maximum consumption that all the units can have when operating at the same time and coexisting with the rest of the units and/or machinery existing in the installation. Manufacturer does not authorise the start-up of units with on-site lighting; a definitive electrical supply is required.

➲ The electrical supply cross-section must be adequate for the power consumption of the unit.

➲ Check the consumption of the unit at full load.

The appliance starts after a delay time. To set the delay time:

➲ Follow the "Regulation and Control Manual".

## 15 Noise Level

RTDF chiller plants incorporate components with a low noise level. The sound pressure levels are shown in the following table, depending on the optional sound attenuation settings installed:

| | Sound pressure level* depending on optional sound attenuation settings (dB(A)) | | |
|---|---|---|---|
| **Modell** | **Unit without optional** | **OAACS ①** | **OAACS ① + OAXIT ②** |
| **AWW-MPM-30961** | 57,4 | 55,0 | 48,5 |
| **AWW-MPM-41201** | 58,1 | 56,2 | 49,6 |
| **AWW-MPM-51922** | 60,0 | 57,2 | 50,9 |
| **AWW-MPM-61801** | 61,4 | 58,1 | 52,0 |
| **AWW-MPM-72402** | 60,8 | 58,6 | 52,1 |
| **MWW-MPM-20601** | 56,5 | 53,3 | 47,2 |
| **MWW-MPM-30961** | 57,4 | 55,0 | 48,5 |
| **MWW-MPM-31201** | 60,4 | 55,4 | 50,1 |
| **MWW-MPM-31202** | 59,0 | 55,2 | 49,3 |
| **MWW-MPM-41701** | 64,6 | 57,3 | 53,4 |
| **MWW-MPM-41801** | 64,6 | 57,3 | 53,4 |
| **MWW-MPM-51922** | 60,0 | 57,2 | 50,9 |
| **MWW-MPM-52402** | 63,2 | 57,7 | 52,7 |
| **MWW-MPM-73402** | 67,6 | 59,9 | 56,2 |
| **MWW-MPM-73602** | 67,6 | 59,9 | 56,2 |
| **BWW-MPM-31201** | 60,4 | 55,4 | 50,1 |
| **BWW-MPM-31202** | 59,0 | 55,2 | 49,3 |
| **BWW-MPM-31701** | 64,5 | 56,5 | 53,0 |

| | Sound pressure level* depending on optional sound attenuation settings (dB(A)) | | |
|---|---|---|---|
| **Modell** | **Unit without optional** | **OAACS** ① | **OAACS** ① **+ OAXIT** ② |
| **BWW-MPM-41801** | 64,6 | 57,3 | 53,4 |
| **BWW-MPM-52402** | 63,2 | 57,7 | 52,7 |
| **BWW-MPM-53402** | 67,4 | 58,9 | 55,8 |
| **BWW-MPM-73602** | 67,6 | 59,9 | 56,2 |

* Sound pressure level of the unit in free field with the compressor operating at full load (180 Hz, 3600 rpm), with directivity 1, measured at 10 metres from the source (non-binding value calculated from the sound power).

① **OAACS**: Acoustic insulation on compressor(s) and oil separators, see section “8.1 Options table”.

② **OAXIT**: AxiTop® diffusers on condenser fans, see section “8.1 Options table”.

The correct installation of the unit must comply with the appropriate noise levels. In determining these levels, the external environment must be considered for acoustic radiation, the type of building for transmitted noise, and the solid elements for vibration transmission. If necessary, have an acoustic study carried out by a specialised technician.

## 16 Maintenance

| ⚠ DANGER! | **Risk of cutting due to sharp ends!** |
|---|---|
| | ▶ Wear safety gloves when working on the unit. |

| ⚠ DANGER! | **Risk of burns due to leaking refrigerant!** |
|---|---|
| | ▶ Wear safety equipment when working on the refrigerant circuit. |

➲ During the service life of the system, the inspections and tests foreseen in the national regulations shall be carried out. Where similar standards do not exist in the national regulations, the in-service inspection information given in Annex D of EN 378-4 may be used.

➲ If a leak is suspected during the inspection, e.g. through the refrigerant temperature or capacity reduction checks, then the leak must be located using appropriate detection equipment and repaired and checked again after the repair in accordance with the regulations in force. The results of the inspection and subsequent actions taken should be included in the operating logbook.

➲ The refrigerant system operator shall ensure that the system is regularly inspected, monitored and maintained.

➲ The marking on the compressor or units must be replaced if any of the legends are illegible.

➲ Maintenance, even when no intervention or adjustment of the refrigerant system is required and no specialised refrigeration engineering knowledge is needed, shall be carried out by a suitably competent person, in such a way that:

- accidents to personnel are prevented;
- damage to property is prevented;
- the system components remain in good working order;
- the purpose and availability of the system are maintained;
- possible refrigerant or oil leaks are detected and repaired;
- energy loss is minimised.

➲ Carry out the maintenance operations indicated in section "16.2 Periodic preventive maintenance schedule".

In general, the metal parts of the unit (chassis, bodywork, heat exchangers, control panel, etc.) should be checked for corrosion. The state of all electrical connections must also be checked, as well as the leakage of the different circuits.

### 16.1 Repair tasks

The following repair work on the unit must only be carried out by a qualified refrigeration engineer:

- Replacement or modification of electrical elements of the unit.
- Modification of mechanical parts.
- Intervention in the refrigeration circuit.
- Handling of protection elements, control panel, start-up, stop and emergency switches.

In addition to the recommended maintenance tasks, the unit shall be affected by the applicable regulations in this area.

### 16.2 Periodic preventive maintenance schedule

RTDF chiller plants are subject to specialised maintenance which must be carried out by qualified personnel. In any case, the following regular preventive maintenance tasks should be carried out to maintain an optimum operating condition.

Maintenance operations shall be carried out in accordance with the following schedules:

**ROUTINE PREVENTIVE MAINTENANCE**

The system must be regularly tested and verified in accordance with the applicable national regulations. The following checks are recommended:

- Oil level in the container.
- Refrigerant charge and leakage.
- Valve stem seals leakage.
- Vibrations.
- Sound pressure and peculiar noises.
- Abnormal odours that may indicate leakage.
- Electrical connection.
- Corrosion of components.

- Damage to paintwork and insulation.
- Cleaning of the condenser and oil cooling coils.

**WEEKLY MAINTENANCE**

➲ With the unit operating at full load, check the following values:
- Check the hydraulic circuit pressure,
- Compressor suction pressure (on the low pressure side),
- Compressor discharge pressure (on the high pressure side),
- Visibility of the load in the sight glass (no bubbles),
- Difference between the water temperatures at the inlet and outlet of the heat exchanger.

➲ Check the status of the alarms on the electronic control (refer to the control manual for their meanings).

**MONTHLY MAINTENANCE**

➲ Perform the operations listed for WEEKLY MAINTENANCE.

➲ Check the refrigerant charge by checking the colour indicator on the liquid sight glass. If the sight glass indicates 'wet', recharge and replace the filter dryer after performing a circuit leak test.

➲ With the unit operating at full load, check the following values:
- Superheating in the compressor suction,
- Actual subcooling of the liquid at the condenser outlet,
- Compressor oil level.

➲ Check that the fans and pumps are working properly.

➲ Check the condition of all the components in the control panel.

➲ Check that all the components in the control panel are tight.

➲ Check the hydraulic circuit for leaks.

➲ Check the hydraulic filter for dirt.

**ANNUAL MAINTENANCE**

➲ Perform the operations listed for MONTHLY MAINTENANCE.

➲ Check the refrigeration circuit for leaks and ensure that no pipes are damaged. In the event of a leak, repair it immediately and check for leaks within one month of repair to ensure that the repair has been effective.

➲ Perform an oil contamination test. If acid, water or metal particles are detected, change the oil in the circuit. The type of oil is indicated in the technical specifications table.

➲ With the unit operating at full load, check the value between the outlet water temperature and the evaporation temperature.

➲ Check the operation of the high pressure switch(es). They must be replaced if they are faulty.

➲ Check the dehydrator filter for contamination (verifying that there is no temperature difference between the inlet and outlet in the pipe). Replace it if necessary.

➲ Check that no water has entered the control panel.

➲ Check the condition of the electrical cables and their insulation.

➲ Check the insulation of the compressor, fan and pump wiring.

➲ Check the condition of the compressor, fan and pump windings.

➲ Clean or replace the hydraulic filter.

➲ Bleed the air from the circuit.

➲ Check that the water and oil flow switches are working correctly.

➲ Check the condition of the thermal insulation on the pipes.

➲ Check the flow of water or glycol water.

➲ Check the condition and concentration of the glycol solution (ethylene glycol or propylene glycol).

➲ Inspect the glycol solution to detect the possible undesirable presence of oil or refrigerant from the primary circuit, which would indicate a heat exchanger failure.

➲ Check the hydraulic pipe for corrosion.

➲ In units with the optional heat recovery (ORCA, ORC080), carry out proper maintenance of the condensation hydraulic circuit, removing any possible incrustations on the walls of the pipes and exchangers.

**SPECIAL MAINTENANCE ELEMENTS**

Below are some recommendations for cleaning the unit's components:

### 16.2.1 Emergency fans

The correct operation of the fans must be checked every 12 months, and they must be replaced every 5 years.

### 16.2.2 Compressors

**MAINTENANCE SCHEDULE FOR COMPRESSOR COMPONENTS**

| Component | Operating hours | | | | | |
|---|---|---|---|---|---|---|
| | 50-100 | 1000 | 10000 | 20000 | 30000 | 60000 |
| Suction filter | | V | V | | V | V |
| Solenoid valves | | V | V | V | V | V |
| Non-return valves | | V | V | V | V | V |
| Bearings | | | | | | R |

| Component | Operating hours | | | | | |
|---|---|---|---|---|---|---|
| | 50-100 | 1000 | 10000 | 20000 | 30000 | 60000 |
| Engine protection device | V | V | V | V | V | V |
| Wiring | V | V | V | V | V | V |
| Screw connections | V | V | V | V | V | V |
| Oil filter | V | V | V/R | V | V/R | R |
| Oil (quantity / quality) | V | V | V/R | V | V/R | R |
| V→ Verify<br>R→ Replace | | | | | | |

### Bearings

The rotor bearings are designed for an operating time of 60,000 hours. However, this is only valid if the compressor is operated within the limits of the application, with enough, quality and always with oil at the correct temperature. Otherwise, the service life can be considerably reduced. In addition, the bearings are only designed to operate in the correct direction of rotation - an incorrect direction of rotation causes an inadmissible load on the bearings and can also lead to damage.

### Oil filter

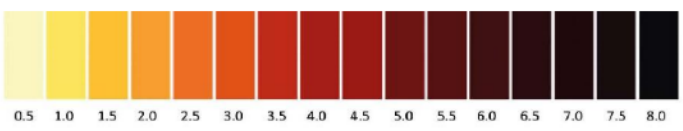
The differential pressure across the filter must always be less than 1.5 bar. If 2 bar is exceeded, the filter must be replaced. In any case, it is recommended to replace the filter every 60,000 hours.

### Oil change

In principle, there is no restriction on the durability of refrigeration oil because it is thermally and chemically very stable. However, since contamination and material abrasion cannot be completely avoided during operation, the quality of the oil should be checked at least once a year. For example, acidic oil damages the winding insulation and can damage the electric motor. The wear and operating mode of the compressor can also be monitored indirectly through the oil quality. **To properly evaluate the oil, a laboratory test is necessary**. However, a first assessment of whether the oil is still usable can already be made based on the appearance of the oil.

### Evaluation of oil quality

The evaluation of the oil quality is based on the colour classification of the oil according to the ASTM colour classification (ASTM D 1500). The classification is as follows:




| ASTM colour | 0,5-1,5 | 1,5-2,5 | 2,5-4,0 | 4,0-6,0 | 6,0-8,0 |
|---|---|---|---|---|---|
| Appearance | Almost transparent, yellowish, without solid components | Almost transparent, yellow to orange, low amount of solid components | Almost transparent, orange to light brown, low amount of solid components | Almost transparent, light brown to reddish brown, low amount of solid components | Reddish brown to dark brown, low amount of solid components |
| Warning | Usable | | Questionable use | Replacement of all oil | Replacement of the oil charge - serious contamination analysis |

**NOTE** This classification applies to clear appearances with low solids content. A clear turbidity indicates water contamination, a higher solids load indicates high wear. With such an appearance, regardless of the colour of the oil, the causes must be examined to avoid serious damage.

### 16.2.3 Maintenance checklist

The installer must carry out the maintenance actions listed in section "16.2 Periodic preventive maintenance schedule" before contacting the manufacturer's service department. In addition, a checklist is included, see section "31. Maintenance checklist".

## 16.3 Proper positioning of the sensors for temperature measurement

ⓘ *Use only calibrated temperature probes for measurement.*

### 16.3.1 Condenser air temperature

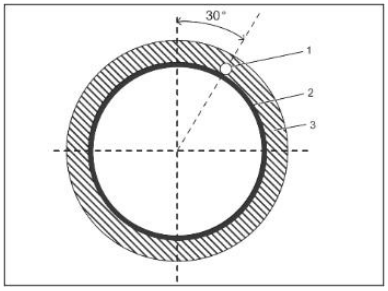
The chiller plants are equipped with an outdoor temperature sensor at the condensing air inlet.

Consult the measured value via the electronic controller (see control and regulation manual).

### 16.3.2 Temperature in refrigerant pipes

The chiller plants have temperature probes installed, to be read by the electronic controller, installed in the chiller:

- Before the electronic expansion valve,
- Inlet to the plate heat exchanger,
- Plate heat exchanger outlet.




➲ If present, remove the insulating material **3** at the measuring point.

➲ Position and fix the appropriate temperature sensor **1** in the refrigerant pipe **2.** The temperature sensor must lie completely flat.

➲ Insulate the measuring point with insulating material (at least 5 mm) before measurement.

➲ Measurement.

➲ After the measurement, remove the temperature sensors and isolate the measuring point adequately.

### 16.3.3 Temperature in hydraulic pipes

➲ If present, remove the insulating material at the measuring point.

➲ Fit and secure the temperature sensor, which must lie completely flat.

➲ Insulate the measuring point with insulating material (at least 5 mm) before measurement.

➲ Measurement.

➲ After the measurement, remove the temperature sensors and isolate the measuring point adequately.

| | |
|---|---|
| **NOTE** | The chiller plants have temperature probes installed for reading through the electronic controller (see control and regulation manual) and thermometers. |

### 16.3.4 Evaporator water temperature

The chiller plants have temperature probes installed for reading through the electronic controller (see control and regulation manual) and thermometers.

### 16.3.5 Heat recovery loop water temperature

The chiller plants have temperature probes installed for reading through the electronic controller (see Control and Regulation Manual) and thermometers.

## 16.4 Cleaning

| | |
|---|---|
| ⚠ DANGER! | **Risk of electric shock!**<br>Disconnect the unit from the power supply.<br>► Ensure that cleaning is carried out by qualified personnel only. |

| | |
|---|---|
| **NOTE** | **Damage due to improper cleaning!**<br>Do not clean with a water or steam jet. |

➲ Periodically check the unit for soiling after initial start-up and clean if necessary.

➲ Clean the unit at least once a year.

➲ The cleaning interval depends on:

- Degree of soiling
- Environmental conditions

➲ Dismantle the sheet metal housing to clean the individual components (see section "20 Disassembly").

➲ Clean the condenser coil only with a soft brush or compressed air.

➲ Do not crush or damage the thin fin blades when cleaning.

➲ Do not use pointed or sharp-edged objects.

➲ Remove very greasy residues with an industrial cleaner.

### 16.4.1 Surface cleaning

➲ To keep the unit free of dust and dirt, simply wipe the surface of the housing with a damp cloth.

➲ Do not use detergents or solvents.

### 16.4.2 Condenser cleaning

➲ As the unit operates, dust and dirt will settle on the surface of the condenser, making airflow difficult.

➲ Periodically, more or less frequently depending on the environment of the unit, the condenser will need to be cleaned. To do this, remove the protective grid by unscrewing the lower screws.

➲ Use air, blowing from the inside to the outside, to remove dirt that has accumulated in the coil inlet, or if this is not possible, use a brush from the outside of the condenser.

➲ Do not apply stress on the fins to avoid deformation.

### 16.4.3 Filter drier

➲ The function of the filter is to keep the refrigeration circuit clean and free of humidity, neutralising the acids that may be found in it.

➲ To check for contamination, measure the temperature difference at pipe level, at the inlet and outlet of the filter drier. If necessary, the filter drier should be replaced.

### 16.4.4 Oil

➲ Regularly check the quality of the oil by means of a contamination test.

➲ If acid, water or metal particles are present, replace the oil in the circuit concerned as well as the filter drier.

➲ If it is necessary to change the oil charge, only new oil identical to the original oil should be used.

**Oil change procedure**

| | |
|---|---|
| ⚠ DANGER! | **¡ Risk of asphyxiation, narcotic effect or cardiac arrhythmia due to inhalation of refrigerant !**<br>► Ensure that the work area is well ventilated. |

| | |
|---|---|
| ⚠ CAUTION! | **¡ Exposure to refrigerant!**<br>It may cause eye, skin, lung, and neurological injuries and irritation.<br>► Use appropriate personal protective equipment.<br>► Ensure that only qualified personnel perform work on the unit. |

| ⚠ CAUTION! | **Electrical hazard!**<br>Rules for unstressed work:<br>▪ Switch off the installation<br>▪ Prevent any possible back feed<br>▪ Check for absence of voltage<br>▪ Earthing and short-circuiting<br>▪ Mark and delimit the work area.<br>Work in accordance with safety and environmental standard EN 378:2017. |
|---|---|

| **NOTE** | If it is necessary to change the oil, only new oil identical to the original oil recommended by the manufacturer should be used.<br>► Deliver used oil to an authorised waste disposal company. |
|---|---|

The steps to follow to change the oil in the unit are detailed below:

➲ Disconnect the power supply to the unit.

➲ Open the balancing valves to equalise the pressures in the refrigerant and oil circuits.

➲ Recover the refrigerant gas.

➲ Empty all sections of the circuit that may contain oil: battery, compressor, separator and oil line at the lowest point, considering any possible residues.

| ⚠ CAUTION! | **¡ Exposure to refrigerant!**<br>► Use appropriate personal protective equipment. |
|---|---|

➲ Replace the oil line filter and compressor filter (on high-power models).

➲ Perform a triple vacuum procedure on the refrigerant and oil circuits.

➲ Break the vacuum by charging the refrigerant.

➲ Charge the oil with slight overpressure and ensure that the oil reaches the compressor to prevent a dry start.

### 16.4.5 Refrigerant

| ⚠ DANGER! | **Risk of burns to eyes or skin due to leaking refrigerant!**<br>Wear safety goggles and gloves when working on the refrigerant circuit. |
|---|---|

| ⚠ CAUTION! | **Exposure to refrigerant!**<br>May cause eye, skin, lung and neurological damage and irritation.<br>► Use appropriate personal protective equipment.<br>► Ensure that only qualified personnel carry out work on the unit. |
|---|---|

| ⚠ WARNING! | **Refrigerant recovery!**<br>There is an obligation to recover the refrigerant for subsequent reuse and/or disposal and it must be handed over to an authorised waste manager within a period not exceeding six months. |
|---|---|

| **NOTE** | The unit is designed to operate with the refrigerant indicated on the nameplate. The use of any other refrigerant in this unit invalidates the warranty. |
|---|---|

➲ The leakage of the cooling circuit must be checked regularly.

➲ In case of leakage, the leak must be repaired immediately, and a leakage check must be carried out within one month of repair to verify that the repair has been effective.

➲ For a partial opening of the refrigerant circuit, precautions must be taken to minimise the amount of refrigerant lost by pumping and isolating the total charge in another part of the circuit, as described in the following section.

### 16.4.6 Hydraulic circuit

➲ After installation and prior to connection and start up, the hydraulic system must be thoroughly cleaned, and any remaining material or impurities must be removed.

### 16.4.7 Hydraulic filter (optional)

➲ The function of the filter is to keep the hydraulic circuit of the unit free of particles that could compromise the life of the unit's components. Periodically, the filter should be checked for dirt and the filter mesh should be replaced if necessary.

## 16.5 Cooling circuit intervention

Although it is unusual to have to intervene in the primary refrigerant circuit of a chiller plant, the following describes the procedure and safety measures to be considered when dealing with toxic and slightly flammable refrigerants.

All flammable gases, when mixed with air in a certain proportion, produce a flammable mixture. Any source of ignition could pose a serious problem, which is why you should always be aware of all safety precautions when working with this type of refrigerant.

All equipment used in a repair process must be suitable for working with ammonia, all tools and measuring equipment must be suitable for this purpose. Special attention should be paid to the following:

- Refrigerant recovery unit
- Leak detectors
- Refrigerant recovery bottles
- Portable lamps

**SECURITY CHECKS**

Before starting work, a few checks must be carried out:

- General work area: Work in confined spaces is prohibited.
- Checking for the presence of refrigerant: A suitable ammonia detector must be always used before and during work to check that the ambient

concentration of refrigerant is less than 10% of the LII (lower flammability limit).

- Check for the presence of a fire extinguisher: Suitable fire extinguishing equipment must be available and the charge and pressure (at least 2 kg of dry powder or equivalent capacity) must be checked.
- Presence of ignition sources: No work involving the presence of ignition sources shall be carried out on systems or piping containing flammable gas. Before commencing any work, the work area shall be carefully inspected with the objective of eliminating any possible sources of ignition.

| ⚠ DANGER! | **Risk of ignition!** |
|---|---|
| | The discharge of static electricity can also be considered as a possible source of ignition, so before carrying out any intervention, contact should be made with a grounded metal beam or structure. |

- Work area ventilation: Ensure that the work area is sufficiently ventilated before accessing the refrigerant system or performing any work.
- Check leak detection and forced ventilation systems, if any, for proper operation.
- Check for the possible presence of refrigerant and/or oil in the secondary fluid.
- Check that the labelling of the unit is correct and still legible.
- Check that there is no voltage supply to the unit until the fault has been rectified.

| ⚠ CAUTION! | **Electrical hazard!** |
|---|---|
| | Rules for unstressed work:<br>▪ Switch off the installation<br>▪ Prevent any possible back feed<br>▪ Check for absence of voltage<br>▪ Earthing and short-circuiting<br>▪ Mark and delimit the work area.<br>Work in accordance with safety and environmental standard EN 378:2017. |

It must be verified that, after an intervention on a component, the seals of the protective housings or the wiring has not been damaged. In short, it must be ensured that the safety of the component is still maintained after the intervention.

**Refrigerant gas recovery**

➲ Even if it is possible to isolate the refrigerant in parts of the refrigerant circuit, it is advisable to recover the entire refrigerant circuit charge in the event of an intervention operation.

➲ Once the refrigerant charge is recovered, several dry nitrogen sweeps must be performed, the vacuum operation must be performed, and again nitrogen sweeps must be performed until no refrigerant remains.

➲ It must be ensured that the vacuum pump outlet is not close to any source of ignition and that the ventilation around the vacuum pump is adequate.

➲ The recovery process must be maintained until the pressure gauges are at -0.7 bar or lower. Because ammonia is very soluble with oil, several recovery cycles may be necessary.

➲ Perform the triple-vacuum operation as described in the following section "Refrigeration system triple-vacuum procedure".

**Refrigeration system triple-vacuum procedure**

➲ To remove moisture from the refrigerant pipe, perform the following triple-vacuum procedure:

1. Purge the low and high circuits with dry nitrogen.
2. Create a vacuum on the high and low sides.
3. Stop the pump. Without losing the vacuum and taking care to purge the hose, slowly inject dry nitrogen up to a pressure of 2 PSIG for approximately 10 minutes.
4. After 10 minutes, break the vacuum by turning on the pump, causing the pump to draw in the 2 PSIG, thus removing the moisture absorbed by the gas.
5. Perform vacuum 30 min. more, after 10 min. vacuum repeat procedure 2 more times.

**Refrigerant charge**

In addition to the above, the following considerations should be considered when carrying out the refrigerant charge:

- It must be ensured that there are no traces of other refrigerants in the hoses.
- The refrigerant bottles must be in an upright position and secured to prevent them from tipping over.
- It must be ensured that the system is properly grounded before charging.
- The total load that has been added to the system should be noted.
- Care must be taken not to overcharge the refrigerant system. It is recommended to charge by weight strictly in accordance with the quantity indicated on the nameplate of the unit.

It is important that after the charging procedure a leakage test is performed before starting the unit.

# 17 Failure Analysis

## 17.1 Most common problems and measures to be taken

| Symptoms | | Causes | Solutions |
|---|---|---|---|
| Compressor does not start | Compressor safety circuit is open | a) A protective device has tripped.<br>b) No water flow in the evaporator<br>c) The flow switch is open | a) Check the system and determine the cause of the trip. When everything is in perfect condition, reset the protective device.<br>b) Check pump and filters. Measure flow rate<br>c) Check the condition of the flow switch and verify liquid circulation in the evaporator. |
| | Compressor safety circuit is closed | a) Anti-short-cycle timing enabled<br>b) Lack of power supply<br>c) Compressor thermal protection activated<br>d) Compressor failure | a) Waiting for the anti-short-cycle time to elapse<br>b) Check the power supply, differential, circuit breaker...<br>c) Check for possible voltage drop on the network<br>d) Overhaul and/or replace compressor if necessary |
| | As soon as the compressor is about to start, the voltage is too low. | a) Mains voltage too low<br>b) Excessive voltage drop at the electrical supply | a) Contact the electricity company<br>b) Check electrical supply section and length |
| Compressor runs intermittently | Activation of frost protection | a) Activation of frost protection<br>b) Set point temperature too low<br>c) Low refrigerant charge<br>d) Low water flow in the evaporator<br>e) Evaporator partially clogged<br>f) Frozen evaporator<br>g) Fluid glycol deficit (%) | a) Check the parameterisation of the frost protection (see regulation and control manual).<br>b) Check that the Set Point is appropriate according to the % of glycol in the mixture.<br>c) Check the refrigerant charge and for possible leaks. Add the corresponding charge.<br>d) Check the water pump<br>e) Determine the degree of fouling by measuring the water pressure drop between the inlet and outlet.<br>f) Measure the pressure drop in the hydraulic circuit. Keep the water circulating (with the compressors stopped) until the evaporator is completely defrosted.<br>g) Adding the appropriate proportion of glycol as appropriate |
| | High pressure switch trip | a) High pressure switch trip<br>b) Low heat exchange in the condenser (dirty condenser and/or low air flow rate)<br>c) Condenser fan out of order<br>d) Water temperature too high<br>e) Air in the cooling circuit<br>f) Very high air inlet temperature | a) Check the differential of the high-pressure switch<br>b) Check air circuits (flow rate, recirculation, clogged air outlets)<br>c) Repair<br>d) Check temperature set point<br>e) Empty and reload<br>f) Check the adjustment of the control thermostat |
| | Bubbles are visible in the sight glass, activation of the low-pressure switch. | a) Low pressure switch trip<br>b) Low refrigerant charge<br>c) Clogged filter drier | a) Check the differential of the low-pressure switch<br>b) Check the charge through the sight glass in the liquid line, perform a leak test, repair if necessary, and recharge again.<br>c) Change it |
| | Evaporating pressure too low, activation of the low-pressure switch | a) Frozen plate heat exchanger<br>b) Liquid filter clogging (has different inlet and outlet temperature)<br>c) Lack of gas<br>d) Very low condenser head pressure<br>e) Expansion valve clogged | a) Check operation of the refrigerant antifreeze sensor.<br>b) Changing the filter<br>c) Search for leakage, complete the load<br>d) Condenser air temperature too low (very high air flow rate), adjust condenser control settings<br>e) Check for possible moisture ingress in the circuit. |
| Unit does not cool, and compressor runs in very long cycles or continuously. | The unit works but does not lower the water temperature. | a) Defective thermostatic sensor.<br>b) Unit incorrectly dimensioned for the load of the installation<br>c) Insufficient air flow or recirculation of air<br>d) Dirty or clogged condenser | a) Check probe value, adjust correction parameter, or replace<br>b) Resize the unit<br>c) Check air circuits (flow rate, recirculation, clogged air outlet)<br>d) Cleaning, clearing air intakes |
| | Suction pressure too high | a) Excessive refrigerant demand on the evaporator | a) Check if the system load is adequate |
| | Very low glycol temperature | a) Set point set too low<br>b) Defective control probe | a) Check Set Point Adjustment<br>b) Check and/or replace the probe |
| | Noisy compressor, low discharge pressure or abnormally high suction pressure | a) Low oil level<br>b) Defective compressor | a) Add oil<br>b) Contact manufacturer, it may be necessary to replace the compressor. |
| Noisy unit | The unit is running noisily | a) Unit installed without anti-vibration mounts<br>b) Possible cavitation in the pump(s) | a) Install anti-vibration mounts<br>b) Check bleeding and pressure of the hydraulic circuit. |
| | Compressor makes abnormal noise | a) Loose fixing<br>b) Lack of oil<br>c) Compressor defect | a) Set<br>b) Add oil up to recommended level<br>c) Replace compressor |

| Symptoms | Causes | Solutions |
|---|---|---|
| High condensing temperature | a) High glycol temperature<br>b) Excessive refrigerant charge and/or presence of air or uncondensables in the circuit | a) Check the heat load and wait for the glycol temperature to approach its set point.<br>b) Bleed off air or uncondensables and recover excess refrigerant |
| The unit stops by activation of the flow switch. | a) Clogged hydraulic filter<br>b) Existence of air in the hydraulic circuit<br>c) Hydraulic pump cavitation<br>d) Defective hydraulic pump | a) Clean and/or replace filter<br>b) Bleed the hydraulic circuit properly to ensure the absence of air.<br>c) Measure the suction pressure of the pump and ensure that it is always higher than 0.8 bar rel. to prevent possible cavitation of the pump.<br>d) Check and/or replace pump |
| Very high pump delivery pressure | a) Closed shut-off valves<br>b) Dirty sediment filter<br>c) Excessive pressure drops in the hydraulic circuit<br>d) Excessive glycol in the fluid | a) Opening keys<br>b) Dismantle and clean sediment filter<br>c) Check length and diameters of pipes and fittings<br>d) Check the appropriate ratio of the glycol mixture (%) accordingly. |
| Visible oil leakage. Oil level too low | a) Oil leakage | a) Check and/or repair the leak. Add oil as required |

## 18 Environmental Impact

### 18.1 Energy Efficiency Ratio (EER)

The Energy Efficiency Ratio (EER) of the chiller plant is defined as the ratio between the cooling capacity and the input power of the chiller for specific operating conditions:

$$EER = \frac{Pf}{Pa}$$

The absorbed power Pa, will be the electrical power absorbed by the unit, while the cooling power Pf can be calculated by the following expression:

$$Pf = \frac{Q \cdot c_p \cdot (Te - Ts) \cdot \rho}{3600}$$

where:

- Pf Cooling capacity (kW)
- Q Flow rate of glycol water ($m^3/h$)
- $c_p$ Specific heat of glycol water (kJ/kg K), as a function of % glycol
- Te Evaporator inlet temperature (°C)
- Ts Evaporator outlet temperature (°C)
- ρ Density of glycol water ($kg/m^3$), as a function of % glycol

* For nominal conditions, the EER values can be found in the technical characteristic's tables (see section "25 Technical Data").

### 18.2 Good practices to minimise energy consumption

It is important to know that the EER value will increase when the evaporating temperature is raised, as well as when the condensing temperature is lowered. To operate at maximum EER conditions, the following is recommended:

➲ Locate the unit in a well-ventilated area avoiding recirculation of air in the condenser.

➲ Adjust the optimum percentage of the glycol mixture accordingly.

➲ Periodic cleaning of the condenser as well as the hydraulic filters.

➲ Adjust the Set Point of the unit to the real needs of the application, avoiding working with an unnecessarily low Set Point.

➲ Use the available floating condenser functions.

➲ In variable flow installations, it is recommended to use 2-way valves instead of 3-way valves.

## 19 Decommissioning

For prolonged downtime of the unit:

➲ Unplug the unit from the mains.

For temporary downtime of the unit:

➲ Follow the "Regulation and Control Manual".

To carry out the indefinite decommissioning of the unit, the following actions must be carried out:

➲ Switch off the unit.

➲ Disconnect the unit from the mains.

➲ Under no circumstances should the refrigerant gas be released into the atmosphere.

➲ Uninstall the unit from its current location.

➲ Have the unit delivered to an authorised waste management company as described in section "11 Transport".

## 20 Disassembly

| ⚠ DANGER! | **Risk of skin cuts due to sharp ends!** |
|---|---|
| | ▶ Wear safety gloves when working with the unit. |

ⓘ *Disconnect the unit from its power supply during disassembly of the registrable panels.*

ⓘ *The panels can be fitted by means of lateral screws.*

➲ Remove the panels to gain access to the interior of the unit and its components.

➲ Remove the top panel to access the condenser fans for repair.

## 21 Waste Management

| NOTE | Do not release the refrigerant gas into the atmosphere. Although it is a natural refrigerant, its recovery is recommended. |
|---|---|

All materials used for the manufacturing and packaging of the unit are environmentally friendly and/or recyclable.

- ➲ The refrigerant must be removed by specialists.
- ➲ Dispose of the refrigerant in an environmentally compatible manner and in accordance with applicable disposal regulations.
- ➲ Dispose of defective units in an environmentally compatible manner in accordance with the applicable disposal regulations.
- ➲ Dispose of the unit or any of its components through a company authorised to remove and recycle this waste, respecting the environment and in accordance with current legislation.
- ➲ Dispose of electrical and electronic equipment separately for proper management in accordance with the provisions of Directive 2012/19/EU of the European Parliament.

## 22 Regulation and Control

Once installed, the unit can be fully controlled from the electronic controller. RTDF chillers incorporate a sophisticated electronic controller, the functions, and features of which are described in the "intarNH3 Regulation and Control Manual" supplied. Similarly, if there are two or more chiller plants connected to a common secondary hydraulic circuit, please also refer to the regulation and control manual for this secondary circuit.

### 22.1 Control logic

The controller is delivered by default configured with the following logic:

- The control shall consider the number of compression loops.
- Depending on the deviation between the reading of the water return probe (default selection) and the set temperature setpoint, the compressors will be activated, and the inverters will modulate their operation according to the required cooling capacity.
- The electronic controller will command the progressive and proportional start of the compression stages, for more details see "Regulation and control Manual".

- ➲ Refer to the "Regulation and Control Manual" to adjust the temperature setpoint in the unit control.

The RTDF process chiller plants are managed by an electronic board and digital control unit, whose functions and characteristics are described in the "Regulation and Control Manual" supplied by the manufacturer.

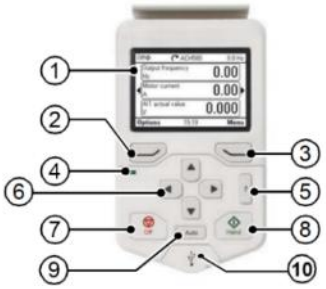
Similarly, if two or more chiller plants are connected to a common secondary hydraulic circuit, also refer to the "Regulation and Control Manual" for this secondary circuit.

### 22.2 Compressor frequency inverter

#### ABB frequency inverter series ACH-580-1

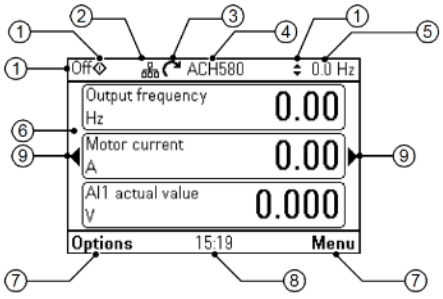
| NOTE | Only qualified personnel should service the inverter.<br>Before working on the inverter, read the instructions in the chapter "Safety Instructions" in the "ACH580 Frequency Inverter manual" supplied. |
|---|---|

#### Control panel




| | |
|---|---|
| 1 | **Control panel screen** |
| 2 | **Left multifunction button.** Use to exit and cancel. Press and hold to exit each view until you return to the home screen. |
| 3 | **Right multifunction button.** Use to select, accept, and confirm. |
| 4 | **Status LED.**<br>**Off:** Panel without power supply.<br>**On and not blinking.** Green: The inverter works normally. Red: active fault in the drive or fault in the panel bus. Check display for fault. **Blinking/flashing.** Green: Blinking: warning active. Flashing: data transfer. Red: Active fault, to restore power cycle the inverter. Blue: Bluetooth function. |
| 5 | **Help.** The content of the help is applied according to the view on the display. |
| 6 | **Navigation buttons**. |
| 7 | **Off.** Function disabled at factory. |
| 8 | **On.** Function disabled at factory. |
| 9 | **Auto.** In local control: The drive will switch to external control. |
| 10 | **USB connector.** |

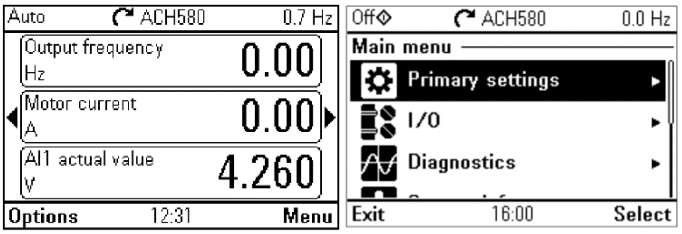
#### Control panel display layout



| | |
|---|---|
| **1** | **Control place and related icons.**<br>**No text**. Indicates local control but governed from another device.<br>**Local**. Control from this panel.<br>**External**. Controlled by I/O or fieldbus. |
| **2** | **Panel bus.** Indicates that more than one converter is connected to the panel. |
| **3** | **Status icon.** The direction of the arrow indicates forward (clockwise) or reverse (counterclockwise) rotation. |
| **4** | **Inverter name.** |
| **5** | **Reference value.** According to menu. |
| **6** | **Content area.** Current content of the view. |
| **7** | **Menu.** Selection of multifunction buttons. |
| **8** | **Clock.** |
| **9** | **Side arrows.** When visible, the navigation buttons are enabled. |

### Main settings, I/O and diagnostics

To access these menus from the home view, first select **Menu** to go to the **Main Menu**. In the **Main Menu**, select the desired menu.




| | |
|---|---|
| **Main settings** | Start, stop and reference. Ramps. Limits. PID control. Communication. |
| **I/O** | Digital and analogue inputs, output relays and I/O extension |
| **Diagnostics** | Diagnostic information: faults and warnings. Helps to solve potential problems. |
| **System info.** | Converter and control panel information. |
| **Energy efficiency** | Use the Energy Efficiency menu to view energy and power values, view and change load analyser settings. |
| **Backups** | Backup and restore functions. |

### Warnings and failures

Warnings do not need to be reset; they are no longer displayed when the cause of the warning ceases. Warnings do not trip the converter; it will continue to run the engine.

On the other hand, faults must be corrected; they secure the inverter and cause its protections to trip, which stops the motor. Once the cause of a fault has been eliminated, it can be restored from the control system.

| Notice | Failure | Name | Description |
|---|---|---|---|
| A2A1 | 2310 | Overcurrent | The output current exceeds the internal limit. This may also be due to an earth fault or phase loss |
| A2B3 | 2330 | Earth leakage | A load imbalance which is normally due to a motor or motor cable earth fault |
| A2B4 | 2340 | Short circuit | There is a short circuit in the motor or motor cable |
| - | 3130 | Input phase loss | The DC voltage of the intermediate circuit oscillates due to the lack of a mains phase |
| - | 3181 | Wiring fault or earth leakage | Incorrect connection of the input and motor cables |
| A3A1 | 3210 | DC bus overvoltage | Intermediate DC circuit voltage is too high |
| A3A2 | 3220 | DC bus undervoltage | Intermediate DC circuit voltage too low |
| - | 3381 | Output phase loss | The three phases are not connected to the motor |
| A7CE | 6681 | Loss com. EFB | Interruption of communication on the integrated fieldbus |
| A7C1 | 7510 | Communication FBA A | Lost communication between the converter (or PLC) and the fieldbus adapter. |

## 23 Regulations and Legislation

- Comply with applicable laws and regulations:
  - Pressure equipment directive 2014/68/EU
  - Machinery Directive 2006/42/EC
  - Low Voltage Directive 2014/35/EC
  - Electromagnetic Compatibility Directive 2014/35/EU
  - Regulation (EU) 2024/1781
  - EU Ecodesign Regulation 2015/1095
  - Safety and environmental standard EN 378:2017
  - European Restriction on the Use of Certain Hazardous Substances (RoHS)
  - Safety regulations for refrigeration installations R. D. 552/2019
- The unit is built and tested in accordance with applicable standards and laws.
- The unit is tested for leakage and function of the refrigerant circuit.

## 24 Warranty

**Validation of the warranty -** The manufacturer guarantees the goods supplied against any manufacturing defect or malfunction for 24 months from the date of validation of the warranty or, failing this, from the date of manufacture.

During the warranty period, the manufacturer shall cover at its expense the repair of the product at its premises, the replacement of the product or the supply of spare parts for defective components, whichever is less burdensome and technically feasible; granting a renewed warranty period of 6 months for the repaired or replaced components. The cost and taxes on the refrigerant are expressly excluded from the warranty coverage if the refrigerant has not been supplied by the factory in hermetically sealed equipment.

The warranty does not cover on-site labour for the replacement of the product or spare parts, nor does it cover indirect damage or consequential loss that can be attributed to the malfunction of the product. In particular, the manufacturer shall not be liable for the Fluorinated Gas Tax stipulated in Law 16/2013, emitted into the atmosphere because of a leak in refrigeration equipment subject to a leakage and resistance test by the refrigeration installer and to a periodic leakage check in accordance with Regulations 517-2014 on F-gases and Safety for Refrigeration Installations, RD 552/2019.

**Execution of the warranty -** Before making a warranty claim, the user must ensure that the instructions for use have been followed correctly and that the malfunction is not due to incorrect use of the appliance.

Normally, the dealer or installation company that sold and installed the appliance will deal with warranty claims and provide service under warranty. The user must contact them within a maximum of two months from the appearance of the defect.

**Exclusions:** Not covered by this warranty:
- Bodily injury or damage to property due to improper or negligent use or lack of diligence on the part of the user to prevent such damage, especially in connection with the preservation of the refrigerated goods.
- Damage caused by faulty installation or causes not attributable to the appliance.
- Consequential damages, to the fullest extent permitted by law, and consequential damages such as loss of production, commercial loss or loss of profit.
- Damage caused by acts of God or force majeure.

**Extinction of the warranty:** The warranty will be void in the following cases:

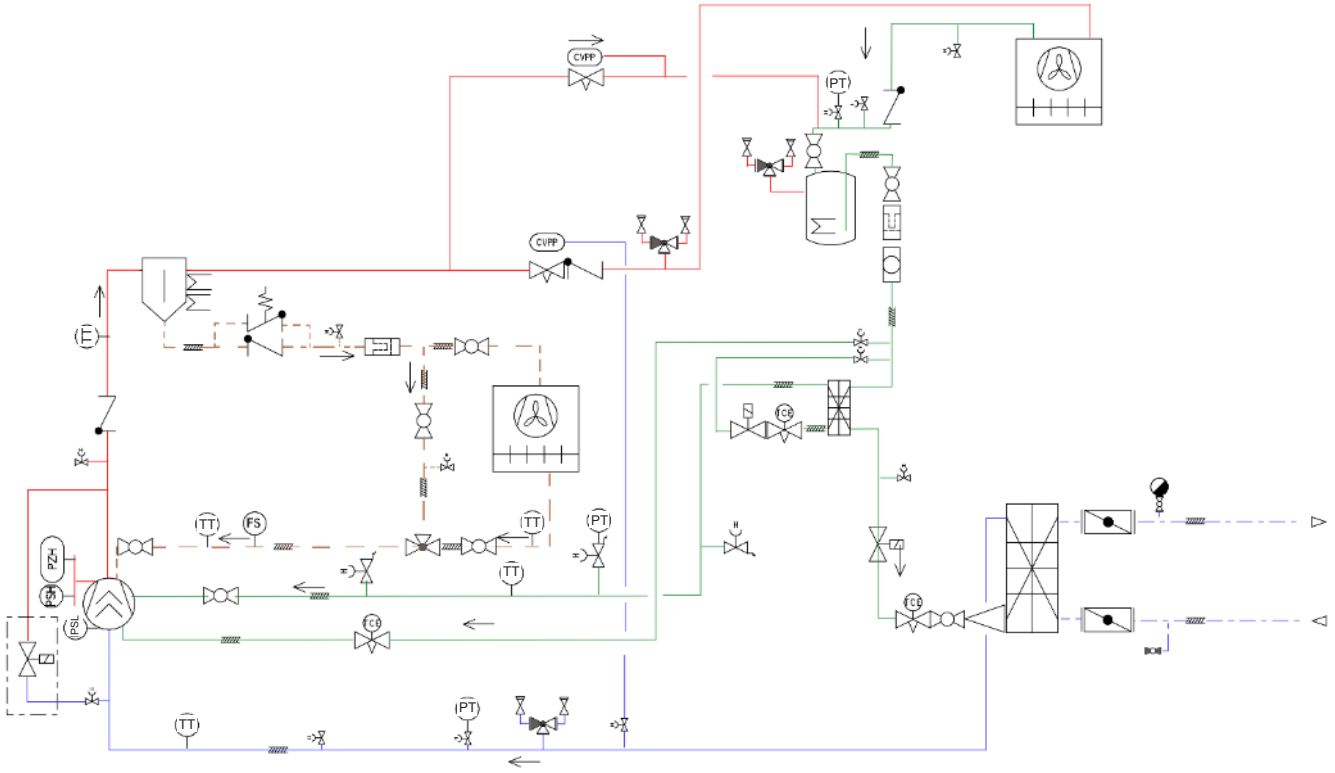
- If repairs, modifications or manipulations by unauthorised personnel are observed.
- In the event of intentional damage, malice or bad faith in the incorrect use of the device.
- If the device is found to have been knocked or dropped.
- If the serial number of the unit or the warranty documentation has been altered or made illegible.

## 25 Technical Data

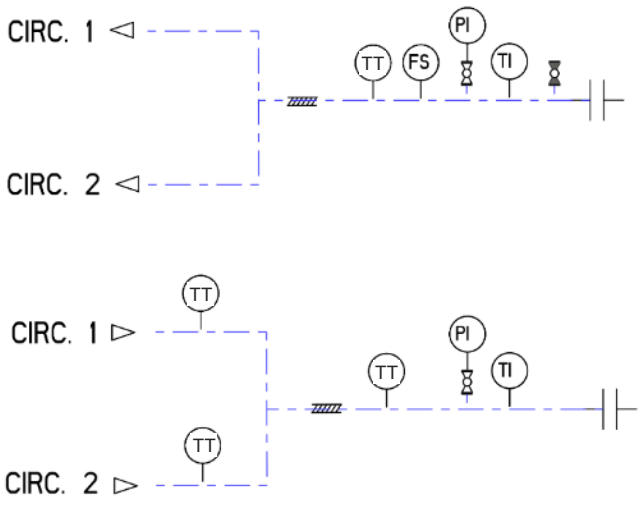
➲ See technical data sheet supplied by the manufacturer.

## 26 Cooling Systems Diagrams

### Standard

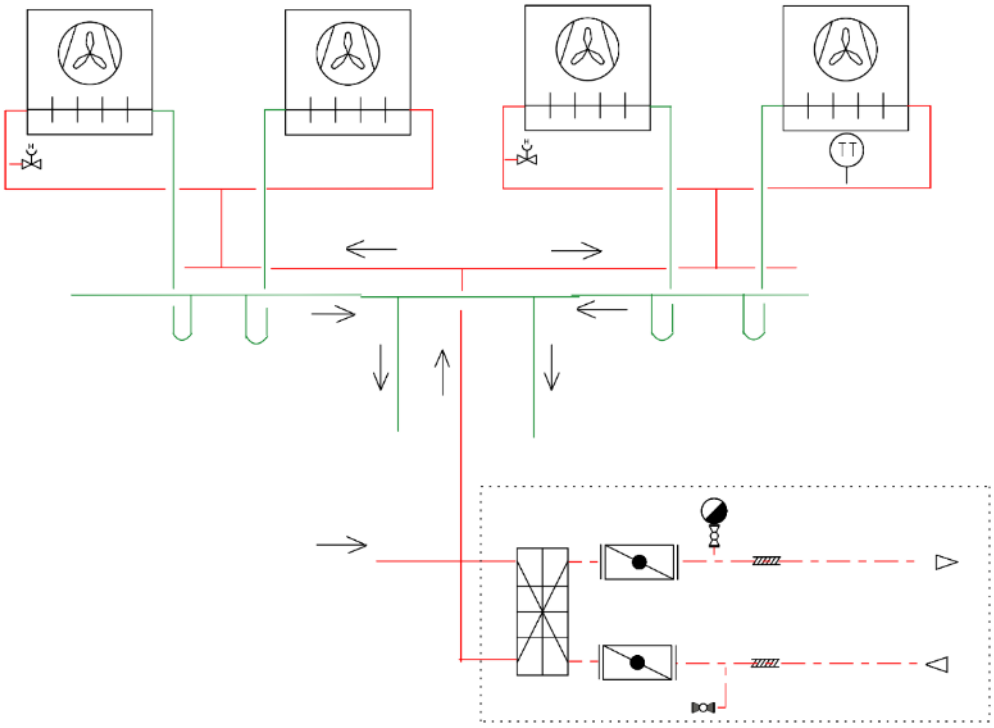



### Hydraulic circuit

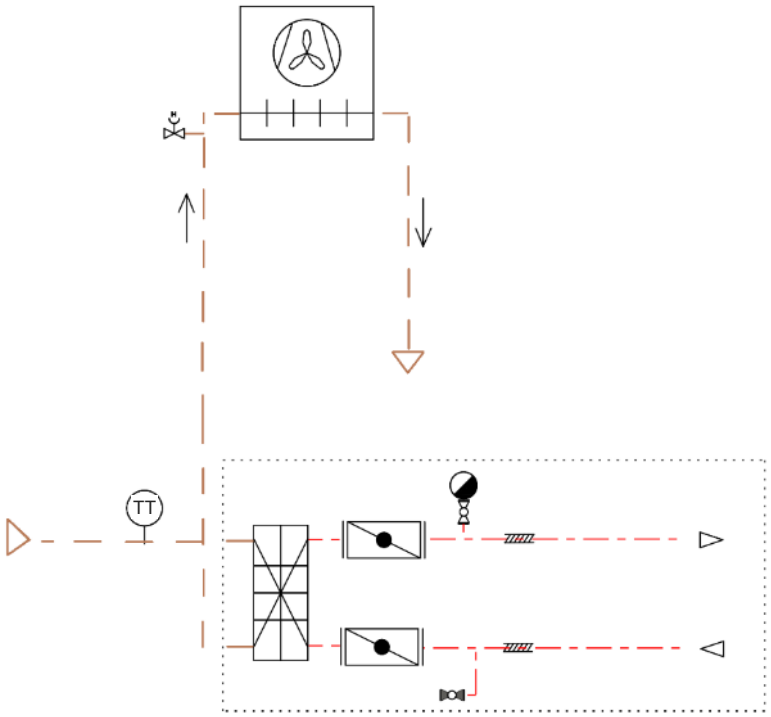



ⓘ *Symbology according to EN 1861:1998.*

## Condenser heat recovery



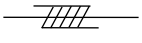

## Oil heat recovery

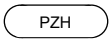



ⓘ *Symbology according to EN 1861:1998.*

## 26.1 Symbology according to EN 1861:1998

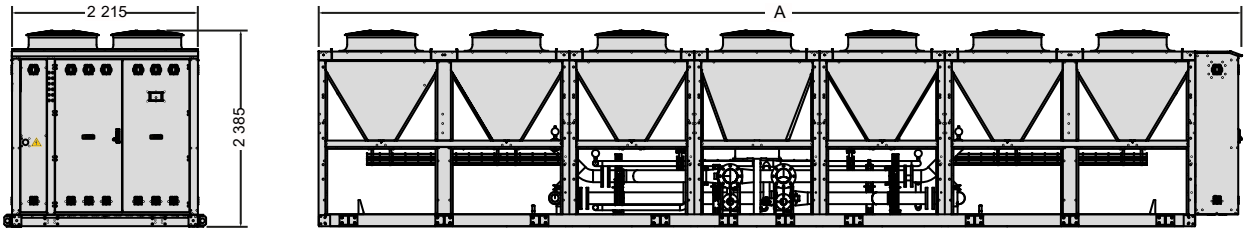
The symbology according to EN 1861:1998 applied in the refrigeration diagrams in this manual is given below:

| Description | Symbol |
|---|---|
| Screw compressor |  |
| Hydraulic pump |  |
| Cooling fluid, primary circuit |  |
| Secondary fluid (piping) |  |
| Flexible pipe (anti-vibration) |  |
| Isolated pipe |  |
| Valve, in general |  |
| 3-way valve |  |
| Ball valve |  |
| Gate valve |  |
| Solenoid valve |  |
| Manual valve |  |
| Safety valve |  |
| Electronic expansion valve |  |
| Non-return valve |  |
| Tare check valve |  |
| Servo-piloted valve ICS |  |
| Detachable joint (flange or thread) |  |

| Description | Symbol |
|---|---|
| Sight glass |  |
| Cartridge filters |  |
| Silencer |  |
| Bleeder |  |
| Butterfly valve |  |
| Heating resistor |  |
| Finned-tube heat exchanger with fan |  |
| Plate heat exchanger |  |
| Liquid receiver |  |
| Shell |  |
| High-pressure switch (manual reset) |   |
| High-pressure limiter |   |
| Low pressure limiter |   |
| Temperature probe |   |
| Thermometer |   |
| Pressure transducer |   |
| Pressure gauge |   |
| Flow switch |   |

## 27 Dimensions

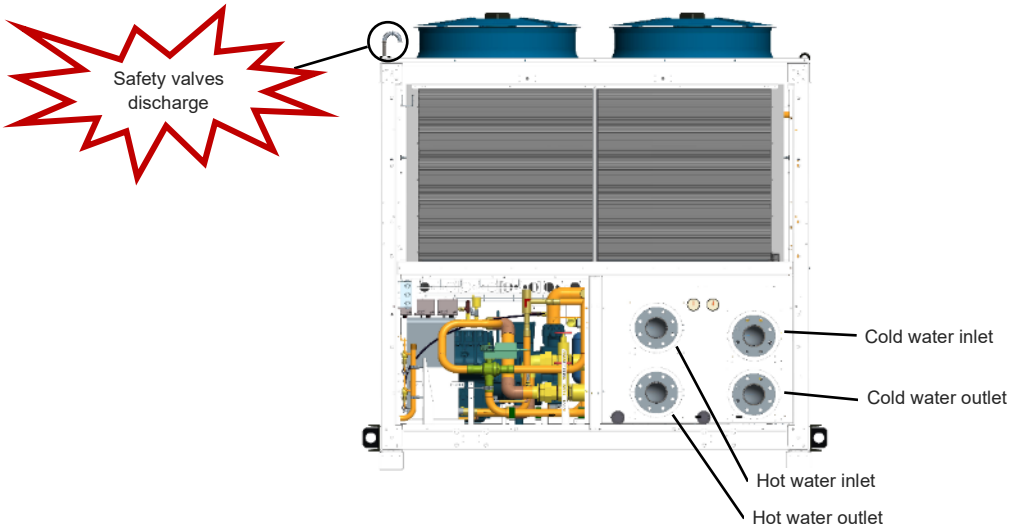
ⓘ *Dimensions of the drawings in mm.*



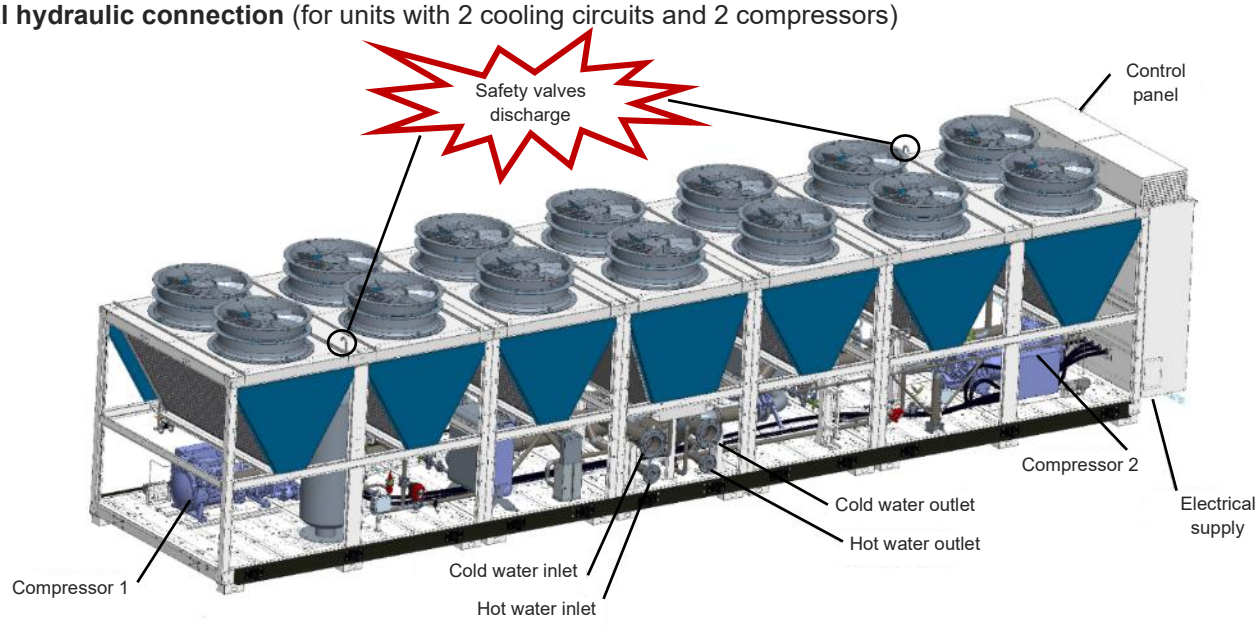

| Dimensions (mm) | A |
|---|---|
| **Size 2** | 3532 |
| **Size 3** | 4977 |
| **Size 4** | 6454 |
| **Size 5** | 7960 |
| **Size 6** | 9406 |
| **Size 7** | 10883 |

## 28 Hydraulic Connections and Electrical Supply

**Front hydraulic connection** (for units with 1 cooling circuit and 1 compressor)



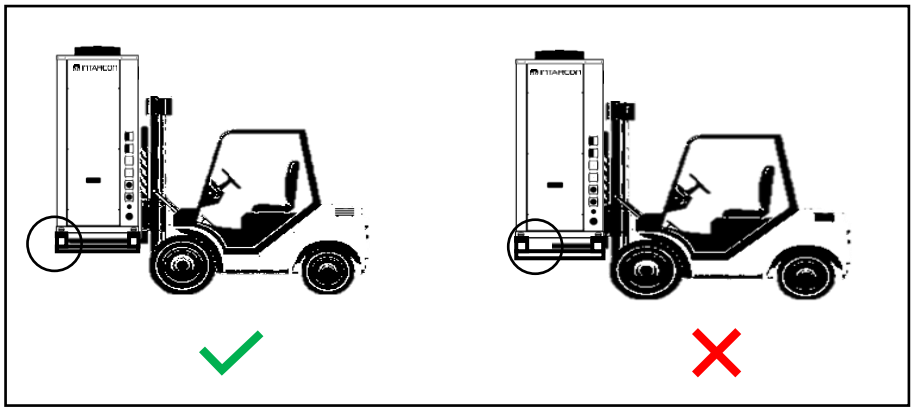

**Lateral hydraulic connection** (for units with 2 cooling circuits and 2 compressors)



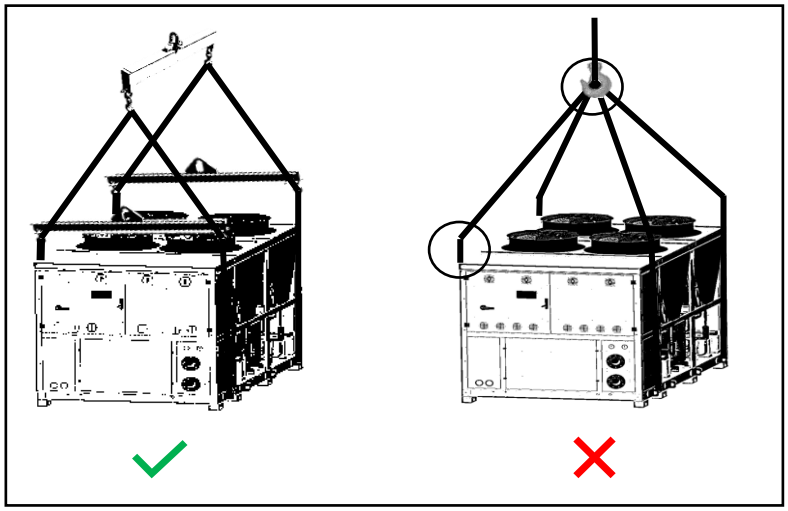
# 29 Schemes for Lifting, Installation and Assembly

## 29.1 Lifting system

### 29.1.1 Lifting by forklift truck



### 29.1.2 Lifting by crane



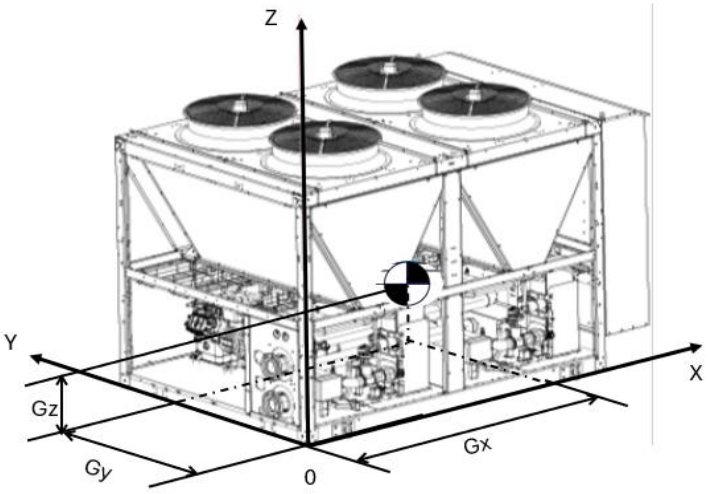
**In ammolite units (WW)**

➲ Check the weight of the unit to be lifted to choose the appropriate lifting unit.

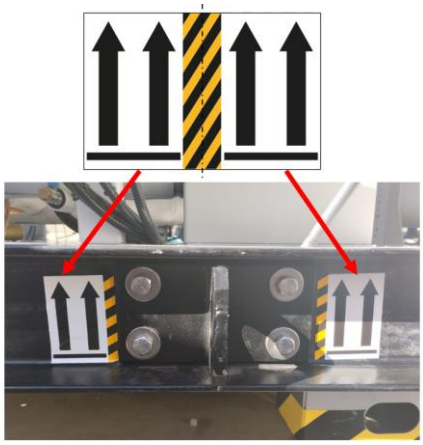
**Center of gravity coordinate table**

| | | Peso [kg] | Gx | Gy | Gz |
|---|---|---|---|---|---|
| ammolite WW-MPM | Size 3 | 4830 | 2570 | 1080 | 1000 |
| | Size 4 | 4890 | 3370 | 1095 | 997 |
| | Size 5 | 7340 | 4040 | 1090 | 972 |
| | Size 7 | 9430 | 5555 | 1090 | 920 |

ⓘ *The weight indicated in the table corresponds to the transport weight (components + refrigerant charge) of the unit with condensing heat recovery (ORC80).*



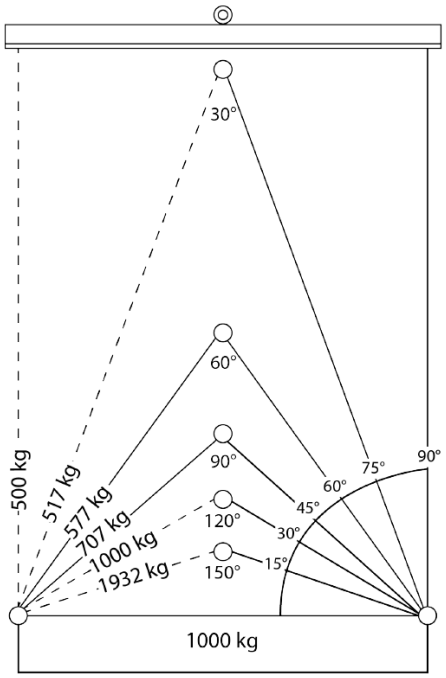
➲ Attach the shackles to the claws located at the base of the unit with the indicated label.



➲ Place the crane hook on the vertical axis of the load's center of gravity and at a height above this center of gravity.

**Lift angle**

The angle between the coupling bars changes the applied load according to the following diagram:

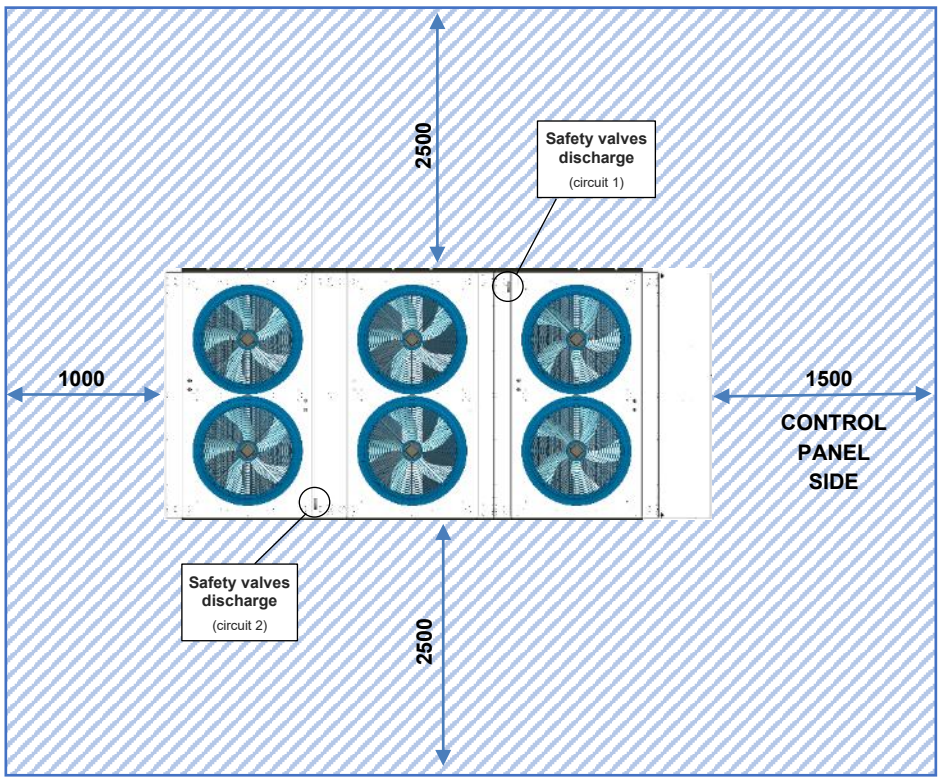



ⓘ *It is recommended to use angles less than 60°.*

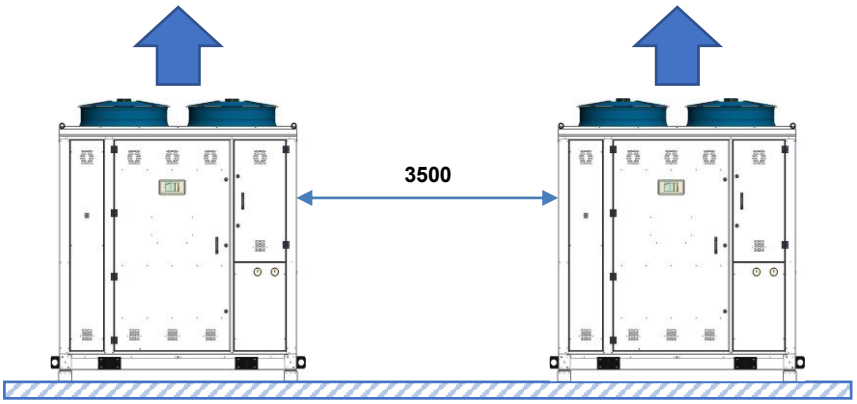
## 29.2 Minimum distances for installation and maintenance

ⓘ *Dimensions of the drawings in mm.*

ⓘ *The unit with axial fans is designed for outdoor installation, as defined in EN 378-3.*




If two or more RTDF chillers are installed close to each other, the following safety distances must be observed:

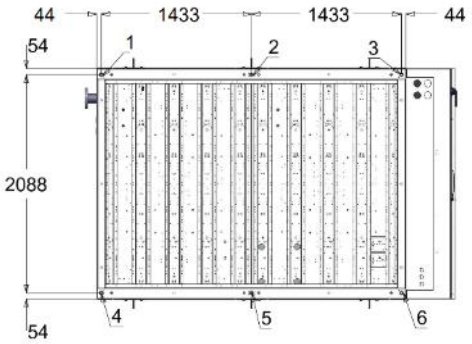


## 29.3 Supports

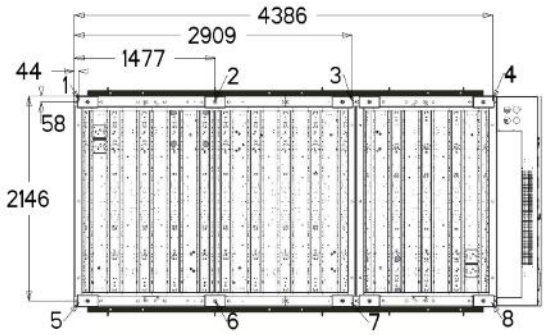
### 29.3.1 Support position and weight distribution

ⓘ *Dimensions of the drawings in mm.*

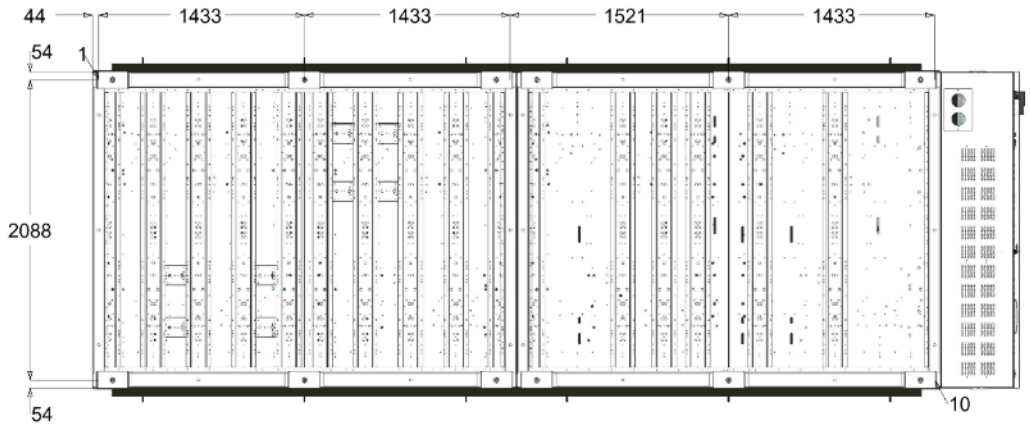
**Size 2**



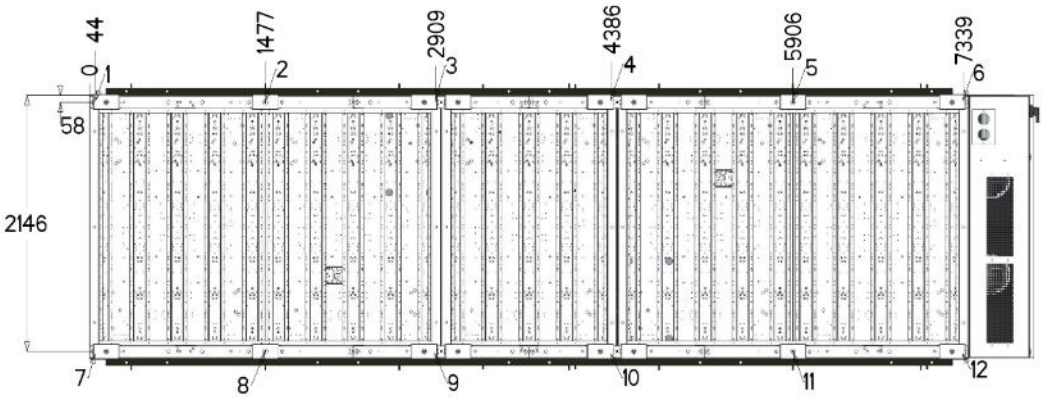

**Size 3**



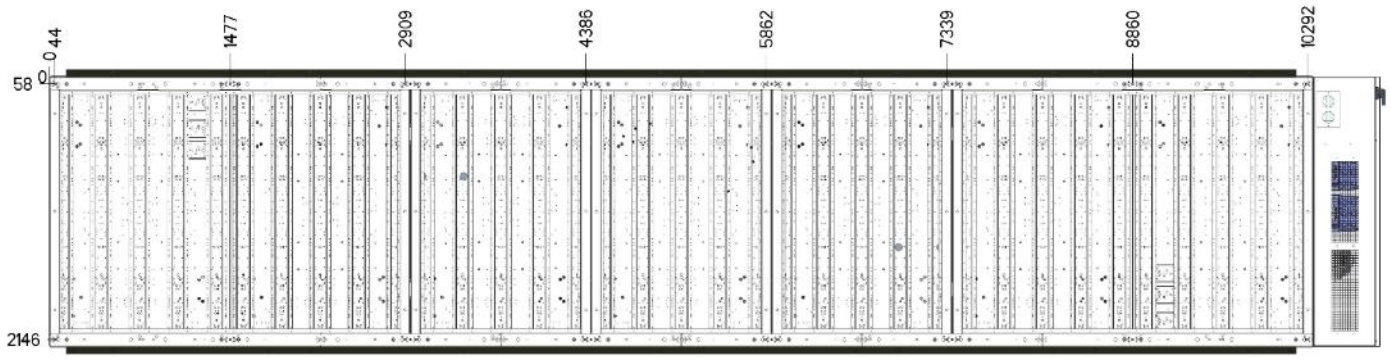

**Size 4**



**Size 5**



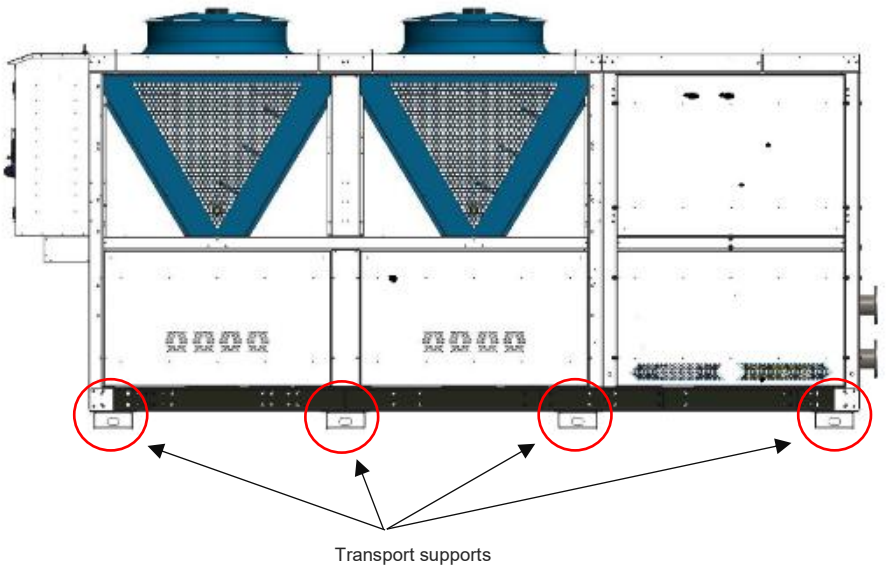

**Size 7**




### 29.3.2 Silentblocks installation

➲ Replace the transport supports with the recommended shock absorbers (silentblocks).

| | | Silentblocks |
|---|---|---|
| RTDF chiller | Size 2 | M16 |
| | Size 3 | |
| | Size 4 | |
| | Size 5 | |
| | Size 6 | |
| | Size 7 | |




## 30 Electrical Circuit Diagram

➲ Refer to the wiring diagram supplied by the manufacturer.

## 31 Maintenance Checklist

➲ Copy maintenance checklist and fill in during maintenance.

# Maintenance checklist

| | | | | | |
|---|---|---|---|---|---|
| Company: | | Telephone number: | | Start of work: | Unit model: |
| Office number: | | Size/type of cold room: | | | |
| Street: | | Original installation (CW): | | End of work: | Serial number: |
| Postcode: | | Year of maintenance: | | | |

| | | |
|---|---|---|
| ☐ | 1 | Check refrigerant unit for damage |
| ☐ | 2 | Check control parameters |
| ☐ | 3 | Check if the safety valves have leaked |
| ☐ | 4 | Check the correct functioning of the exhaust fan and/or leak detector, if any. |
| ☐ | 5 | Check whether the water inlet and outlet shut-off valves are open. |
| ☐ | 6 | Switch off the unit, unplug it from the mains and remove the registration panels. |
| ☐ | 7 | Check for oil slicks around the refrigerant circuit |
| ☐ | 8 | Check insulation and piping for damage and/or erosion |
| ☐ | 9 | Check that all electrical connections are securely tightened. |
| ☐ | 10 | Reinstall the housing and reconnect the main plug. |
| ☐ | 11 | Reboot the system |
| ☐ | 12 | Check compressor(s) and pump(s) for abnormal noise and vibration. |
| ☐ | 13 | Check the condenser fans for proper operation. |
| ☐ | 14 | Check fluid temperature jump in the condenser |
| ☐ | 15 | Check the refrigerant function, check the temperature difference of the fluid in the evaporator and the input power in relation to the nominal value. |
| ☐ | 16 | Check that the service sticker is in place and correct. |
| ☐ | 17 | Updating the inspection sticker |

| Date / signature (name of installer) | Date / signature (customer name) |
|---|---|
| | |

**Note:** Any soiling caused by maintenance should be cleaned.

Trane - by Trane Technologies (NYSE: TT), a global climate innovator - creates comfortable, energy efficient indoor environments for commercial and residential applications. For more information, please visit trane.com or tranetechnologies.com.

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