BARTEC

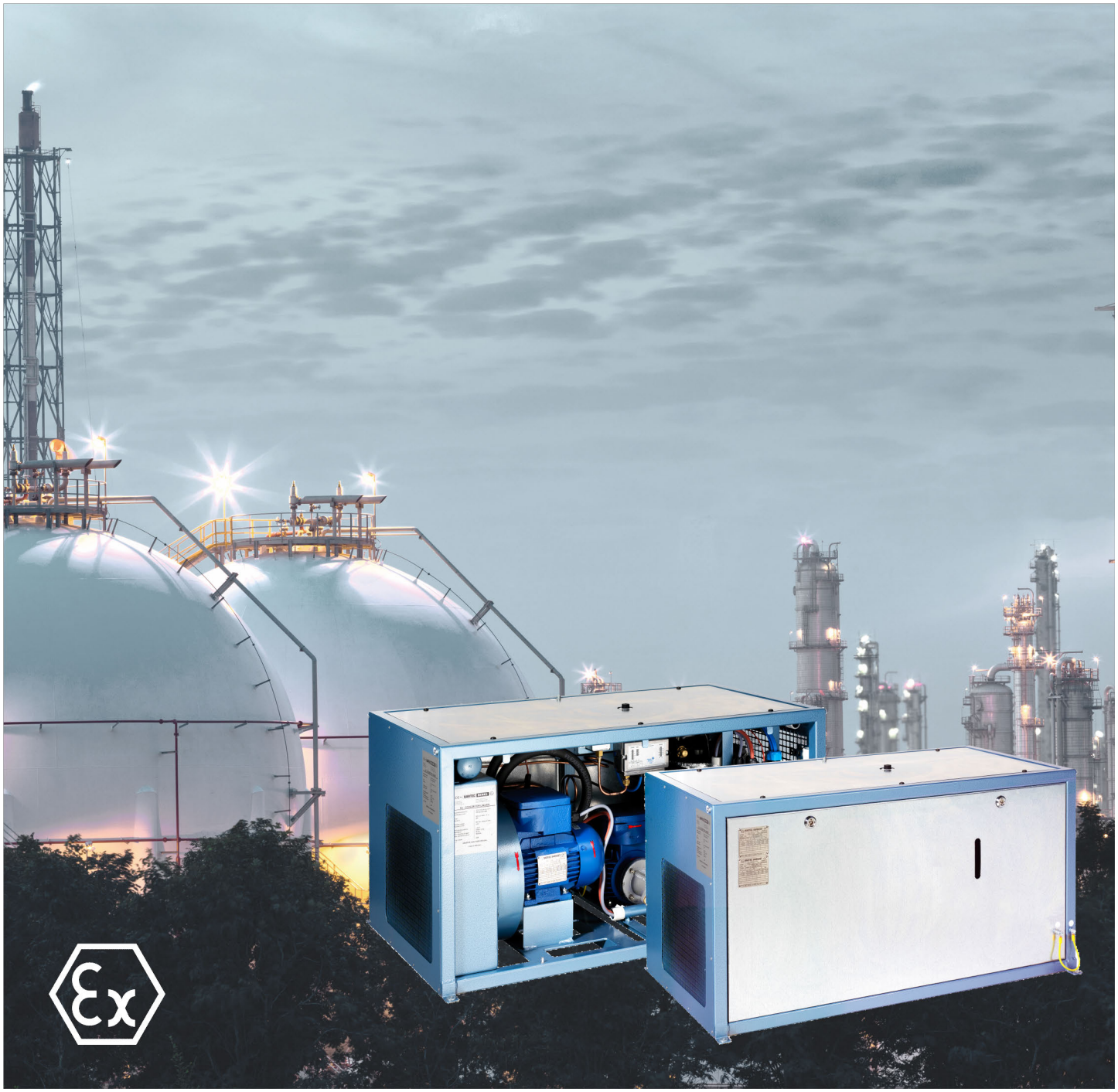
FKS-KWS Chiller for Liquids

Chiller

Operating Instructions

390439MDHEN B V3.0
05/2023

en



Read this manual carefully before installing and using the device. BARTEC BENKE GmbH will not accept any liability for damage caused by failure to observe the manual or the safety instructions.

When translated into other languages, the German version of the manual must be regarded as definitive.

Should you have any queries, please contact the address below:

BARTEC BENKE GmbH
Borsigstraße 10
D-21456 Reinbek

Tel.: +49 (0) 40 72703-500
Fax: +49 (0) 40 72703-363

e-mail: service-pat@bartec.com
service-bsf@bartec.com
Internet: www.bartec.de

Contents

1 General information

In this operating manual the Chiller is named as device. Further information about the device you can find in the *Section 2.1 “Intended use” on page 9*.

The following sections contain information on this operating manual, the symbols used, liability limitations and points of contact in customer service.

1.1 Information on the operating manual

This operating manual provides important information on handling the device. Adherence to all provided safety and operating instructions is the prerequisite for work safety.

☞ Furthermore, the local accident prevention regulations and general safety instructions for the device’s area of application must be observed.

☞ Read the operating manual carefully before beginning any work! It is an integral part of the device and must be stored in the immediate vicinity of the device so as to be accessible for operating personnel at all times.

☞ If the device is handed over to a third party, the operating manual must also be handed over.

For the purposes of clarity, the figures in this operating manual are not necessarily true to scale and may deviate slightly from the actual device model.

As well as the instructions, all other documents contained in the customer folder apply. Observe the safety instructions listed there! An overview can be found in the table of contents in the customer folder.

1.2 Explanation of symbols

Warnings

Warnings are indicated in this operating manual by symbols. The warnings are introduced with signal words indicating the degree of danger at hand.

Observe the instructions under all circumstances and work with care to avoid accidents, injuries to personnel and damage to property.

DANGER	
	**... indicates an immediate hazard which, if not avoided, will result in serious injury or death.**

WARNING	
	**... indicates a possible hazard which, if not avoided, could result in serious injury or death.**

CAUTION	
	**... indicates a possible hazard which, if not avoided, could result in minor injuries.**

NOTICE
... indicates a possible hazard which, if not avoided, could result in damage to equipment or property.

Symbols used in the manual and on the device

The safety warnings on the device are also highlighted with symbols. The following section explains the warning symbols used on the device and in the operating manual.

Warning about a danger area

Warning about poisonous substances

Warning about flammable substances

Warning about potentially explosive atmospheres

Warning about electrical current

Warning about potential hand injuries

Warning about hot surfaces

Warning about automatic start-up
(used with certain devices only)

Warning about low temperature/frost
(used with certain devices only)

Warning of laser beam
(used with certain devices only)

Examples of special warnings

DANGER	
	**Danger of death due to electrical current!** ... indicates life-threatening situations due to electrical current. Failure to observe the safety instructions could result in serious injuries or death. FOR THIS REASON: ☞ The work to be performed may only be carried out by an electrician.

WARNING	
	**Risk of death due to unavailable explosion protection!** ... indicates life-threatening situations in potentially explosive atmospheres. Failure to observe the safety instructions could result in serious injuries or death. FOR THIS REASON: ☞ Work may only be performed by a specialist for potentially explosive atmospheres.

Tips and recommendations

NOTICE	
	**... indicates useful tips and recommendations as well as information for efficient and trouble-free operation.**

1.3 Duties of the operator

The device is used in commercial enterprises. The operator of the device therefore has a legal obligation to ensure work safety. The applicable national standards and laws must be observed.

In addition to the work safety instructions in this operating manual, the safety, accident prevention and environmental protection regulations appropriate to the area of application must be observed.

In addition to this, the operator is responsible for ensuring that the device is always in a technically perfect working condition. Therefore the following applies:

- The operator must ensure that all maintenance intervals specified in this operating manual are adhered to.
- The operator must have all safety equipment inspected regularly to ensure it is fully functional and complete.

The operator must make the necessary safety equipment available to personnel.

1.4 Limitation of liability

All specifications and instructions in this operating manual have been compiled under due consideration of the applicable norms and regulations and the latest technological standards as well as our many years of experience and expertise.

The manufacturer assumes no liability for damage due to the following:

- Failure to observe the instructions in the operating manual
- Improper use
- Use of untrained personnel
- Structural modifications made without prior consent
- Technical modifications
- Use of non-approved replacement parts

The actual scope of delivery of special models can differ from the explanations and diagrams used in this manual if additional options are ordered or due to the latest technical changes.

Otherwise, the obligations agreed upon in the delivery contract, the general terms and conditions and the delivery terms of the manufacturer apply, as well as any legal regulations valid at the time the contract was concluded.

1.5 Copyright

The operating manual is to be treated confidentially. It is intended exclusively for personnel engaged to work with the device. Making the operating manual available to third parties is not permitted without the manufacturer's written consent.

NOTICE	
	**The information, texts, diagrams, images and other illustrations of the contents are copyright protected and subject to commercial protective rights. Every instance of misuse may result in prosecution.**

Reproductions of any type - including excerpts - as well as the application and/or imparting of the content is prohibited without a written statement from the manufacturer. Infringements will be met with a claim for compensatory damages. The right to make further claims is reserved.

1.6 Replacement parts

WARNING	
	**Risk of injury due to incorrect replacement parts!** Incorrect or defective replacement parts can result in damage, faults or total failures as well as impairments to safety. FOR THIS REASON: ☞ Only use spare parts from BARTEC BENKE.

Obtain replacement parts from authorized dealers or directly from BARTEC BENKE. For the address, see *Section 1.7 “Customer service” on page 7*.

WARNING	
	**No explosion protection when using wrong replacement parts!** Some optional spare parts have been modified or parameterized by BARTEC BENKE for a specific purpose. Using original spare parts from the respective manufacturer which have not been modified or parameterized can cause the loss of explosion protection or lead to malfunctions. FOR THIS REASON: ☞ Only use spare parts from BARTEC BENKE.

The replacement parts list can be found in the customer folder.

NOTICE	
	**Contaminated components or assemblies to be repaired or serviced by BARTEC BENKE must always be sent together with a completed decontamination declaration! If this is not provided, repair/maintenance cannot be carried out.** **Templates can be found in the customer folder or they can be requested from BARTEC BENKE (see *Section 1.7 “Customer service” on page 7*).**

1.7 Customer service

Should you require any technical information, our customer service department will be happy to help you.

You can find information on the responsible contact partner at any time by telephone, fax, e-mail or on the Internet.

Furthermore, our employees are always eager to receive any new information and experiences arising from use and which could be valuable for the improvement of our products.

Service address

BARTEC BENKE GmbH
Borsigstraße 10
D-21456 Reinbek, Germany

Tel.: +49 (0) 40 72703-500
Fax: +49 (0) 40 72703-363

E-mail: service-pat@bartec.com
service-bsf@bartec.com

Internet: www.bartec.de

2 Safety

This section provides an overview of all important safety aspects for optimal protection of personnel as well as safe and trouble-free operation.

Failure to observe the operating and safety instructions in this manual can result in considerable dangers.

This chapter describes all the safety and warning signs in line with the risk assessment. The measures for avoiding the respective dangers are described in detail in this chapter. The following chapter will only present the safety and warning signs in shortened form.

Example of shortened safety or warning message

DANGER	
	**Danger of death due to electrical current!** Touching voltage-conducting parts poses an immediate life-threatening hazard. Damage to the insulation or to individual components can cause fatal injury. ☞ Avoidance measures see *chapter 2 “Safety”*.

2.1 Intended use

The **FKS *-KWS-*** chiller type is used especially for industrial cooling of flammable and non-flammable liquids in potentially explosive atmospheres of zones 1 and 2.

The device can be operated both indoors and outdoors. For more information, see *chapter 6.3 “Requirements at the installation location” on page 63*.

Do not make any modifications to the device. Only use spare parts from BARTEC BENKE. Otherwise additional hazards may arise for which the safety devices cannot provide sufficient protection.

WARNING	
	**Danger due to improper use!** Any use which differs from and/or goes beyond the use for which the device is intended can result in hazardous situations. FOR THIS REASON: ☞ Only use the device as intended. ☞ Adhere strictly to all specifications and instructions in this operating manual.

Claims of any type for damages that result from improper use are excluded.

The operator bears sole liability for all damage resulting from improper use.

2.1.1 Improper use

This excludes danger areas where carbon disulfide (T6 < 85 °C) could be released.

2.2 Dangers and risks

The following section names residual risks that have been established in a risk analysis.

☞ Adhere to the safety instructions and observe the warnings in the following sections of this operating manual to reduce health risks and avoid dangerous situations.

Electrical current

DANGER	
	**Danger of death due to electrical current!** Touching voltage-conducting parts poses an immediate life-threatening hazard. Damage to the insulation or to individual components can cause fatal injury. FOR THIS REASON: ☞ If the insulation is damaged, immediately disconnect the power supply and have the damage repaired. ☞ Have work on the electrical systems performed only by electricians. ☞ For all work on the electrical systems, switch off the voltage and test that the circuit is voltage-free. ☞ In addition to the device power supply, all external power supplies to signal and control lines must be free of voltage. ☞ Prior to any maintenance, cleaning and repair work, switch off the power supply and secure it against being switched back on again. ☞ Do not bypass or disable any fuses. When changing fuses, make sure the amp rating is correct. ☞ Keep moisture away from voltage-conducting parts. This could otherwise result in a short-circuit.

Overpressure in refrigerant circuit

WARNING	
	**Risk of injury due to overpressure in refrigerant circuit!** Lines are pressurized even when switched off. In the case of defective or leaky lines, escaping liquids could cause serious injuries. FOR THIS REASON: ☞ Have all work on the refrigerant circuit carried out by qualified personnel only (see *Section 2.8.1 "Qualifications" on page 33*). ☞ Wear suitable protective goggles and gloves.

Hot surfaces

WARNING

Danger of burns due to hot surfaces!

The surfaces on the compressor, condenser and connecting pipelines can become very hot during operation due to high performance requirements. Contact with hot components can cause burns.

FOR THIS REASON:

☞ Always wear protective clothing and gloves during all work in the vicinity of hot components.

☞ Check that all components have cooled to ambient temperature before beginning any work.

Cold surfaces

WARNING

Danger of burns due to cold surfaces!

The surfaces on the evaporator can become very cold during operation due to high performance requirements. Contact with cold components can cause burns.

FOR THIS REASON:

☞ Always wear protective clothing and gloves during all work in the vicinity of cold components.

☞ Check that all components have warmed up to ambient temperature before beginning any work.

Sharp edges

CAUTION

Beware of injury from sharp edges and pointed objects!

Hand injuries can occur if working without appropriate hand protection.

FOR THIS REASON:

☞ Always wear protective clothing and suitable safety gloves when using the device.

Transporting the device

CAUTION

Damage due to improper transport!

Improper transport can result in considerable material damage.

FOR THIS REASON:

☞ When unloading the packaged items during delivery or during in-house transport, exercise caution and observe the symbols and instructions on the packaging.

☞ Only use the intended suspension points.

☞ Remove the packaging only immediately prior to assembly.

WARNING	
	**Risk of death due to suspended loads!** When loads are being lifted, falling or uncontrollably swinging components pose a danger to life and limb. FOR THIS REASON: ☞ Never step beneath suspended loads. ☞ Observe the specifications regarding the provided suspension points. ☞ Do not suspend by protruding machine parts or by the eyebolts of attached components. ☞ Make sure suspension equipment is attached securely. ☞ Only use approved lifting devices and lifting accessories with sufficient load-bearing capacity. ☞ Do not use cracked or chafed cables or belts. ☞ Do not attach cables and belts to sharp edges or corners and do not knot or twist. ☞ Only move loads under supervision. ☞ Set down the load before exiting the workplace.

Dirt and objects left lying around

CAUTION	
	**Danger of tripping due to dirt and objects left lying around!** Dirt deposits and objects left lying around constitute slipping and stumbling hazards and can cause injuries. FOR THIS REASON: ☞ Always maintain a clean and orderly work area. ☞ Remove objects that are no longer required. ☞ Draw attention to stumbling hazards with yellow and black marking tape.

Handling packaging materials

CAUTION	
	**Environmental damage due to incorrect disposal!** Packaging materials are valuable raw materials and can in many cases be reused or expediently processed and recycled. FOR THIS REASON: ☞ Dispose of packaging materials in an environmentally sound manner. ☞ Observe the locally applicable disposal regulations. Have a specialist company handle the disposal if needed.

Refrigerant that is harmful to health and the environment

See *chapter 2.3 “Hazardous substances” on page 18*.

Parts that start automatically

WARNING	
	**Risk of injury from touching parts that start automatically!** Serious injuries can occur when working on the device without protective coverings in place or on “open” fans or drive shafts if these start up automatically. FOR THIS REASON: ☞ Ensure protection against accidental contact is in place before carrying out any work. ☞ If necessary, disconnect the device from the power supply.

Incorrect installation and first commissioning

WARNING

Danger due to incorrect installation and first commissioning! Installation and first commissioning must be conducted by trained specialist personnel who have adequate experience. Errors in installation and first commissioning can lead to life-threatening situations or considerable material damage. FOR THIS REASON: ☞ Have installation and preparations for first commissioning conducted solely by specialists for potentially explosive atmospheres or by qualified electricians. ☞ Before starting work, ensure there is adequate space for the work. ☞ Use caution when handling open, sharp-edged components. ☞ Assemble the components professionally. Comply with the specified screw-tightening torques. ☞ Secure components so that they cannot fall down or tip over.

Improper operation

WARNING

Danger of injury due to improper operation! Improper operation can lead to serious personal injury and material damage. FOR THIS REASON: ☞ All operating steps are to be conducted in accordance with the instructions contained in this operating manual. ☞ Before starting work, make sure that all safety equipment is installed and working properly. ☞ Never disable safety equipment during operation.

Improper fault rectification

WARNING

Danger of injury due to improper fault rectification.

Improper fault rectification can lead to serious personal injury and material damage.

FOR THIS REASON:

- ☞ Before starting work, ensure there is adequate space for the work.
- ☞ Make sure the work area is clean and orderly! Components or tools that are loosely stacked or left lying around are a source of accidents.
- ☞ If components were removed, make sure they are remounted correctly, reinstall all fastening elements and observe the specified screw tightening torques.

Improperly performed maintenance

WARNING

Danger of injury due to improperly performed maintenance work!

Improper maintenance can lead to serious personal injury and material damage.

FOR THIS REASON:

- ☞ Before starting work, ensure there is adequate space for the work.
- ☞ If components were removed, make sure they are remounted correctly, reinstall all fastening elements and observe the specified screw tightening torques.

Incorrect dismantling work

WARNING

Danger of injury due to incorrect dismantling work!

Stored residual energy, components with sharp edges, points and corners in and around the device or on the required tools can cause injuries.

FOR THIS REASON:

- ☞ Before starting work, ensure there is adequate space for the work.
- ☞ Use caution when handling open, sharp-edged components.
- ☞ Dismantle the components in a professional manner. Remember that some components may be very heavy. Use lifting gear if necessary.
- ☞ Secure components so that they cannot fall down or tip over.
- ☞ Should you have any questions, contact the manufacturer.

2.2.1 Safety for explosion protection

Technical modifications

WARNING	
	**Danger of explosions due to technical modifications!** Every unauthorized modification endangers the safety of the device and can result in the failure of the explosion protection and accidents. FOR THIS REASON: ☞ Do not make any technical modifications to the device without prior written consent from the manufacturer. ☞ Only use spare parts from BARTEC BENKE. ☞ Do not carry out any extensive painting (see warning information regarding electrostatic discharge on see *page 17*).

Screw connections of junction box

WARNING	
	**Danger of explosion if the screw connections are not closed properly!** The explosion protection will not be ensured if the screw connections are not closed correctly. FOR THIS REASON: ☞ Tighten screw connections all the way. ☞ Seal screw connections without cables with a suitable sealing plug. ☞ Only use screw connections matching the cable diameter (note clamping area).

Ignition sources from equipment outside the device

WARNING	
	**Danger of explosion due to exposed ignition sources on equipment outside the device.** Equipment operated in intrinsically safe circuits can cause explosions if not connected according to the manufacturer's specifications. FOR THIS REASON: ☞ The total of all capacitance and inductance of all this equipment must be below the thresholds specified in the applicable standards and regulations on explosion protection and in the manufacturer’s specifications.

Danger of explosion due to sources of ignition – refrigerant system

WARNING

Danger of explosion due to sources of ignition!

The refrigerant system is hermetically sealed. It may only be filled in areas without potentially explosive atmospheres in accordance with the manufacturer's instructions.

FOR THIS REASON:

☞ When filling the refrigerant system, ensure that no potentially explosive atmosphere is present.

☞ Follow these operating instructions!
(See *chapter 7.4 "Filling the refrigerant system with refrigerant during initial commissioning" on page 72*)

Electrostatic discharge

WARNING

Danger of explosions due to electrostatic discharge!

Non-metallic components, manual controls made from plastic and insulation from a size of 20 cm² can become electrostatically charged by friction or particle flows.

FOR THIS REASON:

☞ Always clean plastic surfaces with a damp cloth.

☞ Clean the device and surroundings regularly.

WARNING

Danger of explosions due to electrostatic discharge!

Non-metallic stickers from a size of 80 cm² can become electrostatically charged by friction.

FOR THIS REASON:

☞ Always clean BARTEC BENKE stickers with a damp cloth.

WARNING

Danger of explosions due to electrostatic discharge!

Painting the device increases the risk of electrostatic discharge even on metallic surfaces.

FOR THIS REASON:

☞ Do not paint or coat the device.

☞ Make sure that all equipotential bonding connections and lines inside the device are firmly fitted, especially after maintenance work.

WARNING	
	**Danger of explosions due to electric discharge!** Different voltage potentials of contact surfaces can lead to electric discharge. FOR THIS REASON: ☞ Only operate the device with an intact ground connection. ☞ Remove corrosion from the potential connection and potential connections.

WARNING	
	**Danger of explosions due to electrostatic discharge (ESD)!** Touching plastic or operating manual controls made of plastic (such as pressure regulators) may ignite an existing explosive atmosphere! FOR THIS REASON: ☞ Only open the box in a non-explosive atmosphere! ☞ To measure if there is a risk of an explosion, use a device such as a gas warning device.

Please also observe the instructions in *Section 2.4.3 “Special conditions for safe use when cooling flammable fluids” on page 22*

2.3 Hazardous substances

Harmful substances

Substance marking “Gas cylinder”

NOTICE	
	**Substances hazardous to health (refrigerant, cleaning agents, or solvents).** Risk of serious injury caused by chemicals and toxic vapors! If handled improperly, coolant, for example, can escape and evaporate instantly. FOR THIS REASON: ☞ Always wear protective goggles, protective gloves, and protective equipment appropriate for the corresponding refrigerant during all work on the refrigerant circuit. ☞ Observe the safety data sheets as well as the safety information for the filled refrigerant. ☞ The refrigerant contains fluorinated greenhouse gases covered by the Kyoto Protocol.

Environmentally hazardous substances

Substance marking
“Hazardous to water”

NOTICE	
	**Environmentally hazardous substances** Hazardous substances escaping during a malfunction are hazardous to the environment. FOR THIS REASON: ☞ Prevent them from entering bodies of water, the sewerage system or the ground, and/or install the device on a surface that is leak-proof against the hazardous substances occurring in the system. ☞ Use suitably resistant materials for sumps or sealing. ☞ Dispose of residues and waste product professionally. ☞ If pollutant substances are released, take immediate measures to limit the damage.

Danger of suffocation from inert gas

WARNING	
	**Danger of suffocation from inert gas!** In exceptional cases, the unit or the refrigerant circuit may only be filled with nitrogen for transport-related reasons. This can pose a risk of suffocation. It also contains a substance that can produce a combustible atmosphere if it escapes into the air. ☞ If inert gas escapes, ensure good ventilation and temporarily vacate small rooms if necessary.

2.4 Explosion protection

The device is intended for use in potentially explosive atmospheres. The device is designed for cooling liquids from process engineering with value-determining properties.

To enhance its usability, heat loss available from friction, compression and electrical energy can be used as an option to heat the fluid in certain devices and conditions.

The liquids that can be cooled or heated with the device belong to explosion group IIA at most or are non-flammable. When determining the minimum ignition energy of gases, vapors and dusts, the device must be assigned to explosion sub-group IIC and temperature class T4.

This section describes the marking, explosion protections and certificates as well as special conditions.

2.4.1 Marking

Depending on the required approval, the device is labeled in accordance with ATEX directive 2014/34/EU. Other approvals have been received. Details upon request.

Marking according to ATEX
see type plate

Meaning of the markings according to ATEX directive

Marking	Meaning
Device group II	The device may be used in potentially explosive atmospheres, excepting those of mining activities.
Category 2	A potentially explosive atmosphere may occasionally occur. The device ensures a high degree of safety and can be used in zone 1 and zone 2.
G	Materials which form a potentially explosive atmosphere are gases, mist or vapors (not dust).
IIC	Classification of gases and vapors into the subgroups IIA, IIB and IIC depending on their potential to ignite. The explosion protection of the device permits use with subgroup IIC.
T3	Classification of gases and vapors depending on their igniting temperature into the classes T1 to T6 (in accordance with IEC 60079-0). The device is designed for gases and vapors in temperature class: **T3:** 200 °C
Gb	The device guarantees a high level of safety. It can be operated in zone 1 and in zone 2. A potentially explosive atmosphere may occasionally occur.

2.4.2 Explosion protection and certificates

The device and its components are provided with various types of explosion protection, whose principles are briefly described below:

Non-electrical devices Ex h

Design and construction of non-electrical devices for use in explosive atmospheres corresponding to the constructional safety “c” explosion protection.

Pressure-resistant enclosure Ex d

Parts which could be ignited by a potentially explosive atmosphere are kept inside a box. The box is constructed in such a way that in the event of an explosion in the interior, the pressure is maintained and thereby prevents the spread of the explosion to the explosive atmosphere surrounding the box.

Increased safety Ex e

For electrical equipment which does not present ignition sources during normal operation, additional measures are used to prevent inadmissibly high temperatures, sparks and electric arcing.

Components

The device is manufactured in accordance with the EC-type examination certificate from the TÜV (for test certificate no., see customer folder). As part of this approval, the components are also certified as individual parts.

The following table provides an overview of the associated Ex-relevant parts and their marking:

Assembly	Explosion protection
Coolant system	d / e / h
Refrigerant system	d / e / h

Ex-components	Explosion protection
Motors for the circulation pump; condenser fans	e / d
Modified compressor	p / m / e
Associated sensors: PT100, PTC resistance sensor; binary contacts in intrinsically safe circuit	i / e
Central junction box	d / e / i
Pressure resistant control box	d / e / i
Bypass valve option: 3/2-way coaxial valve	m / e
Positive displacement pump or centrifugal pump	h / c
Torsionally flexible claw coupling	

2.4.3 Special conditions for safe use when cooling flammable fluids

When using the device to cool flammable fluids for gas group IIC, carbon disulfide and acetylene above 25% of the lower explosive limit (LEL) LFL are not permitted.

In particular, observe all special conditions mentioned in the certificate and additionally the following:

- Only open the device in a non-explosive atmosphere.
- Any charging mechanism stronger than the manual rubbing of surfaces must be ruled out.
- Do not use the device in areas where external induction currents, strong charge-generating processes, or spraying of electrons occur, or where there is a risk of components and insulation being electrostatically charged to ignition by particle currents.
- Pyrophoric substances in the device as well as abrasive media and solids in the coolant are excluded from the device's scope of application.
  Alternatively, observe all instructions regarding the coolant in the operating manual of the installed pump.
- Avoid compression heat.
- The coolant must be free of any air mixtures or entrapped air during operation.

2.5 Safety equipment

WARNING	
	**Danger of death due to non-functioning safety equipment!** Safety is only guaranteed if the safety equipment is intact. FOR THIS REASON: ☞ Before starting work, check whether the safety equipment is correctly installed and fully functional. ☞ Never disable safety equipment. ☞ Make sure that safety equipment such as emergency off buttons, pull cords, etc., is always accessible (installed by the operator).

NOTICE	
	**Test the function of the safety devices on a regular basis.**

2.5.1 Control box with pressure-resistant enclosure

WARNING	
	**Danger of death due to potentially explosive atmosphere!** Opening the Ex d box means the explosion protection is no longer ensured. FOR THIS REASON: ☞ Do not open if live. ☞ Only open if you have a permit to work with hot items!

For more information, see *chapter 4.4.2 “Pressure-resistant control box” on page 49*.

2.5.2 Components with Ex i switching circuits

The components with Ex i switching circuits are designed as light blue lines. The sensors are regarded as simple electrical operating equipment. The Ex i characteristics can be found in the circuit diagrams of the electrical documentation of the components. The Ex i switching circuit calculations can be provided as required. Please request these from BARTEC BENKE (For contact information see *chapter 1.7 “Customer service” on page 7*).

2.5.3 Main switch

The device has neither its own main switch nor its own emergency off device.

Figure 2.1: Main switch (examples)

Optionally, you can also order a suitable main switch when ordering the device.

If you select another main switch, bear the following in mind:

- The main switch and the emergency off device can be secured against being switched on again.
- For example, it must be possible to secure the main switch with a lock to prevent it from being switched on without authorization.
- The main switch must disconnect from the power supply on all poles.
- Follow the manufacturer's installation information.

2.5.4 Potential equalization

All metallic parts and the components including the pipework are grounded with the frame or via the equipotential bonding rail by design. Observe the following instructions:

- The external potential equalization connection must be connected with the on-site equipotential bonding rail during the installation.
- The entire on-site potential equalization system must be inspected.
- All external conductive parts have a ground connection or are structurally connected with each other.
- The coatings of the insulation are special versions of conductive connections.
- Armaflex AF and Armaflex HT pipes and sheets **outside of our housings may only be used with a conductive coating**.
- Every coating section must be mechanically and securely integrated into the potential equalization. The sections are always to be connected with each other via 2-pole potential connection, **never directly using adhesive surfaces or similar**. Non-coated areas or gaps in the coated areas are permitted providing they do not exceed a size of 20 cm².
- Coatings that are detached, damaged or were removed due to repair work must be replaced. You can order corresponding prefabricated coating strips through our customer service.

WARNING	
	**Danger of explosions due to electrostatic discharge!** All external conductive parts can be prone to electrostatic charging, thereby making them a potential source of ignition. FOR THIS REASON: ☞ Make certain that all external conductive parts have a ground resistance of ≤ 1 GΩ.

The following illustration shows an example of the coating of the insulation:

Figure 2.2: Example coating of insulation

2.5.5 Ignition source monitoring and design safety

Temperatures and pressures are monitored in this device. The maximum permissible surface temperatures and the minimal pressure (low pressure) of the gas in the refrigerant system can be found in the safety-relevant technical data (see *chapter 3 “Technical data” on page 39*).

The regular inspection for this safety equipment can be found at *Chapter 10.9 “Fünfjährige Prüfung” on page 94*. If the safety function trips, this circuit must be reset manually. This procedure is described in *Chapter 4.4 “Electrical control unit” on page 46*.

All moving components are designed in such a way that the kinetic energies do not have any effective sources of ignition. In the case of manual operations, there are corresponding warnings that indicate a potential source of ignition.

2.5.6 Signs and safety warnings

The signs and safety warnings on and around the device are components of the safety equipment. They are described in *Chapter 2.6 “Signs” on page 26*.

- In accordance with the maintenance plan (see *page 89*), their presence and legibility should be checked regularly.
- Replace them if damaged or missing.

2.6 Signs

The following safety instructions and mandatory signs must be attached directly to the device.

They must be attached in the position in which they are delivered and must be clearly legible.

WARNING	
	**Danger of injury resulting from illegible symbols!** Over the course of time, stickers and signs can become dirty or otherwise unrecognizable. FOR THIS REASON: ☞ Always maintain safety, warning, and operating notices in a legible condition. ☞ Replace damaged signs or stickers immediately.

Replacements can be ordered from the manufacturer. For the address to order from, see *Section 1.7 “Customer service” on page 7*

2.6.1 Overview of signs

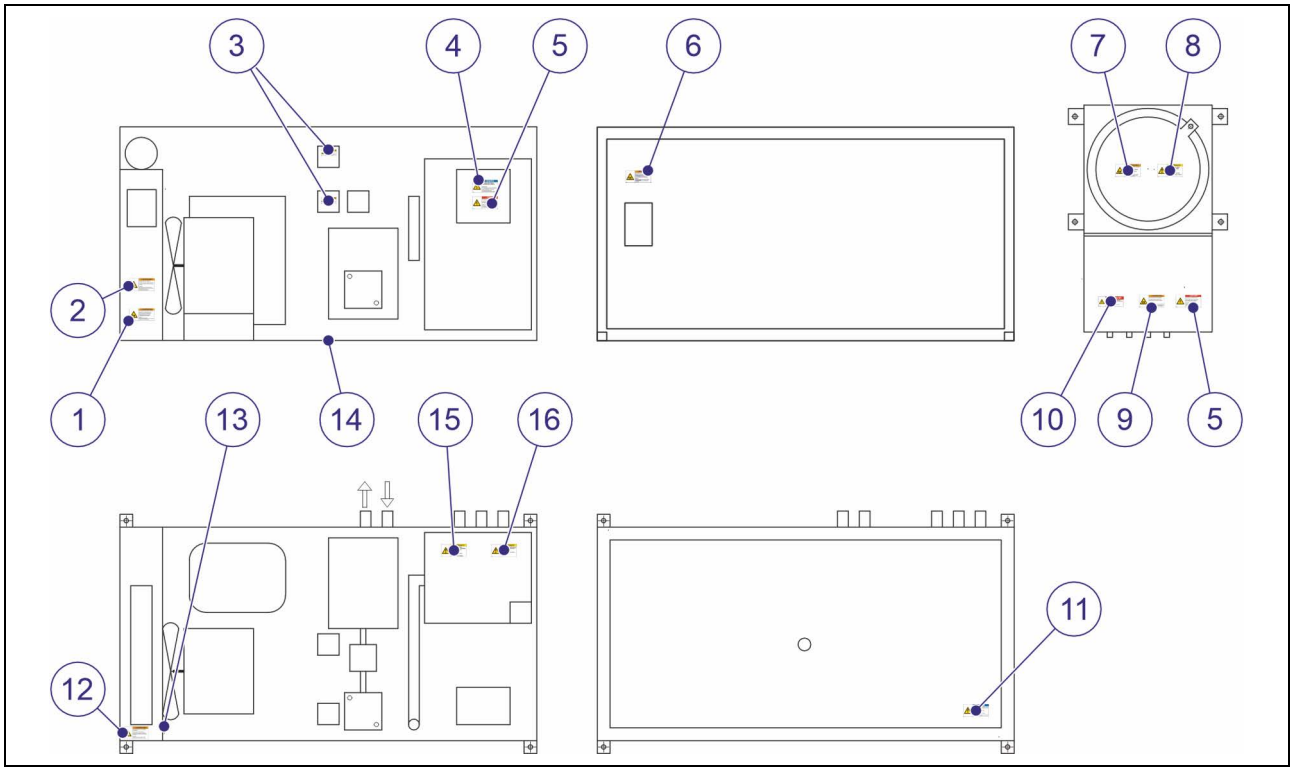
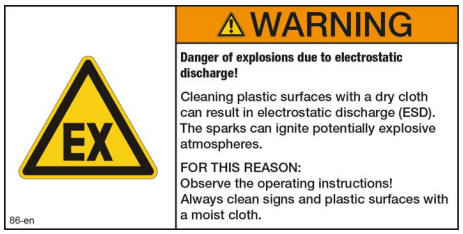


Figure 2.3: Warnings

1. Warning sign: “Danger of explosion due to electrostatic discharge”
2. Warning sign: “Danger of explosion due to ignition sources - refrigerant system”
3. Warning sign: “Danger of explosion due to electrostatic discharges (small)”
4. Warning sign: “Material damage due to incorrect rotational direction on the compressor”
5. Warning sign: “Danger of death due to electrical current”
6. Warning sign: “Danger of explosion due to electrostatic discharge – plastic”
7. Warning sign: “Danger of explosion due to ignition sources inside – wait 5 minutes”
8. Warning sign: “Danger of injury due to falling cover”
9. Warning sign: “Danger of explosion due to formation of sparks”
10. Warning sign: “Danger due to externally applied voltage”
11. Warning sign: “Protection against spillage”
12. Warning sign: “Danger of injury from pressurized gases or liquids”
13. Warning about automatic start-up
14. Kyoto Protocol sticker
15. Warning sign: “Add Temper -55 only”
16. “Coolant mixture” warning label

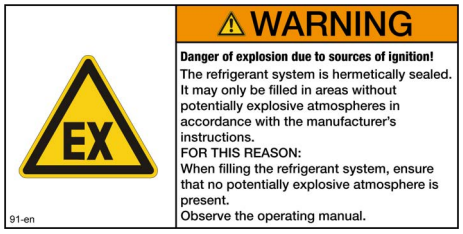
2.6.2 Warnings

Sticker 1 (see *page 27*)



WARNING
Danger of explosions due to electrostatic discharge! Cleaning plastic surfaces with a dry cloth can result in electrostatic discharge (ESD). Any sparks could ignite a potentially explosive atmosphere. FOR THIS REASON: ☞ Observe the operating manual. ☞ Only clean signs and plastic surfaces with a damp cloth.

Sticker 2 (see *page 27*)

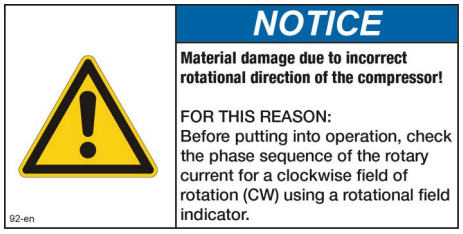


WARNING
Danger of explosion due to sources of ignition! This refrigerant system is hermetically sealed. It may only be filled in areas without potentially explosive atmospheres in accordance with the manufacturer's instructions. FOR THIS REASON: ☞ When filling the refrigerant system, ensure that no potentially explosive atmosphere is present. ☞ Observe the operating manual.

Sticker 3 (see *page 27*)

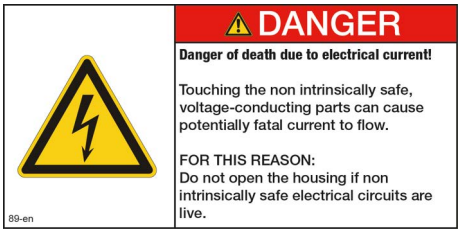
WARNING
Danger of explosions due to electrostatic discharge (ESD)! FOR THIS REASON: ☞ Observe the operating manual. ☞ Only clean signs and plastic surfaces with a damp cloth.

Sticker 4 (see *page 27*)



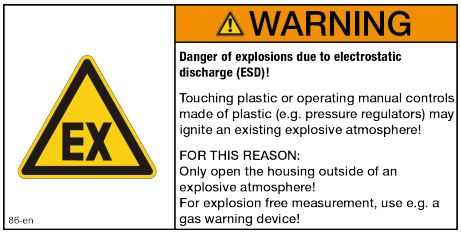
NOTICE
Material damage due to incorrect rotational direction of the compressor! FOR THIS REASON: ☞ Before putting into operation, check the phase sequence of the rotary current for a clockwise field of rotation (CW) using a rotational field indicator.

Sticker 5 (see *page 27*)



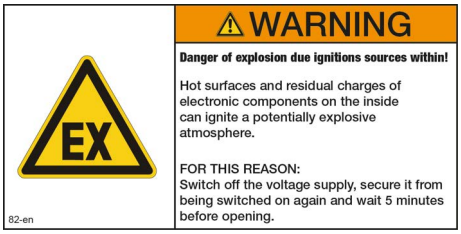
DANGER
Danger of death due to electrical current! Touching the non-intrinsically safe, voltage-conducting parts can cause potentially fatal current to flow. FOR THIS REASON: ☞ Do not open the box if non-intrinsically safe circuits are live.

Sticker 6 (see *page 27*)



WARNING
Danger of explosions due to electrostatic discharge (ESD)! Touching plastic or operating manual controls made of plastic (such as pressure regulators) may ignite an existing explosive atmosphere! FOR THIS REASON: ☞ Only open the box when not in an explosive atmosphere. ☞ To measure if there is a risk of an explosion, use a device such as a gas warning device.

Sticker 7 (see *page 27*)

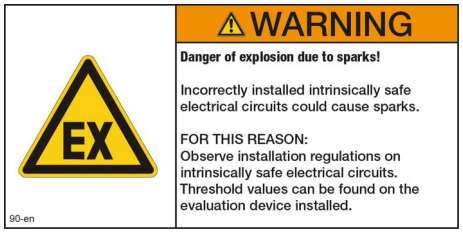


WARNING
Danger of explosion due to ignitions sources within! Hot surfaces and residual charges of electronic components on the inside can ignite a potentially explosive atmosphere. FOR THIS REASON: ☞ Switch off the power supply, secure it from being switched on again, and wait 5 minutes.

Sticker 8 (see *page 27*)

CAUTION
Danger of injury due to falling cover! FOR THIS REASON: ☞ Secure the cover from falling off when removing.

Sticker 9 (see *page 27*)



WARNING

Danger of explosion due to sparks!

Incorrectly installed intrinsically safe electrical circuits could cause sparks.

FOR THIS REASON:

☞ Observe installation regulations on intrinsically safe electrical circuits. Threshold values can be found on the evaluation device installed.

Sticker 10 (see *page 27*)

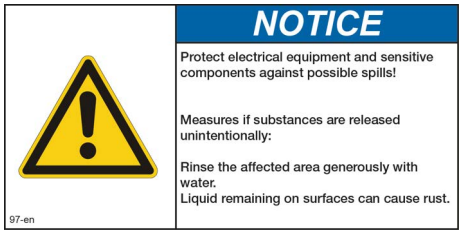
DANGER

Warning about dangerous electrical current even if the device is switched off.

FOR THIS REASON:

☞ Do not touch orange cables.

Sticker 11 (see *page 27*)



NOTICE

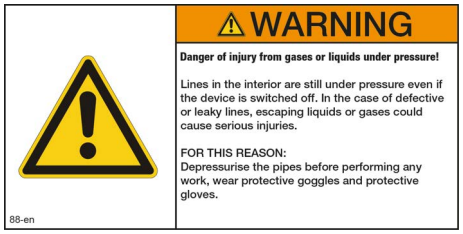
Protect electrical equipment and sensitive components against possible spills!

Measures if substances are released unintentionally:

☞ Rinse the affected area generously with water.

☞ Liquid remaining on surfaces can cause rust.

Sticker 12 (see *page 27*)



WARNING

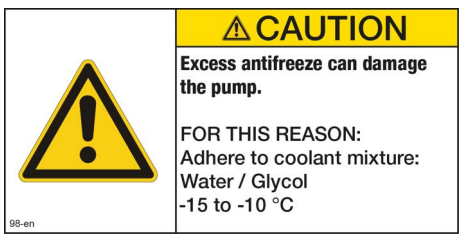
Danger of injury from pressurized gases or liquids!

Lines in the interior are still pressurized even when the device is switched off. In the case of defective or leaky lines, escaping liquids or gases can cause serious injuries.

FOR THIS REASON:

☞ Before performing any work, depressurize the pipes and put on protective goggles as well as protective gloves.

Sticker 15 (see *page 27*)



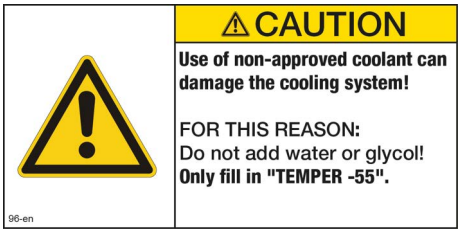
CAUTION

Excess antifreeze can damage the pump.

FOR THIS REASON:

☞ Adhere to coolant mixture level:
Water / Glycol
-15 to -10 °C

Sticker 16 (see *page 27*)



CAUTION	
	Use of non-approved coolant can damage the cooling system! FOR THIS REASON: ☞ Do not add water or glycol! ☞ Only add “TEMPER -55”.

Sticker 13 (see *page 27*)

Warning about automatic start-up.

Sticker 14 (see *page 27*)

Contains fluorinated greenhouse gas according to Kyoto-protocol Enthält vom Kyoto-Protokoll erfasste fluorierte Treibhausgase	R449a 1.1.1 Trifluorehtan..... Pentafluoethan .... 1.1.1.2 ....

Notice regarding compliance with the Kyoto Protocol.

2.7 Safety measures at the installation location

Workspace conditions

- ☞ Ensure that the working area is adequately ventilated.
- ☞ Observe the emission limits. Install an exhaust-air cleaning system if necessary.
- ☞ Do not direct suctioned-off air back into the working area.
- ☞ Install washing facilities and eye baths in the workplace.
- ☞ Install a solvent-proof floor.
- ☞ **Creeping vapors can pose a risk of ignition.** Seal the rooms properly to ensure that gases or vapors cannot enter areas which may contain ignition sources.
- ☞ Install equipment for detecting and reporting gas hazards.
- ☞ Install emergency-off device in easily accessible locations.

Containers and lines

- ☞ Label containers and lines clearly.
- ☞ Only conduct work on containers and lines when they have been thoroughly purged and rendered inert.
- ☞ Protect the device from impermissible external warming.
- ☞ Regularly inspect for leaks.

Working conditions

The infrastructure at the site of the device should be as free as possible from dirt and dust development in order to avoid frequent service cleaning of the condenser fins or the inside of the device.

All information on the type plate must always be observed.

More information on the installation site see *chapter 6.3 “Requirements at the installation location” on page 63*.

2.8 Personnel requirements

All personnel who may work in potentially explosive atmospheres or on refrigeration systems must be sufficiently trained and familiar with the device, system or component/components. This training must include instruction on the device properties, hazardous substances and environmental conditions that relate to the requirements for explosion protection.

2.8.1 Qualifications

WARNING	
	**Danger of injury due to inadequate qualifications!** Improper handling can lead to considerable personal injury and material damage. FOR THIS REASON: ☞ Have all tasks performed only by qualified personnel.

The operating manual refers to the following qualifications for various task areas:

Instructed person

An instructed person has been instructed by the operator on the assigned tasks and on the potential dangers in case of improper behavior.

Trained specialist

Trained specialists have specialist training, knowledge and experience and are aware of the relevant regulations, meaning that they can perform assigned tasks and detect and avoid any possible dangers.

Electrician

Electricians have specialist training, knowledge and experience and are aware of the relevant standards and regulations, meaning that they can perform work on **electrical systems** and detect and avoid any possible dangers.

Electricians are trained for the special locations in which they work and are aware of the relevant standards and regulations.

They are also familiar with all standards and regulations relevant to explosion protection, in particular, but not limited to, all sections of IEC 60079 [***Explosive atmosphere***].

Specialist for potentially explosive atmospheres

Specialists for potentially explosive atmospheres have specialist training, knowledge and experience and are aware of the relevant standards and regulations, meaning that they can perform work on **systems or components in potentially explosive atmospheres** and detect and avoid any possible dangers.

The specialists have knowledge of the various ignition protection types, installation procedures and area partitions in rooms where potential explosions can arise and has certification for experience of knowledge in this area.

These specialists are aware of the rules and regulations applicable to their duties and for explosion protection, in particular, but not solely the ATEX guideline 2014/34/EU and all parts of IEC 60079 [***Explosive atmosphere***].

Specialist for refrigeration and air conditioning technology

Based on their technical training, theoretical knowledge of physical principles, the circulation process of refrigerants, the main components of a refrigeration or air conditioning system, the types of heat transfer and connection technology, specialist personnel are able to carry out work on the refrigerant circuit and recognize and avoid potential hazards independent. In addition, the expert who performs an activity must have a valid certificate according to Directive EU 2015-2067 Article 3.

2.8.2 General requirements

Completed instruction must be logged and confirmed by the persons responsible for instruction and by the persons receiving instruction.

Employees must be persons who can be expected to perform their work reliably. Persons whose reactions are impaired, e.g. by drugs, alcohol or medication, are not permitted.

When selecting employees, observe the age and occupation-specific regulations applicable at the location of deployment.

2.8.3 Unauthorized persons

WARNING	
	**Hazard for unauthorized persons!** Unauthorized persons who do not fulfill the requirements described here are not aware of the hazards posed in the work area. FOR THIS REASON: ☞ Keep unauthorized persons out of the work area. ☞ In case of doubt, address these persons and instruct them to leave the work area. ☞ Interrupt work as long as unauthorized persons are within the work area.

2.8.4 Instruction

The operator must provide instruction to personnel before they are hired, and at least once a year after that. Log the performance of instruction to make it easier to monitor.

Below is an example of an instruction log:

Date	Name	Type of instruction	Instruction provided by	Signature
		First safety instruction for _____		
		Annual safety instruction for _____		

2.9 Personal protective equipment

Wearing personal protective equipment while working is required in order to minimize health hazards.

☞ Always wear the protective equipment required for the corresponding tasks.

☞ Follow the instructions posted in the work area regarding personal protective equipment.

Always wear

Protective work clothing

The following minimum requirements must always be met when performing work:

- Anti-static
- Fire-retardant
- Tight-fitting and closed

No rings, necklaces or other jewelry.

Safety boots

The following minimum requirements must always be met when performing work:

- Category S3 and closed
- Anti-static
- Fire-retardant

Wear for special work

When you are performing special tasks, special personal protective equipment is required. This equipment is referred to specifically in the individual chapters of this operating manual. These special items of safety equipment are described below:

Respiratory protection, filter devices

Protect against hazardous gases, vapors, dusts and similar materials and media.

If a permissible limit value is exceeded by a factor of 100, self-contained respiratory protection apparatus must be used.

Respiratory protection may only be used when there is an oxygen content of at least 17% in the air.

Safety goggles

Protect the eyes from flying objects and sprayed liquids.

Note: Some system operators make the wearing of safety goggles mandatory in general.

Protective gloves (hazardous materials)

Protect hands against contact with hazardous toxic substances.
The glove material must be sufficiently durable and impermeable to the substance in use. Gloves made of fabric or leather are not suitable.

- Before using, check for holes or leaks.
- Clean before removal.

Safety gloves (hot surfaces)

Protect hands against contact with hot surfaces.

Protective gloves (cut protection)

To protect the hands from sharp edges and pointed objects.

2.10 Securing against being switched on again

DANGER	
	**Danger of death due to unauthorised restarting!** During work in danger areas, there is the danger that the power supply can be switched on without authorisation. This poses a life-threatening hazard for the persons in the danger area. FOR THIS REASON: ☞ Adhere to the instructions for securing the device against being switched on again in this operating manual. ☞ Always follow the procedure described for securing the device against being switch on again.

Switch secured with lock
on: _____ at _____ o'clock.

DO NOT SWITCH ON
The lock may only be removed by: _____
once it has been ascertained that there are no persons in the danger area.

☞ Perform the following steps to prevent restarting:

- Switch off the power supply.
- If possible secure the switch with a lock and attach a corresponding sign (see left) to the switch in a place where it can be easily read.
- Have the employee named on the sign keep the key safe.

Switched off
on: _____ at_____ o'clock.

DO NOT SWITCH ON

The device may only be switched on by: _____
once it has been ascertained that there are no persons in the danger area.

If it is **not** possible to secure the switch with a lock,

☞ Set up a corresponding sign (see left).

☞ Ensure that no persons are in the danger zone once all work has been completed.

☞ Make sure that all safety equipment is installed and functioning.

☞ Only then should the sign be removed.

3 Technical data

General data		
Device type	Chiller FKS *-KWS-*	
Refrigeration data		
Refrigerant	R513A or R134A FKS 0.5-KWS: R449A	
Cooling capacity at specified coolant temperature (at x ambient temperature)	FKS 0.5-KWS: FKS 1.4-KWS: FKS 2.4-KWS: FKS 4-KWS FKS 6-KWS FKS 10-KWS	typically 0.5 kW at -35 °C (-31 °F) typically 1.4 kW at 15 °C (59 °F) typically 2.4 kW at 10 °C (50 °F) typically 4 kW at 10 °C (50 °F) typically 6 kW at 10 °C (50 °F) typically 10 kW at 10 °C (50 °F)
Coolant	Temper/water/glycol (depending on application)	
Coolant temperature and coolant pressure	See data sheet in the operating manual of the pump	
Coolant filling quantity	FKS 1.4-KWS: FKS 2.4-KWS: FKS 4-KWS FKS 6-KWS FKS 10-KWS	approx. 20 l approx. 25 l approx. 40 l approx. 40 l approx. 40 l
Coolant temperature (Thermostat setting range)	FKS 0.5-KWS: FKS 1.4-KWS to FKS 10-KWS	-35 to 10 °C (-31 to 50 °F) -5 to 28 °C (23 to 82 °F)
Coolant flow rate		
Circulation pump capacity ±10 %	FKS 0.5-KWS: FKS 1.4-KWS: FKS 2.4-KWS: FKS 4-KWS FKS 6-KWS FKS 10-KWS	400 l/h, 2 to 3 bar 360 l/h, 2 to 4 bar 450 l/h, 2 to 4 bar 600 l/h, 2 to 4 bar 1000 l/h, 2 to 3 bar 1500 l/h, 2 to 3 bar
Coolant system operating pressure P_M:	All variants:	Max. 6 bar(g), open to atmosphere

Specified operating ranges	
Ambient temperature	**All variants:**
Standard:	5 to 40 °C (41 to 104 °F)
High Temperature option:	5 to 55 °C (41 to 131 °F)
Low Temperature option:	-15 to 40 °C (-4 to 104 °F)
Low and High Temperature option:	-15 to 55 °C (-4 to 131 °F)
	Only FKS 0.5-KWS: 5 to 35 °C (41 to 95 °F)
	Other ambient temperatures possible on request!

Electrical data	
Rated current	Dependent on various factors. See type plate
Power consumption	FKS 0.5-KWS: 1.8 kW FKS 1.4-KWS: 1.8 kW FKS 2.4-KWS: 2.3 kW FKS 4-KWS 3.2 kW FKS 6-KWS 4.3 kW FKS 10-KWS 6.5 kW
Pre-fuse	Dependent on various factors. See type plate
Rated voltage	110-690 V AC 50/60 Hz Dependent on various factors. See type plate

Emissions	
Noise emissions	approx. 75 dB(A)
Dimensions and weights	
Dimensions (H x W x D) in mm	FKS 0.5-KWS: 500x960x530 FKS 1.4-KWS: 500x960x530 FKS 2.4-KWS: 600x960x530 FKS 4-KWS 1000x1100x700 FKS 6-KWS 1100x1100x700 FKS 10-KWS 1200x1100x700
Weight	FKS 0.5-KWS: 150 kg FKS 1.4-KWS: 150 kg FKS 2.4-KWS: 160 kg FKS 4-KWS 260 kg FKS 6-KWS 290 kg FKS 10-KWS 310 kg
Connections	
Cable connections	M25 mains supply M20 error message or cable
Hose connections	FKS 0.5-KWS to FKS 2.4-KWS: ½ inch NPT FKS 4-KWS to FKS 10-KWS: depending on application
Service life	
Max. 10 years, depending on ambient conditions and maintenance / servicing	

3.1 Safety-relevant technical data (SIL limits)

High-pressure refrigerant (safety function *KWS-2*)	
Switching threshold off (P_{rel})	20 bar +10 %
Boiling temperature at 21 bar for R134A	70 °C
Boiling temperature at 21 bar for R513A	69 °C
Refrigerant low pressure (safety function *KWS-3*)	
Switching threshold off (P_{rel})	0.2 bar
Switching threshold on (P_{rel})	0.5 bar
Boiling temperature at 1.2 bar abs for R134A	-22 °C
Boiling temperature at 2.5 bar abs for R134A	-4 °C
Boiling temperature at 1.2 bar abs for R513A	-25 °C
Boiling temperature at 2.5 bar abs for R513A	-7 °C
Compressor head temperature (safety function *KWS-4*)	
Switching threshold	90 °C
Magnetic coupling temperature (safety function *KWS-5*)	
Switching threshold off	62 °C
Switching threshold on	59 °C

3.2 Type plate

Main type plate

The main type plate is located on the rear side of the box and contains the following information:

- Manufacturer
- Type
- Ex marking (explosion protection marking)
- Certificate number
- Serial number
- Year of manufacture
- Rated voltage
- Rated current / pre-fuse
- Refrigerant
- Refrigerant quantity
- Operating pressure
- Cooling capacity
- Ambient temperature
- Protection class

Compressor type plate

The compressor type plate is located on the rear side of the box and contains the following information:

- Manufacturer
- Type
- Ex marking (explosion protection marking)
- Certificate number
- Serial number
- Year of manufacture
- Rated voltage
- Rated current RLA
- Starting current (LRA)
- Refrigerant
- Ambient temperature

Control unit type plate

The control unit type plate is located on the rear side of the box and contains the following information:

- Manufacturer
- Type
- Ex marking (explosion protection marking)
- Certificate number
- Serial number
- Year of manufacture
- Rated voltage
- Rated current
- Pre-fuse
- Ambient temperature
- Protection class

4 Design and function

4.1 System overview

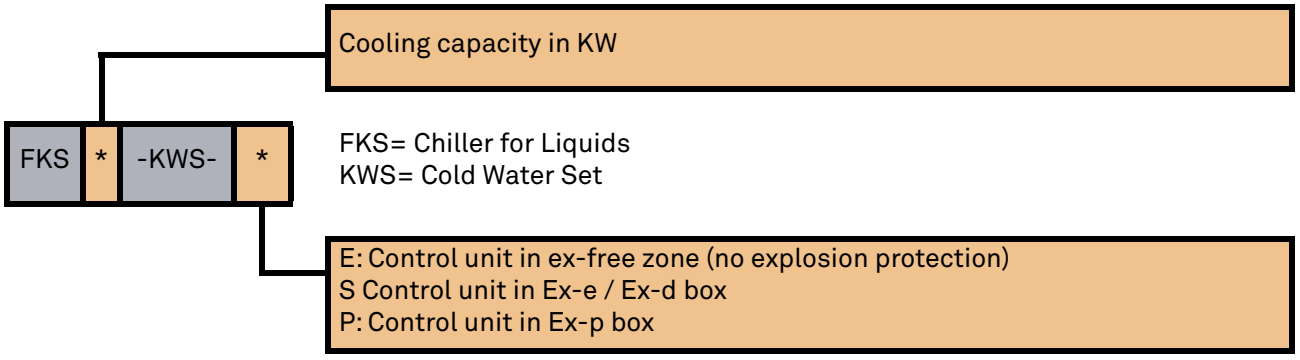
The complete device consists of the following functional elements:

Painted steel frame (standard), galvanized fold-down plugs in the front and the rear, upper protective cover is screwed. The construction includes a refrigeration unit, pressure switch circulating pump, chiller storage tank with level switch and thermostat regulator and a central Ex-e terminal box. The box corresponds to IP2XB. The installed components correspond to min. IP54.

Core technical data	Note
Connection voltage:	This is customer-specific information and subject to constant change. For current values, please see the technical documents provided; some information can also be found on the type plate.
Power consumption	
Cooling capacity	
Device dimensions	
Thermostat control range	-5 °C / 28 °C (standard)

4.2 Type key

The coding is explained below:



4.3 Description of assemblies

Refrigerant system

The refrigerant system consists of all components to provide the cooling capacity. A non-flammable refrigerant is used for this purpose.

Sight glass:

A moisture indicator is located in the sight glass.
The indicator shows the following:

- Green: no moisture in the refrigerant.
- Yellow: too high moisture content in the refrigerant.

Compressor:

A compressor is a machine (hydraulic machine) that supplies mechanical work to an enclosed gas; compressors are used for compressing gases. They increase the pressure and density of the gas. Refrigerating machines operate with a gaseous refrigerant.

Coolant system

The refrigerant system consists of all components for short intermediate storage and external transport of the cooling capacity to the customer process.

A non-flammable coolant is used as standard,
e.g. temper/water/glycol (depending on the application).

If flammable coolants or products are used in the coolant circuit, suitable procedures must be followed for filling and draining.

Reference to supplier documentation

The other components are described in the following sections in the context of their functions. Please also observe the instructions of the respective manufacturers.

4.4 Electrical control unit

NOTICE	
	**The control unit is not part of the device and is certified separately if necessary.**

All non-ex-proof equipment required for safe operation of the deviceis installed in an explosion-proof enclosure, e.g. explosion protection types Ex e, Ex p, or pressure-resistant enclosure Ex d. Alternatively, the control unit can be installed in a switchgear compartment outside the potentially explosive atmosphere.

For safety reasons, all assembly and installation work on the explosion-proof components may only be carried out and documented by qualified personnel trained in explosion protection.

For all further relevant information on the installation components of other manufacturers, which are required for proper operation, maintenance, and repair, as well as the safety instructions for explosion protection of individual type-tested equipment, please refer to the enclosed documentation, e.g:

- Operating instructions of associated manufacturers for:
  - Ex motors
  - Pressure switch
  - Thermostat circulation pump
  - Axial coupling
  - Floating switch
  - Ex box
  - Junction box, etc.
- For information on safe operation during maintenance and repair of the device, please always observe the operating and maintenance instructions in the separate operating manuals of the respective manufacturer.

The following chapters describe various control unit designs.

4.4.1 Safety function of ignition source monitoring

The safety-relevant technical data is monitored using an electrical control unit (see *chapter 3.1 “Sicherheitsrelevante technische Daten (SIL-Grenzwerte)” on page 43*). The electrical circuit diagram can be found in the supplied customer folder.

Temperatures and pressures are monitored. The maximum permissible surface temperatures and the minimum pressure of the gas in the static pressurization of the refrigerant circuit (in this case the refrigerant pressure) can be found at *Chapter 3.1 “Sicherheitsrelevante technische Daten (SIL-Grenzwerte)” on page 43*. The description of the regular inspection for this safety equipment can be found in *Chapter 10.9 “Fünfjährige Prüfung” on page 94*.

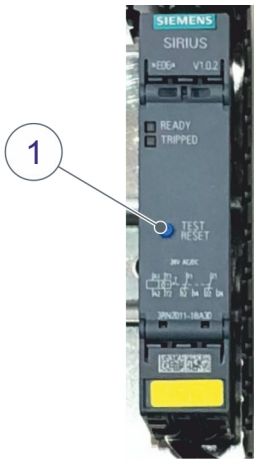


Figure 4.1: Thermistor monitoring device

After the safety monitoring has been triggered, it must be reset manually. You can find the reset button of the safety function on the thermistor monitoring device from SIEMENS **(1)**, which is located in the control box (see also *Figure 4.3 on page 49*).

If the device is delivered in combination with one of our analyzers, this monitoring device is located in the control box (Ex p), as shown in the following example *Figure 4.2 on page 48*.

Analyzer control box

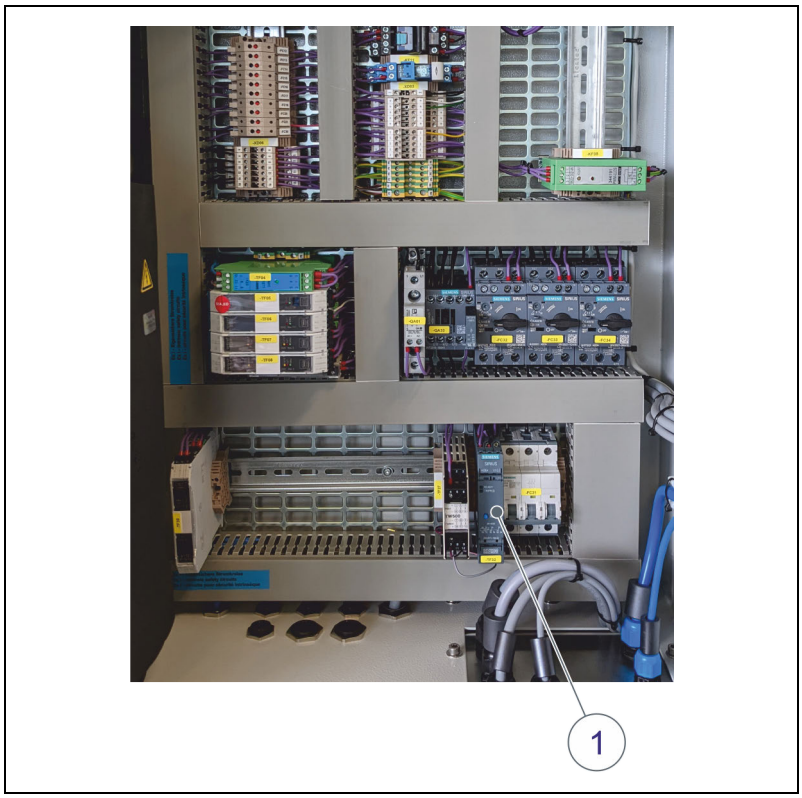


Figure 4.2: Control box of an analyzer (example)

4.4.2 Pressure-resistant control box

Design variant:

Figure 4.3: Ex d box

4.4.3 Control unit on switchgear panel

If the control unit is to be installed outside the potentially explosive atmosphere, the control unit is supplied on a switchgear panel.

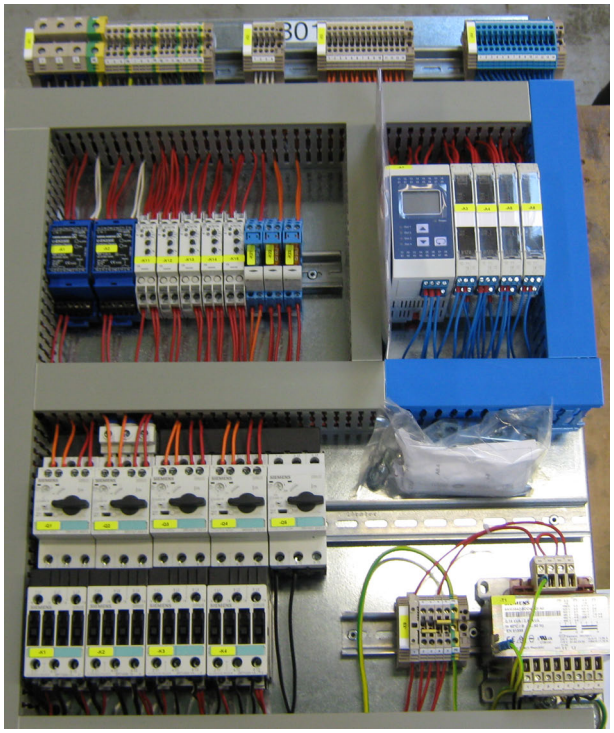


Figure 4.4: Switchgear panel with control unit (example)

4.5 Brief description

The device is cooled by a refrigerating machine consisting of a fully hermetically sealed compressor, an air-cooled condenser with axial fan, thermostatic expansion valve, storage tank, circulation pump, and refrigerant evaporator.

All elements of the refrigeration system are connected via pipelines to form a closed circuit in which CFC-free refrigerant is circulated. The heat exchange in the refrigerant takes place in the refrigerant evaporator, which the cooling liquid can flow through as can the refrigerant in opposite directions.

Due to the strong pressure drop of the refrigerant at the expansion valve and the evaporation energy released as a result, the atomized refrigerant evaporates and extracts the heat energy from the refrigerant agent (water-glycol mixture).

4.6 Functional principle

The refrigerant system works according to the familiar compression procedure. The pressure of the liquid refrigerant decreases due to the change in aggregate state that occurs during refrigeration as a result of expansion and evaporation in the evaporator. The refrigerant vapor is liquefied again by the pressure increase (compression) from low to high gas pressure in the compressor and subsequent condensation in the condenser. This procedure is repeated constantly. The maximum permissible operating pressure of the refrigerant is monitored by the pressure switch.

When the pressure conditions in the refrigerant circuit are normal, the connected contacts of pressure switches are closed. Under normal thermal load, no impermissible high pressure may occur on the pressure side of the compressor and no extreme low pressure may occur on the suction side. If faults occur in the refrigerant circuit due to pressure losses or pressure increases, as well as high compressor head temperatures outside the permissible limit values, the entire refrigeration system is shut down immediately.

The refrigeration circuit of the device is hermetically sealed.
The refrigerant used is non-flammable.

The compressor is fully hermetically encapsulated and the electrical connection is cast in a spark-proof manner (encapsulation, explosion protection *mb*). To monitor impermissible high compressor temperatures, a temperature sensor is screwed into the top of the compressor capsule. The limit temperature can be found at *Chapter 3.1 “Sicherheitsrelevante technische Daten (SIL-Grenzwerte)” on page 43*.

The sensor circuit is of the *increased safety* explosion protection; it is electronically monitored against line breakage and short-circuit and immediately switches off the entire refrigeration system in the event of a fault.

The fan motor(s) are of an explosion-proof design. Fan(s) I and II are controlled by the refrigerant pressure from the evaporator via the corresponding pressure switches in larger systems.

All pressure switches are plumbed and sealed to prevent erroneous or improper changes in limit values. **The set pressure values have an effect on the explosion protection.**

NOTICE	
	**The hermetically sealed refrigerant system is part of avoiding the risk of ignition.** **The low pressure of the refrigerant system must always be higher than the ambient atmospheric pressure.**

Refrigerant receivers are collecting vessels for liquid refrigerant from the condenser to ensure that the E-valve only receives liquid, vapor-free refrigerant. Receivers are always used when the required cooling capacity is subject to large fluctuations.

The refrigerant dryer serves to catch dirt and moisture. The sight glass can be used to determine the fill levels and for the quality control of the refrigerant.

Units that are installed outdoors also have a condenser pressure regulator installed between the condenser and the receiver, which keeps the condensing pressure at a minimum pressure by accumulating the refrigerant in the receiver, even at low outside temperatures. The differential pressure valve opens when the receiver pressure is too low and allows hot gas to flow into the receiver to increase the pressure.

All fan blades can be made of aluminum or plastic material with a surface resistance $\leq 10^9\ \Omega$.

All components in the refrigeration system are arranged for ease of service. The electrical connections of the electric motors from the condenser fan, circulation pump, refrigeration compressor, temperature sensor, and the intrinsically safe circuits for the pressure monitors, floating switch, and thermostat are laid out in the Ex e junction box.

4.6.1 Coolant circuit

Using the evaporator/heat exchanger in the storage tank, the coolant, e.g., a water/glycol mixture, is cooled down to the set temperature and pumped into the cooling circuit by means of a circulation pump and later returned to the storage tank.

For temperature control, a thermostat with mechanical controller can be installed in the storage tank. The tank serves as a circuit reserve for the cooling water mixed with antifreeze, the liquid level is monitored by means of a floating switch at the “Min Level” level. Missing coolant can be refilled manually using a filler neck with screw cap. The coolant level can be checked from the outside of the storage tank via a sight glass.

4.6.2 Cooling a system-side coolant circuit (option)

Alternatively, the evaporator coil can be used to cool a coolant circuit on the system side via a plate heat exchanger. Components such as the circulation pump and storage tank are then not required. Instead, the device is equipped with a flow monitor and a temperature sensor in the coolant circuit. The flow monitor guarantees that the compressors are only active when the coolant is flowing. The temperature sensor is used to control the temperature. For further information, please refer to the technical documentation supplied.

4.6.3 Application for low temperatures

Devices for low temperatures are filled with a different refrigerant; they differ from the other “normal” cooling systems only in the capacity of the type designation on the type plate. For example, the designation **FKS 0.5 -KWS */*** in the cooling capacity then states that a maximum cooling capacity of 0.5 KW is still available at an evaporation temperature of -35 °C.

The storage tank is filled with a special heat carrier, *Temper 40*, which ensures a freezing protection of approx. -50 °C.

Glycol mixtures must not be added.

The function of the coolant circuit corresponds as described to that of cold water systems.

4.6.4 Option: Dust filter

If the filter becomes increasingly dirty, with the air permeability of the dust filter constantly deteriorating and the differential pressure thus constantly increasing, the switch contact is activated and signals:

Filter mat soiled

Diagnosis:

- **Small differential pressure:**
  Good air permeability; filter mat OK.
- **Large differential pressure:**
  Filter mat dirty; replace filter mat!

4.7 Functional diagram

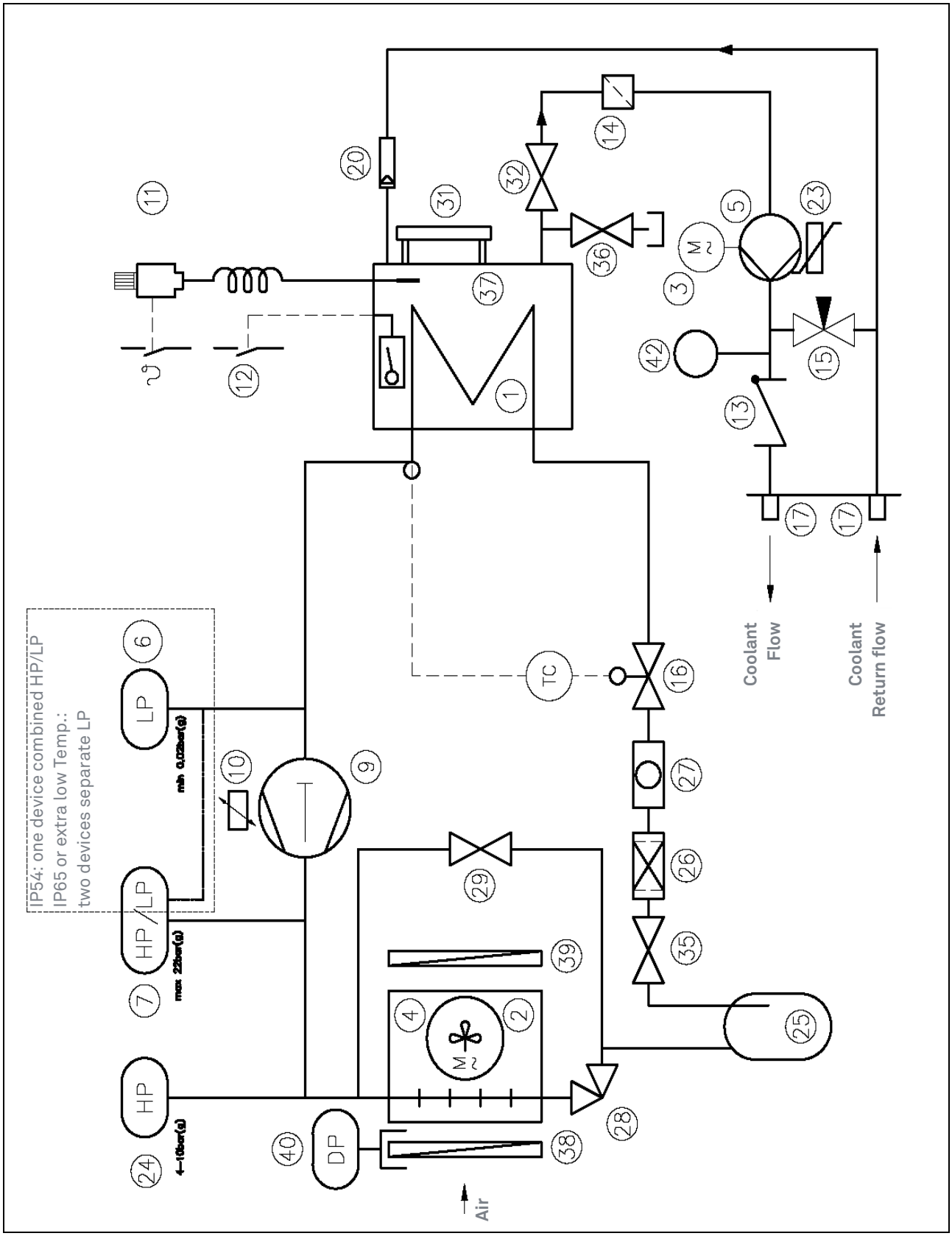


Figure 4.5: Functional diagram FKS-KWS (example)

Key for functional diagram of components

Number	Component
1	Evaporator coil
2	Liquefier
3	Circulation pump electric motor
4	Fan motor
6	Low-pressure switch
7	High-pressure / low-pressure switch
8	n/a
9	Compressor
10	Temperature sensor
11	Thermostat
12	Fill-level switch
13	Non-return valve
14	Filter
15	Needle valve
16	Injection valve
17	Bulkhead fitting coolant inlet/outlet
25	Refrigerant collector
26	Refrigerant dryer
27	Refrigerant fill level sight glass
31	Coolant fill level sight glass
32	Coolant shut-off valve
35	Refrigerant shut-off valve
36	Discharge valve

5 Transport, packaging, and storage

The following transport and storage conditions must be observed.

5.1 Safety

Personnel

The transport work described here may only be performed by trained specialists or by employees of the manufacturer.

Personal protective equipment

Wear the basic protective equipment specified in *chapter 2 “Safety”* and the following additional protective equipment:

- Protective gloves
- Head protection if necessary

5.2 Safety instructions for transport

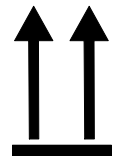
Improper transport

CAUTION	
	**Damage due to improper transport!** Improper transport can result in considerable material damage. ☞ Preventive measures See *chapter 2 “Safety”*.

Suspended loads

WARNING	
	**Danger of death due to suspended loads!** When loads are being lifted, falling or uncontrollably swinging components pose a danger to life and limb. ☞ Preventive measures See *chapter 2 “Safety”*.

5.3 Symbols on the packaging

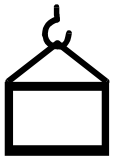


This way up
The arrows indicate the top side of the packaged item. They must always point upwards, otherwise the content can be damaged.

Protect against moisture
Protect the packaged items against moisture and store in a dry place.

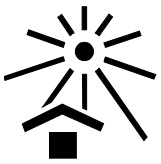
Lift here
Lifting equipment (chains, lifting belts) should only be attached to the points indicated with this symbol.

Centre of gravity
Indicates the centre of gravity of packaged items.
Take the centre of gravity into consideration when lifting and transporting.



Weight of suspended load
Indicates the weight of packaged items.

Handle the packaged item in a manner appropriate for the indicated weight.



Protect against heat
Protect packaged items against heat and direct sunlight.

Caution, fragile
Indicates fragile goods.
Handle packages carefully, do not push or strap.

5.4 Transport inspection

☞ Inspect the delivery immediately upon reception for completeness and possible transport damage.

☞ If externally visible transport damage is detected, proceed as follows:

- Do not accept the delivery or only with reservations.
- Note the extent of damage on the transport documents or on the delivery note of the carrier.
- File a claim.

NOTICE	
	**File a claim for every defect as soon as it is detected. Damage claims can only be honoured within the applicable claim deadlines.**

5.5 Packaging

Packaging

The individual packaged items are appropriately packed for the expected transport conditions. Only environmentally sound materials have been used for the packaging.

The packaging is designed to protect the individual components from transport damage, corrosion and other damage until the time of their assembly. Therefore do not destroy the packaging and only remove it immediately prior to assembly.

Handling packaging materials

Separate packaging materials by type and size and reuse or recycle.

CAUTION	
	**Environmental damage due to incorrect disposal.** Packaging materials are valuable raw materials and can in many cases be reused or expediently processed and recycled. ☞ Avoidance measures see *chapter 2 “Safety”*.

5.6 Transport

☞ Always use the specified handling device for lifting and transporting the device.

NOTICE	
	**The device must always be transported and stored in an upright position to prevent any liquid such as oil or refrigerant from flowing into the compressor!**

5.7 Storage

Damage caused by improper storage is not covered by the warranty obligations of BARTEC BENKE.

☞ Always drain the coolant circuit before storing the device. Otherwise, damage to the coolant circuit may occur at low temperatures due to the coolant freezing. BARTEC BENKE always delivers the device with an empty coolant circuit.

☞ Only store the device where the following conditions are fulfilled:

- Only store in the original packaging.
- **Always upright**
- Low vibration
- Do not store outdoors.
- Store in a dry and dust-free location.
- Do not expose to any aggressive media.
- Protect against direct sunlight.
- Storage temperature: -35 to 70 °C
- Relative humidity: 5 to 75 %, non-corrosive
- If the device is to be stored for longer than 3 months, check the condition of all parts and the packaging regularly. If necessary, replace or touch up the corrosion protection.

NOTICE	
	**If it has been stored in its original packaging for longer than twelve months from the date of delivery, BARTEC BENKE must perform maintenance and servicing.** **Please contact customer service.**

NOTICE	
	**Under certain circumstances, individually packaged items may have instructions regarding their storage conditions which exceed the requirements mentioned here. These are to be observed accordingly.**

6 Installation and preparation for first commissioning

Installation and commissioning together with the Ex-control unit, if present, must be carried out in compliance with the national regulations for the installation of systems in potentially explosive atmospheres (e.g. EN 60079-14).

6.1 Safety

The device and control unit must be connected to the local equipotential bonding during installation (see see *chapter 2.5.4 "Potential equalization" on page 24*).

Personnel

- The installation and preparation for commissioning may only be performed by specialists for potentially explosive atmospheres.
- Work on the electrical system may only be performed by qualified electricians.

NOTICE	
	**Work is not normally necessary on the refrigerant circuit. If work is nevertheless necessary on the refrigerant circuit, this work may only be carried out by a qualified electrician for refrigeration and air-conditioning technology (see *chapter 2.8 "Personnel requirements" on page 32*).**

Personal protective equipment

Wear the basic protective equipment specified in *chapter 2 "Safety"* and the following additional protective equipment:

- Safety goggles
- Protective gloves
- Hearing protection if necessary

NOTICE	
	**If other protective equipment is required for certain tasks, this is stated in the warnings in this chapter.**

Fundamental principles

WARNING	
	**Danger due to incorrect installation and first commissioning!** Installation and first commissioning must be conducted by trained specialist personnel who have adequate experience. Errors in installation can lead to life-threatening situations or considerable material damage. ☞ Preventive measures see *chapter 2 "Safety"*.

Electrical current

DANGER	
	**Danger of death due to electrical current!** Touching voltage-conducting parts poses an immediate life-threatening hazard. Damage to the insulation or to individual components can cause fatal injury. ☞ Avoidance measures see chapter 2 “Safety”.

Securing against being switched on again

DANGER	
	**Danger of death due to unauthorized restarting!** During work in danger areas, there is the danger that the power supply can be switched on without authorisation. This poses a life-threatening hazard for the persons in the danger area. ☞ Avoidance measures see *chapter 2 “Safety”*.

Electrostatic discharge

WARNING	
	**Danger of explosions due to electrostatic discharge (ESD)!** Touching plastic or operating manual controls made of plastic (e.g. pressure regulators) may ignite an existing explosive atmosphere! FOR THIS REASON: ☞ Preventive measures see *chapter 2 “Safety”*.

6.2 Main switch

The device has neither its own main switch nor its own emergency off device. For information on selecting a suitable main switch, refer to *section 2.5.3 “Main switch” on page 24*.

For this reason, perform the following steps before commissioning the device:

☞ Install a main switch which disconnects all poles from the power supply.

☞ Install an emergency off device for the device and integrate it in the system control safety chain during operation as part of a system. **The operator is obliged to prepare suitable protective devices and safeguards.**

When installing, make sure that:

☞ The emergency off device must be connected in such a way that no situations can arise that endanger persons or property if the power supply has been interrupted or activated.

☞ Install the main switch and emergency off device in an easily accessible location close the device.

☞ Label the main switch and emergency off device so that they can be clearly associated with the device.

6.3 Requirements at the installation location

Ambient conditions

The device is solely intended for use at a fixed location in an area that provides protection against the elements. Depending on the design, it may also be operated outdoors. A simple roofing protection (available as an option) is recommended for the device to protect it from weather-related influences.

In order not to expose the device to additional heat from solar radiation if set up outdoors, we as the manufacturer recommend installing it in a **direction facing away from the sun** if local conditions permit.

The device may only be operated at the indicated device-specific ambient temperatures. Information on this can be found on the type plate and in the diagram supplied.

WARNING	
	**Danger of bursting due to strong heat radiation!** This can lead to considerable pressure increases in the refrigerant circuit when the unit is switched off. FOR THIS REASON: ☞ Protect the unit from strong heat radiation.

The device must be integrated by the operator into its own existing lightning protection system.

The device is designed for installation on a level foundation or equivalent floor surface. When selecting a location, check that the load-bearing capacity and size of the location are sufficient and that there is sufficient free space for maintenance work. The device must be installed with low vibration.

Before each first commissioning, the mains voltage, the maximum nominal current and all power data on the device type plate must be compared with the installed connected values before switching on the main switch. A rotational field inspection must always be performed.

☞ Ensure that the intake and exhaust openings of the condenser and the Ex-motors are kept clear.

The following minimum clearances to an opposite wall must be maintained:

- Condenser intake side (left): approx. 0.5 m
- Front side: approx. 1.0 m
- Rear side: approx. 0.5 m
- Exhaust side: approx. 0.5 m

Observe the dimensions of the device to be able to maintain the required distances (see *chapter 3 “Technical data” on page 39*).

The device must be installed stationary at the installation site, using the mounting holes to prevent it from slipping.

All data on the ambient conditions see *chapter 3 “Technical data” on page 39*.

Observe the dimensions of the device to be able to maintain the necessary clearances (see the plans and technical documents supplied).

6.4 Connecting electrical connections

The connecting lines between the control unit and device are only connected to the control unit on one side. The connection to the device must be made during installation.

Before every first commissioning, and before switching on, the mains voltage, maximum nominal current and all performance data on the type plate of the device must be compared to the installed connection values. **A rotational field inspection must always be performed.**

6.4.1 Connecting the power supply and signal lines

- This work may only be performed by a qualified electrician.
- Special tools required:
  - Electrician’s equipment

The following tightening torques must be observed:

Cross-section	Tightening torques
2.5 mm²	0.4 – 0.6 Nm
4 mm²	0.5 – 1.0 Nm
6 mm²	0.8 – 1.6 Nm
10 mm²	1.2 – 2.4 Nm
16 mm²	2.0 – 4.0 Nm

Electrical current

DANGER	
	**Danger of death due to electrical current!** Touching voltage-conducting parts poses an immediate life-threatening hazard. Damage to the insulation or to individual components can cause fatal injury. ☞ Avoidance measures see chapter 2 “Safety”.

Connecting the connection lines

NOTICE	
	**For the installation of intrinsically safe circuits, the special requirements outlined in standard 60079-14 section 12 must be observed, particularly relating to the cables in cable routing.** **The device must be included in the local equipotential bonding (cable cross-section at least 16 mm²).**

All external cable connections for the motor, open-loop and closed-loop control circuits must be installed correctly in the Ex e terminal box in accordance with the electrical documentation supplied by BARTEC BENKE.

Normally, the control unit is located in a pressure-resistant housing. The pressure-resistant housing may be installed inside the device or supplied for installation outside the device. In exceptional cases, the control unit is to be operated outside the potentially explosive atmosphere, in which case it is supplied on a switchgear panel.

Main switch and integration in an emergency off concept required

The device has neither its own main switch nor its own emergency off device (further information see *chapter 6.2 “Main switch” on page 62*).

Preparation

WARNING	
	**Danger of explosion due to open ignition sources of operating material outside the device!** Equipment operated in intrinsically safe circuits can cause explosions if not connected according to the manufacturer's specifications. ☞ Preventive measures see *chapter 2 “Safety” on page 9*.

Control unit separate from the device

☞ Make sure that the ambient temperature of the control unit components is always between -20 and 60 °C.

☞ Install a fuse in the supply line to the device in accordance with the technical data.

☞ Data that is important for the installation can be found in the supplied electrotechnical documentation and the terminal diagram.

☞ Before starting the work, make sure that the mains voltage available matches the operating voltage specified on the type plate.

Connecting the intrinsically safe circuits (Ex i)

For the installation of intrinsically safe circuits, the special requirements outlined in DIN EN 60 079-14 section 12 must be observed, particularly relating to the cables in cable routing, separation distances, grounding etc.

Information on the capacitances and inductances of the cables for the intrinsically safe circuits can be found on the switchgear panel.

Control unit on a switchgear panel for non-potentially explosive atmospheres

☞ Mount the switchgear panel properly in a suitable electrical operating space. Take the IP protection class into account. Information on the IP protection class can be found on the type plate on the switchgear panel.

If flammable coolant or product is used in the coolant circuit (max. gas group *IIA*), the operator must take suitable measures when filling/emptying.

Otherwise, observe the following measures:

☞ Drain/fill the pipeline **slowly**.

☞ **Slowly** open and close the filling valve or shut-off valve system-side. Make sure that the coolant flows into a collection container, if necessary.

☞ Rinse the pipeline with coolant until no more air bubbles appear.

☞ Purge the pipeline for another 2 minutes. Make sure that the existing collection container does not overflow.

☞ Only conduct work on containers and pipelines when they have been thoroughly purged and purged with inert gas.

7 First commissioning

The device has been inspected for functional safety by the manufacturer at the factory during test operation. All pressure, temperature thresholds as well as the motor protection switch are already set.

Make sure that all preparatory work for commissioning has been performed.

NOTICE	
	**Installing the device and the necessary preparations for first commissioning are described in *Chapter 6 "Installation and preparation for first commissioning" on page 61*.**

7.1 Safety

Personnel

Commissioning may only be performed by specialists for potentially explosive atmospheres.

Personal protective equipment

Wear the basic protective equipment specified in *chapter 2 "Safety"* and the following additional protective equipment:

- Safety goggles
- Protective gloves
- Hearing protection if necessary

NOTICE	
	If other protective equipment is required for certain tasks, this is stated in the warnings in this chapter.

Hot operating materials

WARNING	
	**Danger of burns due to hot operating materials!** Operating materials can reach high temperatures during operation and cause burns upon contact. ☞ Avoidance measures see *chapter 2 "Safety"*.

Hot surfaces

WARNING	
	**Danger of burns due to hot surfaces!** Contact with hot components can cause burns. ☞ Avoidance measures see *chapter 2 "Safety"*.

Cold operating materials

WARNING
 **Danger of burns due to cold operating materials!** Operating materials can reach low temperatures during operation and cause burns upon contact. ☞ Preventive measures see *chapter 2 “Safety”*.

Cold surfaces

WARNING
 **Danger of burns due to cold surfaces!** Contact with cold components can cause burns. ☞ Preventive measures see *chapter 2 “Safety”*.

Electrostatic discharge

WARNING
 **Danger of explosions due to electrostatic discharge (ESD)!** Touching plastic or operating manual controls made of plastic (e.g. pressure regulators) may ignite an existing explosive atmosphere! ☞ Preventive measures see *chapter 2 “Safety”*.

Danger of explosion due to sources of ignition – refrigerant system

WARNING
 **Danger of explosion due to sources of ignition!** The refrigerant system box is protected with static pressurization. It may only be filled in areas without potentially explosive atmospheres in accordance with the manufacturer’s instructions. ☞ Preventive measures see *chapter 2 “Safety”*.

Danger of suffocation from inert gas

WARNING
 **Danger of suffocation from inert gas!** In exceptional cases, the unit or the refrigerant circuit may only be filled with nitrogen for transport-related reasons. This can pose a risk of suffocation. It also contains a substance that can produce a combustible atmosphere if it escapes into the air. ☞ Preventive measures see *chapter 2 “Safety”*.

7.2 Potential equalization and conductive parts

☞ Connect the external potential equalization connection with the on-site equipotential bonding rail.

☞ Observe the safety instructions in *section 2.5.4 "Potential equalization" on page 24*.

7.3 Putting device into operation

CAUTION	
	**In exceptional cases, the unit or the refrigerant circuit may only be filled with nitrogen for transport-related reasons.** **If the device has been supplied with a protective nitrogen filling (approx. 1 bar), the device may not be switched on under any circumstances in this state; otherwise, the device may be severely damaged.** **Therefore, after filling of the coolant, also follow the instructions in *section 7.4 "Filling the refrigerant system with refrigerant during initial commissioning" on page 72*.**

First follow the steps in *Chapter 6 "Installation and preparation for first commissioning" on page 61*.

☞ **Before each first commissioning of the device, perform all the listed tests!**

☞ Please also observe the instructions in *section 9.2.1 "Notes on checking the coolant level" on page 82*.

☞ Fill the device with coolant and suitable antifreeze (e.g. glycol) as follows before switching it on:

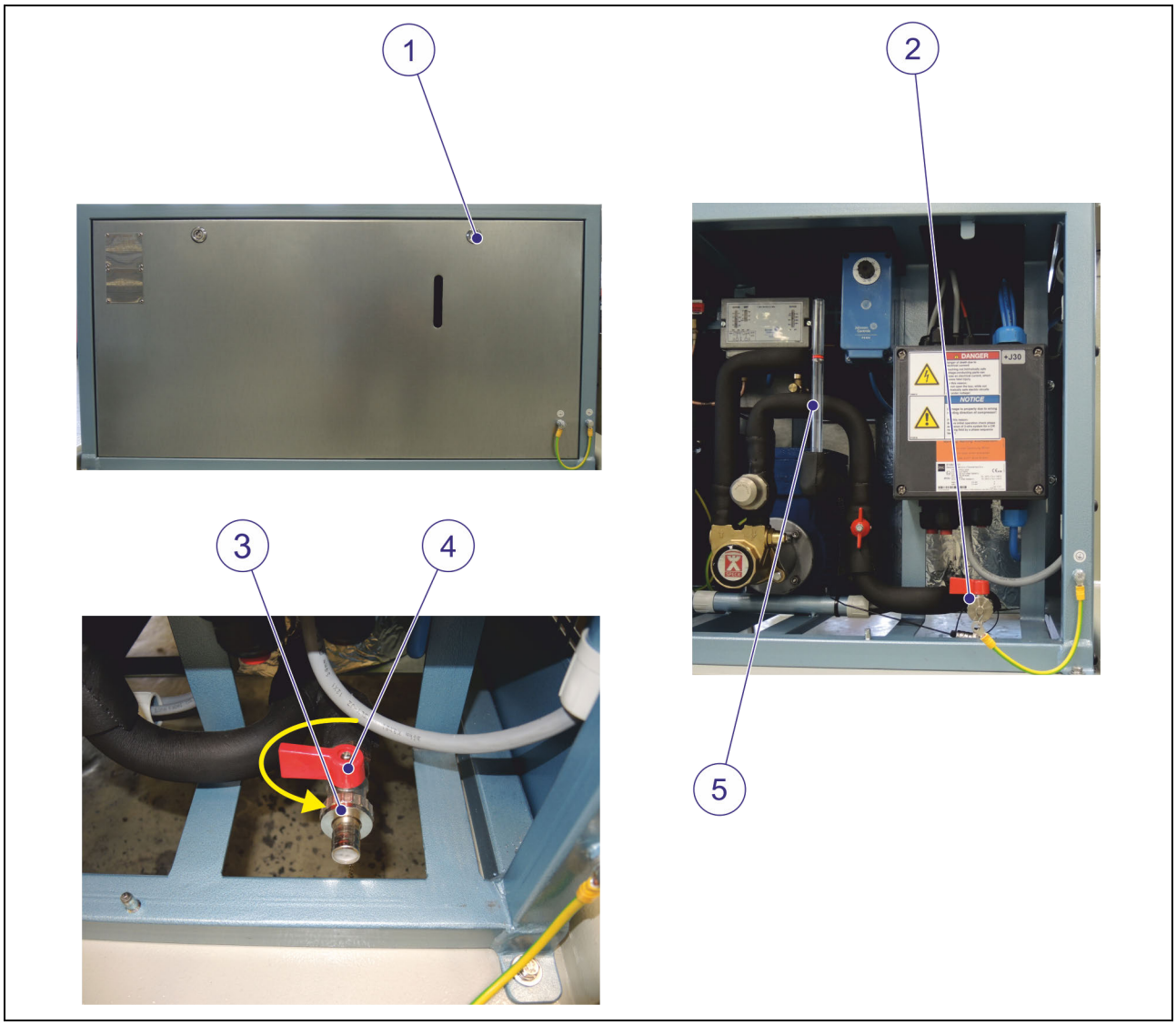


Figure 7.1: Filling the device

- ☞ Open and remove the cover of the device **(1)**.
- ☞ Remove the cap of the inlet and outlet container **(2)**.
- ☞ Fit the hose connection adapter **(3)**.
- ☞ Connect a hose with a funnel, open the ball valve **(4)** and carefully fill the coolant mixture until the *Max* mark is reached in the sight glass **(5)**.
- ☞ Close the ball valve **(4)**.
- ☞ Remove the hose with funnel.
- ☞ Dismantle the hose connection adapter **(3)**.
- ☞ Fix the closure of the inlet and outlet container **(2)**.
- ☞ Fit the cover of the device **(1)**.

Once all installation work is complete, the following checks must be performed:

Before closing the device flaps, all installation materials as well as tools etc. must be removed from the device and the Ex-control.

Similarly, all removed protective covers and housing lids (e.g. junction box) must be closed again so they are safe for operation. All cable entries must be checked for tightness in the screw connection. Free cable entries must be closed.

All connections must be checked for tensile strength and compliance with the terminal strip connection diagram. **It is essential to check the rotational field with a rotational field meter!**

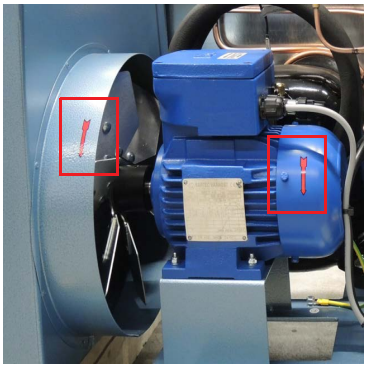


Figure 7.2: Fan and pump

☞ **Make sure that the compressor does not start.**
Depending on the design, the compressor's direction of rotation must be correct.

☞ Check whether the fan and the pump rotate in the correct direction: The red arrow must point downwards in each case.

☞ To do this, select the cooling water temperature higher than the ambient temperature on the thermostat or switch off the motor protection switch from the compressor (see electrical engineering documentation). If the rotation direction is incorrect, there is a risk of compressor damage even during short-term operation!

The power supply and the frequency range must match the specified device data on the type plate.

Parts that start automatically

WARNING	
	**Risk of injury from touching parts that start automatically!** Serious injuries can occur when working on the device without protective coverings in place or on "open" fans or drive shafts if these start up automatically. FOR THIS REASON: ☞ Preventive measures see *chapter 2 "Safety"*.

Cooling a system-side coolant circuit (option)

☞ Before switching on the device, make sure that the intended amount of coolant flows through the device heat exchanger!

CAUTION	
	**Standing coolant can freeze in the heat exchanger! This will destroy the heat exchanger!**

7.4 Filling the refrigerant system with refrigerant during initial commissioning

Work on refrigerant systems may only be carried out by suitably trained specialist personnel. The refrigerant system has already undergone a test at the factory; all parameters are preset.

☞ **Only fill the device with refrigerant outside of an explosive atmosphere; if necessary, measure to ensure that there is no risk of explosion.**

☞ All national requirements for filling a refrigerant system must be followed. Required tests such as a pressure-resistance test and leak test are to be performed during this operation.

☞ When filling the system with refrigerant, **do not exceed the specified amount under any circumstances**. Otherwise, the efficiency of the air conditioner may be impaired or the components of the refrigerant circuit may be damaged.

The following procedure is to be performed with calibrated measuring instruments:

(1) Switch off the device

(2) Connect a suitable assembly aid to the filling valves of the refrigerant system.

(3) Evacuate the system, hoses, and measuring equipment for at least 2 hours to below approx. 270 Pascal / 0.0027 bara or create a vacuum to dry the device. Wait 5 minutes and observe the displays.

(4) Refer to the type plate for the refrigerant type and fill level of the system.

(5) Fill liquid refrigerant into the high-pressure side of the refrigerant system, determining the filling quantity with a suitable scale.

(6) Switch on the device and, if necessary, slowly add any refrigerant still missing on the low-pressure side while the compressor is running.

(7) Unscrew the assembly aid and close the filling valves with closing caps.

(8) Check filling valves for leaks

NOTICE	
	**Warning sign:** **Do not put the device into operation when it is filled with nitrogen!** ☞ Remove the warning sign after filling the refrigerant.

NOTICE	
	**Minor deviations from the procedure are permissible, in particular for points 5 and 6, if it has been assessed as permissible by appropriately qualified personnel for cooling systems.**

7.5 Operation

After switching on the device, the fan, the compressor and the circulation pump start immediately. The compressor and the fan are in operation until the set temperature of the coolant has been reached.

8 Operation

This chapter provides a brief overview of how to operate the device. The safety instructions for switching the device on and off and for operating it must be observed.

8.1 Safety

Personnel

The device may only be operated by specialists for potentially explosive atmospheres.

Personal protective equipment

Wear the basic protective equipment specified in *Chapter 2 "Safety" on page 9* as well as the following additional protective equipment:

- Safety goggles
- Protective gloves
- Hearing protection if necessary

Fundamental principles

WARNING	
	**Danger of injury due to improper operation!** Improper operation can lead to serious personal injury and material damage. ☞ Preventive measures see *chapter 2 "Safety"*.

8.2 Switching on

☞ Make sure that all housing parts are properly fitted. Mount them if required.

☞ Switch on the power supply with the main switch.

8.3 Operation

In normal operating circumstances, the device works fully automatically. The fan motor unit for the exhaust air operates continuously. The compressor and fan motor unit for the outdoor air only operate when the thermostat switches on cooling mode.

A potential-free changeover contact switches a *Ready for operation* fault message. This message is made available for external processing via the signal cable (see also Chapter see *chapter 6.4 "Connecting electrical connections" on page 64* under "*Signal line connection*"). The associated connections in the electrical junction box are described in the enclosed circuit diagram.

8.4 Switching off

The device can be switched off by switching off the power supply.

The power supply of the device can be switched off for e.g. maintenance and troubleshooting by switching off at the main switch or the pre-fuse (installed by the operator) at any time.

8.5 Setting the target temperature

The set point temperature is preset by BARTEC BENKE. You can adjust the set point temperature to your application field.

8.6 Shutting down in an emergency

☞ Activate your emergency off device or the main switch.
The device is disconnected from the power supply.

8.7 What to do in an emergency

☞ Observe the safety instructions in the event of danger.

After the emergency

☞ Depending on the type of fault, have it rectified by the manufacturer or rectify it yourself. Read more on this in *Chapter 9 “Faults” on page 77*.

WARNING	
	**Danger of death due to premature restarting!** If the device is switched on again prematurely, there is a danger of fatal injuries to all persons in the danger area. FOR THIS REASON: ☞ Before switching on again, make sure that there are no persons in the danger area.

☞ Check the device before restarting and ensure that all safety equipment is installed and fully functional.

9 Faults

The following chapter describes the possible causes of faults and the work required to rectify them.

☞ If faults occur frequently, the maintenance intervals must be shortened according to the actual load.

☞ If the faults cannot be remedied with the following instructions, please contact the manufacturer:

See *chapter 1.7 “Customer service” on page 7*.

9.1 Safety

Personnel

- The troubleshooting work described here may only be performed by specialists for potentially explosive atmospheres.
- Work on the electrical systems may only be performed by electricians.
- **Persons who carry out work on the refrigerant circuit must be in possession of a valid certificate according to Directive EU 2015-2067 Article 3. Otherwise, work on the refrigeration circuit must only be carried out by BARTEC BENKE.**

Personal protective equipment

Wear the basic protective equipment specified in *chapter 2 “Safety”* and the following additional protective equipment:

- Safety goggles
- Protective gloves
- Hearing protection if necessary
- Respiratory protection if necessary

Fundamental principles

WARNING	
	**Danger of injury due to improper fault rectification.** Improper fault rectification can lead to serious personal injury and material damage. ☞ Preventive measures see *chapter 2 “Safety”*.

Electrical current

DANGER	
	**Danger of death due to electrical current!** Touching voltage-conducting parts poses an immediate life-threatening hazard. Damage to the insulation or to individual components can cause fatal injury. ☞ Avoidance measures see chapter 2 “Safety”.

Securing against being switched on again

DANGER

Danger of death due to unauthorized restarting!

During work in danger areas, there is the danger that the power supply can be switched on without authorisation. This poses a life-threatening hazard for the persons in the danger area.

☞ Avoidance measures
see *chapter 2 “Safety”*.

Explosion protection

WARNING

Loss of explosion protection in the event of a fault.

The device contains ignition sources. Faults which affect the explosion protection can result in a potentially explosive atmosphere being ignited.

FOR THIS REASON:

☞ Preventive measures
see *chapter 2 “Safety”*.

WARNING

Explosion protection is no longer provided when pressure monitoring is deactivated!

The control box contains ignition sources. Operating the device in a potentially explosive atmosphere with pressure monitoring of the control box deactivated can cause an explosion.

☞ Preventive measures
see *chapter 2 “Safety”*.

Hazardous substances

WARNING

Danger of injury from toxic substances!

Swallowing, inhaling or contact with skin or eyes can lead to serious, permanent health damage or death.

☞ Avoidance measures
see *chapter 2 “Safety”*.

Hot operating materials

WARNING

Danger of burns due to hot operating materials!

Operating materials can reach high temperatures during operation and cause burns upon contact.

☞ Avoidance measures
see *chapter 2 “Safety”*.

Hot surfaces

WARNING

Danger of burns due to hot surfaces!

Contact with hot components can cause burns.

☞ Avoidance measures
see *chapter 2 “Safety”*.

Cold operating materials

WARNING

Danger of burns due to cold operating materials!

Operating materials can reach low temperatures during operation and cause burns upon contact.

☞ Preventive measures
see *chapter 2 “Safety”*.

Cold surfaces

WARNING

Danger of burns due to cold surfaces!

Contact with cold components can cause burns.

☞ Preventive measures
see *chapter 2 “Safety”*.

Electrostatic discharge

WARNING

Danger of explosions due to electrostatic discharge!

Non-metallic components, manual controls made from plastic and insulation from a size of 20 cm² can become electrostatically charged by friction or particle flows.

FOR THIS REASON:

☞ Preventive measures
see *chapter 2 “Safety”*.

WARNING

Danger of explosions due to electrostatic discharge!

Non-metallic stickers from a size of 80 cm² can become electrostatically charged by friction.

FOR THIS REASON:

☞ Preventive measures
see *chapter 2 “Safety”*.

WARNING

Danger of explosions due to electrostatic discharge!

Painting the device increases the risk of electrostatic discharge even on metallic surfaces.

FOR THIS REASON:

☞ Preventive measures
see *chapter 2 “Safety”*.

WARNING	
	**Danger of explosions due to electric discharge!** Different voltage potentials of contact surfaces can lead to electric discharge. FOR THIS REASON: ☞ Preventive measures see *chapter 2 “Safety”*.

WARNING	
	**Danger of explosions due to electrostatic discharge (ESD)!** Touching plastic or operating manual controls made of plastic (e.g. pressure regulators) may ignite an existing explosive atmosphere! FOR THIS REASON: ☞ Preventive measures see *chapter 2 “Safety”*.

Opening the housing

WARNING	
	**Explosion hazard due to improper opening of the housing!** Opening the housing can ignite an existing explosive atmosphere. ☞ Only open the housing away from an explosive atmosphere! ☞ To measure if there is a risk of an explosion, use, e.g. a gas warning device!

NOTICE	
	**For further safety-relevant notes on explosion protection, hazardous substances and handling the device see *chapter 2 “Safety” on page 9*.**

Behaviour in the event of faults

In principle:

☞ If faults arise that pose a direct danger to personnel or property, switch the device off immediately with the emergency off device.

☞ Determine the cause of the fault.

☞ Depending on the type of fault, have it rectified by the manufacturer or rectify it yourself.

☞ If the fault rectification requires work in the danger zone, switch off the device and ensure it cannot be switched on again.

9.2 Troubleshooting

Fault table

Faults not listed here may only be diagnosed and rectified by the manufacturer or specialists authorised by the manufacturer.

WARNING	
	**Risk of injury due to incorrect replacement parts!** Incorrect or defective replacement parts can result in damages, faults or total failures as well as impairments to safety. FOR THIS REASON: ☞ Only use replacement parts from BARTEC BENKE. ☞ See *chapter 2.1* “Intended use”.

Error	Possible cause	Remedy
Air/coolant is not sufficiently cooled	Refrigerant quantity is too low (Bubble formation discernible in the sight glass)	Increase fill level
	Thermostat is not set to the correct temperature or is defective	Set thermostat accordingly Replace defective thermostats
	Ambient temperature is too high	Protect the device against direct sunlight.
	Cooling capacity too low	Increase cooling capacity
	Condenser dirty	Clean device
Unusual noises, vibrations	Loose or defective motor mountings, machine imbalance or poor bearing condition Torsional backlash or wear on coupling	Check motor mountings, machine balance or condition of bearings Check torsional backlash or wear on coupling
Refrigeration compressor not working	Pressure switch has tripped	Replace pressure switch Check or actuate manual reset/ acknowledgement on the pressure switch
	Cold ambient temperature, low-pressure switch has tripped The refrigerant circuit has cooled down to the ambient temperature. The pressure switches have reached hysteresis in their switching behavior. The switching threshold for switching on the chiller is above the current pressure at the corresponding boiling temperature (see *chapter 3.1 “Safety-relevant technical data (SIL limits)” on page 42*).	Reheat the refrigerant in the pressure switch to restore higher pressure in the refrigerant circuit. This serves to switch the chiller on again.

Error	Possible cause	Remedy
No circulation of coolant	Pressure switch is defective	Replace pressure switch
	Lack of refrigerant in the system	Increase fill level
	Power supply has been interrupted	Restore power supply
	Motor circuit breaker has tripped	Eliminate fault
Refrigeration compressor switches on/off	Condenser is dirty	Clean condenser
	Lack of refrigerant in the system	Increase fill level
	Ambient temperature is too too warm/cold	Check/change installation location of device
	Injection valve is defective	Replace injection valve
Loss of coolant above *min. level* alarm signal at short intervals	Possibly leaks in the coolant circuit	Check the entire coolant circuit for leaks and rectify them. **Check the level at the sight glass of the storage tank once a month.**

CAUTION	
	**Malfunctions in the refrigerant system (electrical and refrigeration) may only be repaired by authorized specialist companies!** **In the event of malfunctions on the device or individual parts, please check first whether you can rectify the fault with the help of the appropriate operating manual. If that is not possible, please contact the manufacturer immediately.**

9.2.1 Notes on checking the coolant level

NOTICE	
	**When refilling the coolant, a suitable antifreeze agent, e.g. glycol, must always be added (steps for filling the device see *chapter 7.3 "Putting device into operation" on page 69*)!** **Antifreeze limit: MIN. -15 °C / MAX. -10 °C**

Pressure relief

If the cooling water pressure is too high, which can occur, for example, if the water flow is blocked in the coolant circuit due to severe throttling or shut-off of a fitting, a preset bypass valve protects the electric motor and the circulation pump from overload.

CAUTION	
	**Refinery water must not be used as cooling water due to its poor quality! The cooling water temperature can be set by hand on the temperature controller, thermostat e.g. to 10 °C.**

NOTICE	
	**If there is no thermostat, the cooling water is controlled automatically via a temperature sensor in the storage tank and a computer-supported outlet control.**

9.3 Starting up after rectifying a fault

After rectifying a fault, perform the following steps for restarting:

☞ Reset the emergency off devices.

☞ Make sure that nobody can be endangered by switching on the device.

☞ Put the device back into operation.

10 Maintenance

Regular maintenance must be carried out in order to ensure optimal and fault-free operation. The following section describes the most important maintenance work and the safety measures to be observed.

10.1 Safety

Personnel

The maintenance work described here may only be performed by **specialists for potentially explosive atmospheres** or **by employees of the manufacturer**.

Work on the electrical systems may only be performed by electricians.

Maintenance work on the refrigerant circuit may only be carried out by a qualified person corresponding to the Implementation Regulation (EU) 2015/2067. The work may only be carried out by persons who are in possession of a certificate according to Category 1.

The refrigerant circuit is under high pressure due to the refrigerant. Independent of the condition of the aggregate, the refrigerant poses a danger to health (local freezing due to uncontrolled escape). Please ensure you observe the safety data sheet of the refrigerant in line with the current directive.

In the event of a malfunction, you must contact a specialist company who can repair the system professionally.

Modifications to the pressure monitors are not permitted. If problems occur, consult BARTEC BENKE because these are ex-relevant safety devices.

NOTICE	
	**BARTEC BENKE recommends that operating and maintenance staff be trained by the manufacturer**

Personal protective equipment

Wear the basic protective equipment specified in *chapter 2 “Safety”* and the following additional protective equipment:

- Safety goggles
- Protective gloves
- Hearing protection if necessary
- Respiratory protection if necessary

NOTICE	
	**If other protective equipment must be worn for certain tasks, this is stated in the warnings in this chapter.**

Fundamental principles

WARNING

Danger of injury due to improperly performed maintenance work!

Improper maintenance can lead to serious personal injury and material damage.

☞ Preventive measures see *chapter 2 “Safety”*.

Electrical current

DANGER

Danger of death due to electrical current!

Touching voltage-conducting parts poses an immediate life-threatening hazard. Damage to the insulation or to individual components can cause fatal injury.

☞ Avoidance measures see chapter 2 “Safety”.

Securing against being switched on again

DANGER

Danger of death due to unauthorized restarting!

During work in danger areas, there is the danger that the power supply can be switched on without authorisation. This poses a life-threatening hazard for the persons in the danger area.

☞ Avoidance measures see *chapter 2 “Safety”*.

Replacement parts

WARNING

Risk of injury due to incorrect replacement parts!

Incorrect or defective replacement parts can result in damage, faults or total failures as well as impairments to safety.

FOR THIS REASON:

☞ Only use spare parts from BARTEC BENKE.

☞ See *chapter 2 Safety* “Intended use”.

Pressurized liquids and gases

WARNING

Danger of injury due to liquids or gases under pressure!

Lines are under overpressure even when switched off. In the case of defective or leaky lines, escaping liquids or gases could cause serious injuries.

☞ Avoidance measures see *chapter 2 “Safety”*.

Hot operating materials

WARNING
 **Danger of burns due to hot operating materials!** Operating materials can reach high temperatures during operation and cause burns upon contact. ☞ Avoidance measures see *chapter 2 “Safety”*.

Hot surfaces

WARNING
 **Danger of burns due to hot surfaces!** Contact with hot components can cause burns. ☞ Avoidance measures see *chapter 2 “Safety”*.

Cold operating materials

WARNING
 **Danger of burns due to cold operating materials!** Operating materials can reach low temperatures during operation and cause burns upon contact. ☞ Preventive measures see *chapter 2 “Safety”*.

Cold surfaces

WARNING
 **Danger of burns due to cold surfaces!** Contact with cold components can cause burns. ☞ Preventive measures see *chapter 2 “Safety”*.

Electrostatic discharge

WARNING
 **Danger of explosions due to electrostatic discharge!** Non-metallic components, manual controls made from plastic and insulation from a size of 20 cm² can become electrostatically charged by friction or particle flows. FOR THIS REASON: ☞ Preventive measures see *chapter 2 “Safety”*.

WARNING
 **Danger of explosions due to electrostatic discharge!** Non-metallic stickers from a size of 80 cm² can become electrostatically charged by friction. FOR THIS REASON: ☞ Preventive measures see *chapter 2 “Safety”*.

WARNING	
	**Danger of explosions due to electrostatic discharge!** Painting the device increases the risk of electrostatic discharge even on metallic surfaces. FOR THIS REASON: ☞ Preventive measures see *chapter 2 “Safety”*.

WARNING	
	**Danger of explosions due to electric discharge!** Different voltage potentials of contact surfaces can lead to electric discharge. FOR THIS REASON: ☞ Preventive measures see *chapter 2 “Safety”*.

WARNING	
	**Danger of explosions due to electrostatic discharge (ESD)!** Touching plastic or operating manual controls made of plastic (e.g. pressure regulators) may ignite an existing explosive atmosphere! FOR THIS REASON: ☞ Preventive measures see *chapter 2 “Safety”*.

Parts that start automatically

WARNING	
	**Risk of injury from touching parts that start automatically!** Serious injuries can occur when working on the device without protective coverings in place or on “open” fans or drive shafts if these start up automatically. FOR THIS REASON: ☞ Preventive measures see *chapter 2 “Safety”*.

10.2 Maintenance plan introduction

The maintenance plan provides an overview of the most important maintenance work. The sections below describe further maintenance work in detail.

If increased wear is detected at regular inspections, shorten the required maintenance intervals according to the actual degree of observed wear.

If you have questions on maintenance tasks and intervals, contact us at our service address (see *page 7*).

10.3 General instructions

- After work on the pipelines or components made of copper, the protective coating must be restored.
- Ensure potential equalization, especially of coatings of external pipes (jacketed insulation).
  See *Section 2.5.4 "Potential equalization" on page 24*.
- Observe the maintenance section in this manual as well as of the coolant pump and coupling.

10.4 Weekly inspection

The weekly visual inspection must be performed by a **specialist for potentially explosive atmospheres**.

You can perform the weekly visual inspection **while the device is in operation** and with the housing closed.

☞ Check the equipotential bonding of the Ex-d control box and the air conditioner is firmly in place and for corrosion. Renew the equipotential bonding if necessary.

☞ Check the connection line and connecting lines between the control unit and air conditioner for damage. Replace the electric cables if necessary. Only use replacement parts from BARTEC BENKE.

10.5 Monthly inspection

The monthly inspection must be performed by a **specialist for potentially explosive atmospheres**.

☞ Switch the device off. Remove the cover in the exterior area of the device. To do so, release the transport eye at the top of the device and the fastening bolts on both sides.

☞ Remove the protective cover. Remove the covering plate on the air-conditioned side. Release the fastening bolts to do so.

☞ Perform the following checks:

- Visual, acoustic and haptic inspections for e.g. vibration, imbalance, defective fan blades, unusual running noises, missing protective covers as well as defective equipotential bonding.
- Check the torsional backlash or wear on the coupling. Always observe the manufacturer's documentation of the coupling!
- Replace or repair damaged parts.
- Perform a visual inspection of the inner housing and all airways for contamination and corrosion. Remove all contamination and, if necessary, repair the affected components.

☞ Clean the cooling fins from the condenser.

☞ Make sure that the cooling air can flow unhindered in the external air circuits. Remove any foreign objects.

☞ Check the fans for damage.

☞ Examine the Ex-d control box for signs of corrosion, especially in an aggressive atmosphere. Check that the threads on the cover can move easily. Grease if necessary. If you are opening the housing, perform additional checks as described below:

- Check the high pressure switch (switching point: depending on the refrigerant used, according to the function diagram - see customer folder). Block the air flow in the exterior air circuit to do this.

☞ Examine the refrigerant for moisture with the aid of the indicator in the sight glass.

☞ Check whether there is liquid on the decondensation tray for the coolant pump. If there is a noticeable amount of liquid in the tray, check the coolant pump for leaks and replace it if necessary.

☞ If the coolant pump is leakproof, set the antifreeze precisely (see *chapter 9.2.1 "Notes on checking the coolant level" on page 82*). You can use a device such as a refractometer to measure the antifreeze.

☞ Clean the decondensation tray.

☞ Check the electrical cables for damage, in particular the compressor cables that are subjected to vibrations.

☞ Fit the covering plate and cover on the device.

10.6 Annual inspection

The annual inspection must be performed by a **cooling system installer with knowledge of explosion protection**.

☞ Check the condition of the insulation (visual and haptic inspection), and, if necessary, the coating and the equipotential bonding if present.

☞ Switch the device off. Dismantle the covering plate and protective cover from the device.

☞ Inspect the refrigerant circuit for leaks:
Check the pressure on the suction and pressure side of the compressor. To do so, connect a filling station to the respective filling socket.
Remove the meter and the hoses.

For refrigerant pressure set points, see refrigerant used.

The formation of bubbles in the refrigerant circuit sight glass can be an additional sign of a shortage of refrigerant. After approx. 10 to 15 minutes of running time, no strong bubble formation may occur.

☞ If the measured pressures deviate from the target values, check the fill quantity of the refrigerant. You will find the target value on the type plate.

☞ When refilling, check that the two low-pressure switches are working (switching point 0.4 to 0.6 bar). **Check each low-pressure switch individually!** The low-pressure switches assure the explosion protection. They monitor the *Ex-p* pressurization of the refrigerant circuit.

WARNING	
	**Danger of explosion due to sources of ignition!** The refrigerant system is hermetically sealed. It contains ignition sources. Opening in potentially explosive atmospheres can cause explosions. ☞ When filling the refrigerant system, ensure that no potentially explosive ambient atmosphere is present.

For reasons of environmental protection, BARTEC BENKE recommends that you document your consumption of refrigerant. However, there is no obligation to do so as yet for devices containing refrigerant quantities below 3 kg.

After repair work on the refrigerant circuit, in particular after the repair of a leak, an inspection must be performed within one month to ensure that the repair was successful.

☞ If there are signs of condensate inside the control box:
Check the electrical connections for corrosion, particularly if the control box is set up outside.

☞ Check the electrical connections in the control box and junction box for firm fitting.

☞ Check the high pressure switch (switching point: depending on the refrigerant used, according to the function diagram - see customer folder). Block the air flow in the exterior air circuit to do this.

☞ Check the excess temperature safety monitoring of the compressor and the motors. To do so, disconnect the corresponding PTC sensors from the terminal strip in the junction box. If no alarm is trig-

gered, check the corresponding safety circuit and repair it if necessary. Once an alarm has triggered, you have to reset the motor protection and triggering device in the control box.

☞ Fit the covering plate and cover on the device. Switch the device on.

10.7 Three-year inspection

Ambient temperature	Maintenance interval
+5 to +40 °C	Replacement of motor bearings: Every 4 years or 20,000 operating hours
-20 to +55 °C	
-35 to +40 °C	Replacement of motor bearings: Every 3 years or 10,000 operating hours

10.8 Four-year inspection

Ambient temperature	Maintenance interval
-35 to +40 °C	Replacement of motor bearings: every 4 years or for 2 pole motors: 20,000 operating hours or for 4, 6 or 8 pole motors: 40,000 operating hours

10.9 Five-year inspection

Every 5 years the following safety functions must be checked to ensure that hazards emanating from the device are reliably prevented. When checking, proceed as described in the sections below.

10.9.1 Safety function *KWS-1*

Preparation of the test

☞ Provide a collection vessel.

☞ Remove the top and front covers.

☞ Switch on the Chiller.

Performance of the test

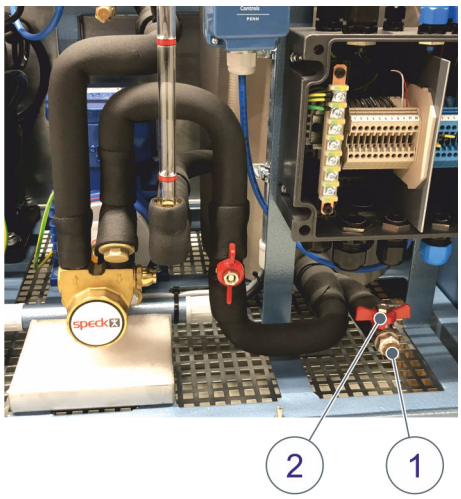


Figure 10.1: Coolant outlet

- ☞ Close the drain valve **(2)**.
- ☞ Remove the coolant outlet cap **(1)**.
- ☞ Place the collecting vessel under the coolant outlet **(1)**.
- ☞ Open the drain valve **(2)**.

If the minimum fill level of the coolant is reached, the chiller is switched off and the error lamp lights up. This completes the test successfully.

- ☞ Close the drain valve and refill the Chiller with the recovered coolant.
- ☞ Switch on the Chiller.

Test not successful

- ☞ If the chiller does not switch off automatically when the minimum level is reached, switch off the chiller, disassemble the level sensor, check it and replace it with a new one if necessary. To do this, contact customer service (see *chapter 1.7 “Customer service” on page 7*).

10.9.2 Safety function *KWS-2*

Monitoring the high-pressure side

Test preparation

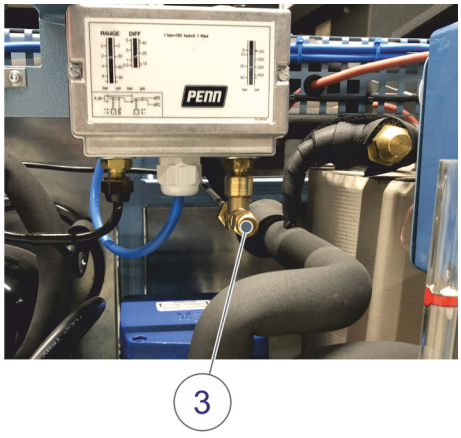


Figure 10.2Pressure connection on the high-pressure side

- ☞ Connect a pressure gauge to the high-pressure side at the pressure connection **(3)**.
- ☞ Have a piece of cardboard or similarly strong, air-impermeable material at the ready. It should correspond to the size of the intake opening on the chiller.
- ☞ Switch on the chiller.

Performance of the test

- ☞ Block the airflow at the intake opening by holding the prepared cardboard in front of it.
- ☞ Observe the pressure on the high-pressure gauge. The pressure should increase.

After reaching the maximum pressure of the refrigerant, the chiller is switched off and the warning lamp lights up (see *chapter 3.1 “Safety-relevant technical data (SIL limits)” on page 42*).

This means that the test has been successfully completed.

☞ Remove the cardboard.

☞ Remove the pressure gauge.

☞ Switch on the chiller again.

Test not successful

☞ If the chiller does not switch off automatically when the maximum pressure is reached, switch off the chiller, remove the pressure switch, check it, and replace it with a new one if necessary.
To do this, contact customer service (see *chapter 1.7 “Customer service” on page 7*).

10.9.3 Safety functions *KWS-3*

Monitoring of the low-pressure side

The low-pressure side is monitored in the safety function *KWS-3* via pressure switch (IP65 or IP56) with a cut-off pressure for the function of the refrigerant system.

Test preparation

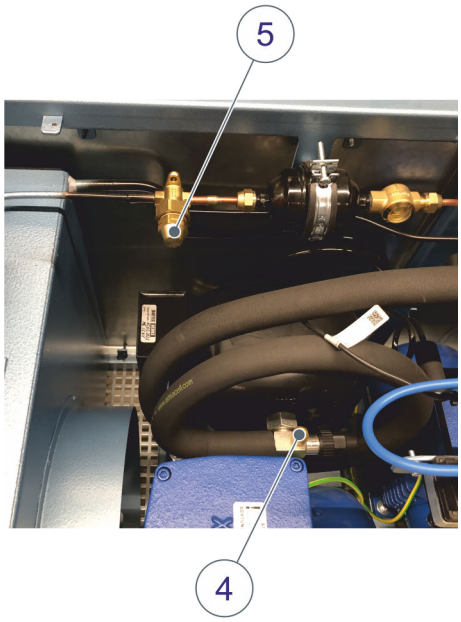


Figure 10.3: Pressure connection on the high-pressure side

☞ Connect a pressure gauge to the low-pressure side at the pressure connection **(4)**.

☞ Close the shut-off valve of the refrigeration line **(5)**.

☞ Switch on the chiller.

Performance of the test

☞ Observe the pressure on the low-pressure gauge. The pressure should drop (see *chapter 3.1 “Safety-relevant technical data (SIL limits)” on page 42*).

After the minimum pressure of the refrigerant is reached, the chiller is switched off and the warning lamp lights up. This means that the test has been successfully completed.

☞ Open the shut-off valve of the refrigeration line.

☞ Remove the pressure gauge.

☞ Switch on the chiller again.

Test not successful

☞ If the chiller does not switch off automatically when the minimum pressure is reached, switch off the chiller, professionally remove the pressure switch, check it, and replace it with a new one if necessary.
To do this, contact customer service (see *chapter 1.7 “Customer service” on page 7*).

10.9.4 Safety functions *KWS-4*

The temperature at the compressor head is monitored via a PTC thermistor resistor. A temperature-controllable hot air gun is required for the test.

Test preparation

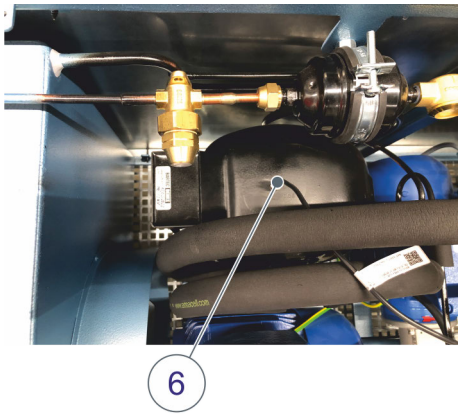


Figure 10.4: PTC thermistor resistor

☞ Turn the PTC thermistor resistor out of the threaded bushing **(6)**. Avoid twisting the connecting cable.

☞ Switch on the chiller.

Performance of the test

☞ Heat the PTC thermistor resistor with a hot air gun starting at 80 °C.

☞ Gradually increase the temperature and continue to heat the PTC thermistor resistor.

After reaching the switching temperature of the PTC thermistor (see *chapter 3.1 “Safety-relevant technical data (SIL limits)” on page 42*), the chiller is switched off and the warning lamp lights up. This means that the test has been successfully completed.

☞ Allow the PTC thermistor resistor to cool down.

☞ Mount it again.
Avoid twisting the connecting cable.

☞ Switch on the chiller again.

Test not successful

☞ If the chiller does not switch off automatically when the maximum temperature is reached, switch off the chiller, remove the PTC thermistor resistor, check it, and replace it with a new one if necessary. To do this, contact customer service (see *chapter 1.7 “Customer service” on page 7*).

10.9.5 Safety functions *KWS-5* (KWS 0.5 kW only)

The magnetic coupling temperature is monitored via a temperature sensor (PT100) in combination with a transducer. A temperature-controllable hot air gun is required for the test.

Test preparation

☞ Remove the insulation from the cover of the magnetic coupling.

☞ Remove the PT100.

Performance of the test

☞ Heat the tips of the PT100 to approx. 50 °C using the hot air gun.

☞ Gradually increase the temperature and continue to heat the PT100.

After reaching the switching temperature of the PT100 (see *chapter 3.1 "Safety-relevant technical data (SIL limits)" on page 42*), the chiller is switched off and the warning lamp lights up. This means that the test has been successfully completed.

☞ Allow the PT100 to cool down.

☞ Mount it again.

☞ Put the insulation back on the PT100.

☞ Switch on the chiller again.

Test not successful

☞ If the chiller does not switch off automatically when the switching temperature is reached, switch off the chiller, remove the PT100, check it, and replace it with a new one if necessary.
To do this, contact customer service (see *chapter 1.7 "Customer service" on page 7*).

10.10 Ten-year inspection

Replace the fan blades every 10 years.

NOTICE	
	If the device is operated at ambient temperatures below -20 °C or above 55 °C for longer periods of time, the motors and fans can be expected to have a shorter service life.

10.11 Measures after maintenance

After completion of the maintenance work and before switching on, carry out the following:

☞ Check that all previously loosened screw connections have a tight fit.

☞ Make sure that all previously removed protective devices and covers have been properly reinstalled.

- ☞ Make sure that all tools, materials and other equipment used have been removed again from the work area.
- ☞ Clean the work area and remove any substances that have leaked, such as liquids, processing material or similar.
- ☞ Make sure that all protective devices on the system are functioning flawlessly.
- ☞ Start device operation again.
- ☞ After 2 hours of operation, check all connections for leaks and make a general visual inspection.

10.12 Refrigerant malfunctions

☞ Switch the device off.

☞ Remove the covering plate and protective cover from the device.

CAUTION	
	**The fan and the drive shaft now have no contact protection!** FOR THIS REASON: ☞ Never reach your hand into the impeller when the device is running. Always keep an appropriate distance from the intake opening!

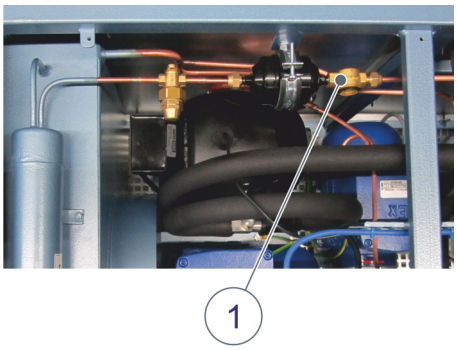


Figure 10.5: Moisture indicator

☞ Switch on the device and observe the sight glass **(1)** during operation (see also item **(27)** in *Figure 4.5 on page 54*).
The liquid (refrigerant) must not show any strong bubbling effects (vapor bubbles) after approx. 2 to 4 minutes of running time.
Strong effervescence is always a sign of too little refrigerant!
Carry out the instructions described in *Section 10.12.1 “Refrigerant shortage” on page 99*.

☞ A moisture indicator is installed in the center of the sight glass.
The color change of the indicator occurs as follows:

- “Dry” = green (refrigerant OK)
- “Damp” = yellow
  (refrigerant contaminated with water)
  Carry out the instructions described in
  Section 10.12.2 “Moist refrigerant” on page 100.

10.12.1 Refrigerant shortage

If there is too little refrigerant in the device, proceed as follows:

☞ Switch the device off.

☞ Remove the meter and the hoses.

☞ Select the refrigerant according to the type plate.

☞ Connect the refrigerant bottle to the installation aid.

☞ Switch the device on.

☞ Gradually fill the refrigerant circuit with liquid refrigerant.

☞ End the filling process when the sight glass is full of liquid and free from vapor bubbles.

☞ If the moisture indicator is green, attach the covering plate and the protective cover to the device. Otherwise, follow the instructions in the next section.

10.12.2 Moist refrigerant

If the moisture indicator is yellow, proceed as follows:

☞ Switch the device off.

☞ Properly extract the refrigerant from the refrigerant circuit and pump it into a separate pressure vessel.

☞ Remove and replace the refrigerant dryer.

☞ Flush the refrigerant circuit sufficiently with dry nitrogen, then evacuate the device for a longer period of time.

☞ Select the refrigerant according to the type plate.

☞ Fill the refrigerant circuit with fresh refrigerant.

☞ Attach the covering plate and the protective cover to the device.

☞ Switch the device on again.

11 Dismantling

At the end of its service life, the device must be dismantled and disposed of in an environmentally friendly manner.

11.1 Safety

Personnel

- Dismantling may only be performed by specialists for potentially explosive atmospheres.
- Work on the electrical system may only be performed by qualified electricians.
- Removal of the device and draining/disposing of the refrigerant may only be carried out by a refrigeration and air conditioning specialist.

Personal protective equipment

Wear the basic protective equipment specified in *chapter 2 "Safety"* and the following additional protective equipment:

- Safety gloves if necessary
- Safety goggles

Fundamental principles

WARNING	
	**Danger of injury due to incorrect dismantling work!** Stored residual energy, components with sharp edges, points and corners in and around the device or on the required tools can cause injuries. ☞ Preventive measures see *chapter 2 "Safety"*.

DANGER	
	**Danger of lethally toxic substances!** Leaks can cause toxic substances to accumulate on the inside, which can cause serious or fatal injury if inhaled. ☞ Preventive measures see *chapter 2 "Safety"*.

☞ Remove operating materials, auxiliary materials and any remaining processing materials in an environmentally friendly manner.

11.2 Disconnecting electrical connections

- This work may only be performed by a qualified electrician.
- Special tools required:
- Electrician's equipment

Electrical current

DANGER	
	**Danger of death due to electrical current!** Touching voltage-conducting parts poses an immediate life-threatening hazard. Damage to the insulation or to individual components can cause fatal injury. ☞ Avoidance measures see chapter 2 "Safety".

Procedure

☞ Disconnect the device completely from the mains.

☞ Ensure it cannot be restarted.

☞ Open the junction box.

☞ Disconnect all cables and pull them out of the junction box.

☞ Unscrew the equipotential bonding cable from the rack.

☞ Close the junction box.

11.3 Draining and disconnecting pipelines

Before the final dismantling or shut-down of the device for operational or age reasons, the refrigerant and the coolant, must be professionally removed from the circuit and then disposed of in line with the applicable legal regulations.

Disassembly of the device and draining the refrigerant may only be carried out by an authorized refrigeration specialist.

CAUTION	
	**Environmental hazard.** Improper disposal of hazardous substances poses a threat to both health and the environment. FOR THIS REASON: ☞ **Never release the refrigerant into the atmosphere!**

11.3.1 Draining the refrigerant

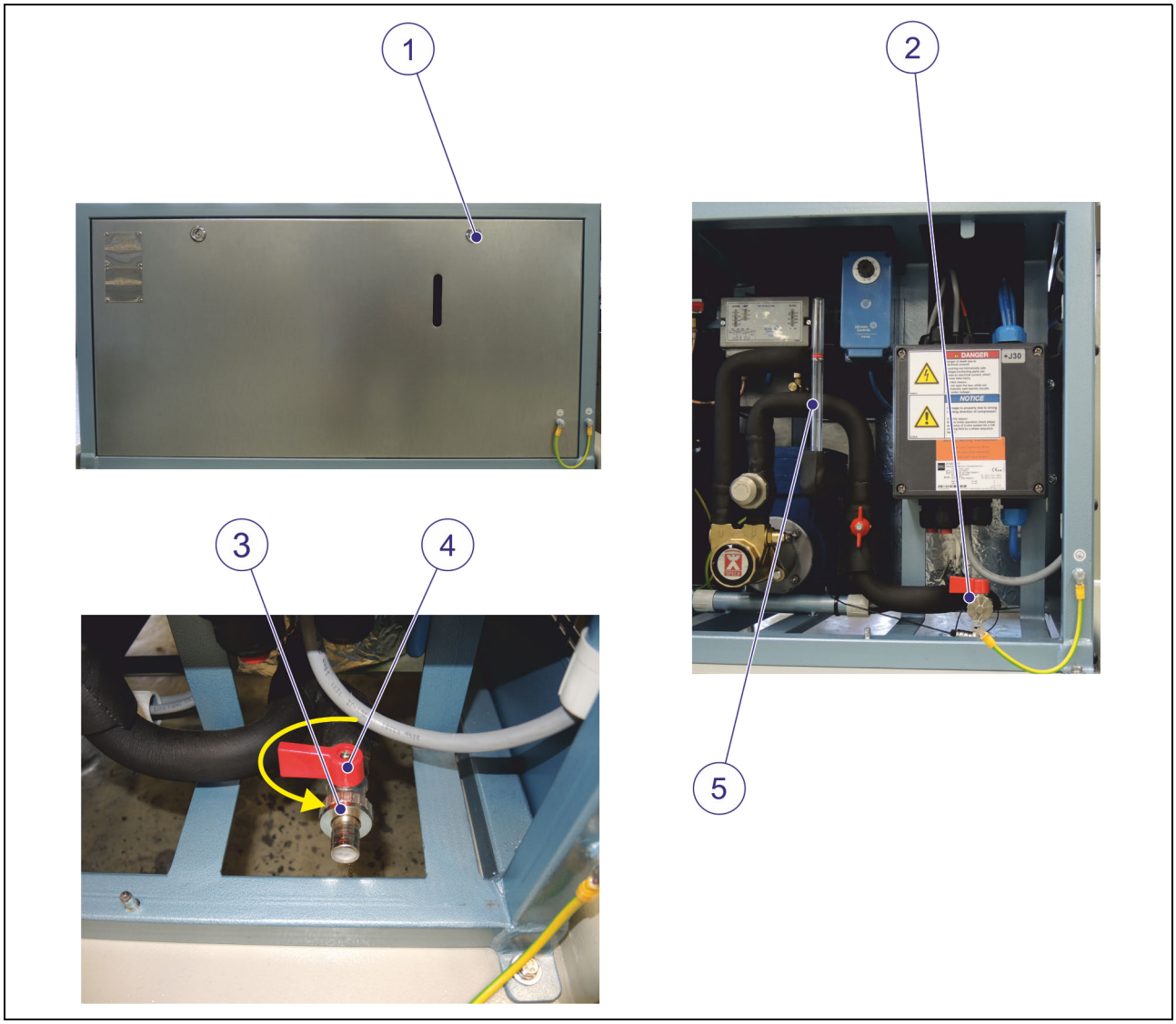


Figure 11.1: Draining the refrigerant

- ☞ Open and remove the cover of the device **(1)**.
- ☞ Remove the cap of the inlet and outlet container **(2)**.
- ☞ Fit the hose connection adapter **(3)**.
- ☞ Connect one hose and place the other end in a shallow collection container. **Draining can be done using the force of gravity or by pumping (if pump is available).**
- ☞ Open the ball valve **(4)** and let the coolant run into the collection container until the device is completely drained. **Make sure that the collection container does not overflow. If the entire volume of coolant does not fit into the collection container, close the ball valve (4) and empty the collection container and continue draining.**
- ☞ Open the ball valve **(4)** again and close it after the device is completely drained.

☞ Remove the hose.

☞ Dismantle the hose connection adapter (3).

☞ Fix the closure of the inlet and outlet container (2).

11.4 Disposal

- Have the rack completely disposed of by a recycling company approved for refrigerating systems.
- The protective hood can be disposed of as all-metal.
- The control unit and cables can be disposed of as electronic scrap.

CAUTION	
	**Environmental damage due to incorrect disposal.** Improper disposal damages the environment. FOR THIS REASON: ☞ Have electric scrap, electronic components, lubricants and other auxiliary media disposed of only by authorized specialist companies. They are subject to the rules on special waste treatment.

Your local authorities or specialist disposal companies can provide you with information on environmentally friendly disposal.

Hazardous substances

Sort the hazardous materials according to their properties and have them disposed of professionally.

CAUTION	
	**Environmental hazard.** Improper disposal of hazardous substances poses a threat to both health and the environment. FOR THIS REASON: ☞ Observe local laws and regulations regarding the disposal of hazardous materials.

12 Index

L

M

O

P

R

S

T

U

W