OPERATING INSTRUCTIONS

Original manual

GEA BluAstrum

Chiller

COPYRIGHT

LEGAL NOTICE

This manual is part of the technical documentation for the scope of delivery. It contains important instructions for ensuring safe and proper transport, installation, start-up, economic operation, maintenance and repair of the product. Their observance helps in avoiding dangers, reducing repair costs and down-times and increasing the reliability and durability of the product.

This manual is intended for the users of the product and is specifically intended for the operating company and its operating and maintenance personnel.

It is essential that the operating company and its operating and maintenance staff read this manual prior to transport, installation, start-up, use, maintenance, repair, disassembly and disposal. This obligation to read also applies to personnel involved in activities in the life phases of the product.

The operating company must supplement this manual with instructions regarding health and safety at work and environmental protection on the basis of existing national regulations for industrial safety.

In addition to this manual and the binding accident prevention regulations valid for the respective country and area where the product is used, the recognised technical regulations for safe and professional work must also be observed.

This manual is part of the product. The entire documentation comprises this manual and all additional operating instructions supplied with the unit. They must be kept readily available where the product is installed. The entire documentation must also be forwarded if the product is installed at another location and if the product is sold.

The manufacturer reserves the right to make technical modifications during the course of further development of the product covered by this manual.

Illustrations and drawings in this manual are simplified representations. As a result of the improvements and changes, it is possible that the illustrations do not exactly match the product you are operating. The technical data and dimensions are subject to change. No claims can be made on the basis of them.

The manufacturer cannot accept liability for damages

- which occur during the warranty period as a result of
  - improper operating conditions and conditions of use,
  - inadequate maintenance,
  - improper operation,
  - incorrect installation,
  - incorrect or improper connection of the main electrical drive,

- or which result from or can be attributed to improper modifications or failure to observe the instructions;
- through the use of accessories or spare parts which were not supplied or recommended by the manufacturer.

SYMBOLS USED

⚠ Danger

Stands for an immediate danger leading to severe physical injuries or death.

► Description for avoiding the danger.

⚠ Warning

Stands for a potentially dangerous situation leading to severe physical injuries or death.

► Description for avoiding the dangerous situation.

⚠ Caution

Stands for a potentially dangerous situation which could lead to minor physical injuries or damage to property.

► Description for avoiding the dangerous situation.

Notice

Stands for important information that must be observed for the intended use and function of the product.

► Description of the required action for the intended function of the product.

PREFACE

In addition to other products, the portfolio of GEA Refrigeration Germany GmbH includes complete chillers and heat pumps.

In light of the fact that the working principle is identical, GEA documentation differentiates between the terms chillers and heat pumps as follows:

A chiller is a system where the application focus lies on generating refrigeration (cooling a liquid secondary circuit), regardless of possible heat recovery options via a liquid-cooled condenser and/or oil cooler. The GEA chillers include the standard GEA Blu series BluAstrum, BluGenium, BluAir (duo), BluX (duo) as well as the modular GEA Grasso FX series and the MX as a special series.

A heat pump is a system where the application focus lies on generating heat (heating a liquid heated medium). Here, the heat exchanger concept on the high pressure side is optimised with respect to this application. GEA heat pumps include the standard GEA Red series RedAstrum, RedGenium and the special series GEA Grasso HX.

The GEA Blu-Red Fusion product can be seen as a two-stage heat pump or also as a combined chiller-heat pump. Since the product is always (also) designed for a specific heating application, it is formally part of the GEA Red Standard series.

Many components and modes are used in the same way in different GEA chiller and heat pump product series. The descriptions of some components and operating principles are thus expressed in general terms in this document.

The figure on the front page shows the product in a project-specific version (project-related modifications possible).

LAYOUT INFORMATION

Bullet points and numbered list characters

Bullet points are used to separate logical contents within a section:

- Bullet point 1
  - Types of bullet point 1.
- Bullet point 2
  - Types of bullet point 2.

Numbered list characters are used to separate enumerations within a descriptive text:

Descriptive text with consecutive numbering:

- Numbered list point 1
- Numbered list point 2

Handling instructions

Handling instructions prompt you to do something. Several steps in sequence time form a handling sequence that should be completed in the prescribed order. The handling sequence can be divided into individual steps.

Handling sequence

1. Handling sequence step 1
   - step 1,
   - step 2,
   - step 3.
2. Handling sequence step 2

The subsequent handling sequence is the expected result:

→ Result of the handling sequence.

Individual handling steps

Individual handling steps are marked thus:

- Individual work steps

TABLE OF CONTENTS

TABLE OF FIGURES

1 General Information

1.1 Information about the document

This operating manual is part of the technical documentation. It contains advice for operating the product safely, properly and economically. The observance of the operating manual helps in avoiding dangers, reducing repair costs and down-times, and increasing the reliability and durability of the product.

This operating manual is directed at the users of the product and is specifically intended for the operating company and its operating and maintenance personnel. This operating manual must be read prior to transport, installation, start-up, maintenance, repair, disassembly/disposal. It is imperative to strictly observe the instructions and information given!

All work explained in this operating manual must only be carried out by technical personnel.

This operating manual must be supplemented with instructions based on prevailing national regulations regarding industrial safety, health protection and environmental protection.

In addition to this operating manual and the mandatory accident prevention regulations applicable for the respective place of installation, the accepted technical regulations for safe work according to good professional practices must also be observed.

The operating manual is part of the total product. The entire documentation, consisting of this operating manual as well as all supplied additional instructions, must always be kept easily accessible at the place of installation of the product. The complete set of documentation must also accompany the product if it is sold.

1.2 Manufacturer address

GEA Refrigeration Germany GmbH is a company of the GEA Group AG and provides its customers around the world with high-quality components and services for refrigeration and process technology applications.

Locations:

GEA Refrigeration Germany GmbH
Werk Berlin
Holzhauser Str. 165
13509 Berlin, Germany
Tel.: +49 30 43592-600
Fax: +49 30 43592-777
Web:www.gea.com
E-Mail: refrigeration@gea.com

GEA Refrigeration Germany GmbH
Werk Halle
Berliner Straße 130
06258 Schkopau/ OT Döllnitz, Germany
Tel.: +49 345 78 236 - 0
Fax: +49 345 78 236 - 14
Web:www.gea.com
E-Mail: refrigeration@gea.com

1.3 Customer services

GEA Refrigeration Germany GmbH supplies products of high quality and reliability. In addition, the manufacturer ensures continuous operation of the refrigeration and process technology system and provides exceptional service for the supplied components.

1.3.1 Technical customer service department

Do you require support from the technical customer service department? Specially trained, experienced service technicians are available on call for you in order to provide assistance in case of technical problems and to offer support in the framework of our after-sales service.

24/7 Hotline:

the hotlines can reached around the clock on every day of the week:

- **Wireless**
  +49 (0) 172 39 12 050
- **Landline, weekdays from 7 to 17 hours**
  +49 (30) 43 59 27 61
  +49 (30) 43 59 27 62
- **Email:**

Service.germany@gea.com

outside of Germany, Austria and Switzerland please contact:

- **local sales office**

  www.gea.com

technical support for liquid chillers with reciprocating compressors in Germany, Austria and Switzerland

- **24/7 Hotline**

  +49 (345) 78236 20

The specialists of our Technical Customer Service department support you in installations, acceptances, maintenance, operating questions, on-site inspections and repairs of our products.

1.3.2 Spare parts

General information about spare parts for GEA heating and refrigeration technology is available via "*https://www.gea.com/en/service/spare-parts/heating-refrigeration/*".

Spare parts for GEA heating and refrigeration technology can be purchased through the B2B business portal **"GEA BluShop"** .

Usually you will receive your spare parts within 24 hours after placing the order.

GEA BluShop

The GEA BluShop is accessible for authorised B2B contractual partners in the field of heating and refrigeration technology.

As an authorised contractual partner of GEA heating and refrigerating technology, you can access the GEA BluShop directly via: "*https://blushop.gea.com/shop/*"

As an authorised contractual partner, you can apply for access to the GEA BluShop using the "Register" option on the page "*https://blushop.gea.com/shop/*" or send an email to "*Support.BluShop@gea.com*".

For general inquiries and information about the GEA BluShop, please address your emails to "*Support.BluShop@gea.com*".

GEA service technicians use the following access to the GEA BluShop "*https://geacloud.sharepoint.com/sites/connect-rt/SitePages/GEA-HRT-BluShop.aspx*".

In addition, it is possible to contact the Spare Parts Sales department at GEA Refrigeration Germany GmbH via the following services.

- **Email**

  ScrewSpareParts@gea.com

- **Mobile phone, outside working hours**

+49 (0) 172 30 14 579

These services are gradually being replaced by the possibilities of the GEA BluShop (*https://www.gea.com/en/products/compressors/blushop/*).

1.3.3 Training courses

Notice

All work on our systems must only be carried out by technical personnel!

► Acquire the technical know-how required for this in good time!

Comprehensive training courses are held regularly for service technicians and mechanics, thus ensuring the safe and proper use and maintenance of our systems.

- **Contact:**

  www.gea.com/contact

1.3.4 Service contracts

There is the possibility of concluding a long-term agreement for services (service contract). For more information about the content, scope and conditions of possible services, please contact Technical Support.

- **Email:**

  Info@gea.com

1.4 Declaration of Conformity, Declaration of Incorporation

Notice

One of the following documents, depending on the product, is part of the product documentation for the respective project:

► Declaration of incorporation
► Declaration of conformity

1.5 CE mark

By affixing the CE mark, the manufacturer confirms the conformity of the product with the applicable EC Directives and compliance with the principle requirements stipulated within them.

Fig.1: CE mark

The CE mark is affixed to the nameplate.

The CE mark for products from GEA Refrigeration Germany GmbH is provided as defined in the Pressure Equipment Directive, i.e. pressure equipment is placed on the market with the required equipment parts with safety function. This complete assembly is subject to the Pressure Equipment Directive.

Compliance with the machinery directive is confirmed by the respective supplied certificate.

2 Safety

2.1 Intended use

Notice

Observe the chapter "Intended use" in the installation and maintenance manual for the compressor!

► The installation and maintenance manual for the compressor is part of the product documentation.

A product may only be operated up to a defined final pressure which, with a certain safety margin, is below the maximum permissible final pressure according to the product label.

It is imperative that you comply with the applicable conditions of use with respect to pressure and temperature for the product. (Compliance with the operating conditions even if, for example, an external condenser is used for liquid chillers.)

Do not change the setting values of the safety pressure switch. This would endanger the operating safety of the system.

If the switch-off value is set higher than the maximum permissible pressure (see EN378-2) of the high pressure section of the system, this will lead to bursting of the vessel of this section of the system.

The operating regime stipulated by the manufacturer, especially for the starting phase of the system, must be observed.

Operating parameters according to the technical specification and parameter list of the order must be monitored and must not be exceeded or undercut.

The product has been designed and manufactured for a specific application under defined conditions of use. Unauthorised structural modifications are not permitted. We assume no liability for any resulting damage. In the interest of further development, GEA Refrigeration Germany GmbH reserves the right to make technical modifications. The product described here corresponds to the state of the art at the time this operating manual was published.

The manufacturer must be consulted in all cases as to the permissibility of modification in the event of any change application or conditions of use.

The secondary refrigerant circuit must be designed in such a way that a constant swept volume is ideally ensured on the evaporator. If the swept volume is reduced, this can lead to freezing of the secondary refrigerant and to triggering the system safety device.

Any changes to the swept volume must be mentioned in the order specification.

For heat pumps, the evaporator can optionally be configured as an ammonia cascade heat exchanger. In this design model, the supply and drainage of the compressed/condensed NH_3 from the refrigerant system must be ensured.

The flow of media through the high pressure side heat exchanger must be guaranteed. If the rate of flow is reduced or obstructed, there will be an increase in discharge pressure followed by the compressor shutting down.

Do not make any modifications to the product and the compressor control.

These may impair the safety and functionality of the product. They will also invalidate the guarantee.

The pressure equipment described here must not be operated for any purpose other than the function and application described in the following chapter. If the pressure equipment is not used according to the regulations, safe use of the product is not guaranteed. The supplier/installer or the operator, not the manufacturer, is responsible for all injury to personnel and damage to property which results from non-authorised use.

The pressure equipment is not designed for dynamic loads. If there is a risk of lightning strikes, the pressure equipment must be earthed. The supplier/installer must include instructions for regular inspection of the pressure equipment in its operating manual and must specify the procedure to be followed by the end user in the event of damage. In order to prevent burns or frostbite, the pressure equipment must not be touched during operation. This can be prevented by appropriate safety measures. The appropriate warning signs must be affixed. Refrigerating systems/heat pumps must be equipped with safety valves according to EN 378. The supporting surface must provide sufficient rigidity.

The supplier/installer must exercise due care when installing the accessories for the pressure equipment. The pressure equipment must not be damaged during installation, unprotected spots must be protected against corrosion. The pressure equipment must be filled only with the refrigerant specified in the contract. The pressure equipment must be installed in the system in such a way that no vibration or pulse is transferred to the pressure equipment. The connection lines must be installed only when de-energised.

Intended use includes observance of this manual and all supplied operating manuals as well as compliance with the maintenance and service intervals and conditions stipulated therein.

Improper use of the equipment shall void any warranty entitlement and approval for operation.

2.2 Warning against foreseeable abusive use

A product is said to have been abused if:

Notice

Unauthorised refrigerants, fuels as well as secondary refrigerants and cooling media are used.

► Observe the specifications for the project!

Notice

electrical components are wrongly connected.

► Observe voltage and frequency!

Notice

mechanical components are wrongly connected.

► Observe pressure and temperature!

- The supporting, hanging and storage facilities are misused,
- Control and regulation units including control software are tampered with,
- The driving power generated by the motor is used for purposes other than the operation of the respective compressors and pumps.

2.3 Operator duty of care

The statutory regulations for meeting the obligation to exercise due care must be observed.

Meeting the obligation to exercise due care according to the current level of technology requires that everything that is

- technically possible (use of accepted technological rules) and
- economically reasonable

be done to prevent damage in a protectively safe manner.

2.4 Subsequent changes

Changes may only be carried out by qualified persons or persons with suitable training with the manufacturer's consent and must strictly comply with the rules set out in the maintenance manual for the components concerned.

The following maintenance notes must be observed:

Only use original manufacturer replacement or spare parts for repairs and to replace parts subject to wear and tear. They must be requested from the spare parts service.

2.5 General safety instructions and dangers

The safety aspects that must be observed during operation of the product are detailed in the chapter on "Safety".

The product was developed, manufactured and is reliable according to the currently valid rules of technology. It was checked and has left the factory in a safety-related perfect condition.

The specifications of the product documentation and certifications must be observed in order to obtain this state for the for the operating time. The general safety regulations and the provisions and guidelines referred to in this documentation must at least be observed when operating the product.

Only compliance with all provisions and guidelines will enable optimum protection of the personnel as well as dangers to the environment and the safe and smooth operation of the product.

2.6 Legal foundations (Germany)

The following standards, regulations, ordinances and laws have to be strictly observed to ensure the safety and functional reliability of the product:

- **EC Machinery Directive 2006/42/EC**
- **EC Pressure Equipment Directive 2014/68/EC**– AD data sheets 2000
- **Hazardous Incident Ordinance** (12th BImSchV) with 1st failure VwV

- **Federal Immission Control Act** (BImSchG), 4th BimSchV
- **Water Resources Act**(WHG), VawS
- **Hazardous Substances Ordinance** (GefStoffV)
- **Recycling and Waste Management Act**(KrW-AbfG)
- **DIN EN 378, Part 1 to Part 4 / VO 2009/125/EC** Safety-related technical requirements and environmental requirements
- **Accident Prevention Regulation**including implementing regulations (BGR 500, chapter 2.35) on refrigeration plants, heat pumps and cooling equipment (BGV B3) regarding noise
- **EN 12284** Refrigerant fittings, safety related technical definitions, testing and marking
- **DIN 2405**Pipes in refrigeration plants, marking
- **VDMA Specifications**in particular VDMA 24 243 and 24 020
- **VDI Guidelines**
- **Instruction Sheets for Handling Ammonia, Instruction Sheet for halogenated hydrocarbons containing fluorine BGI 648**
- **Safety data sheet**for ammonia and other refrigerants and refrigeration oils

The list of rules and standards has been taken from Status Report No. 5 of the German Refrigeration and Air Conditioning Engineering Association "Safety and environmental protection in ammonia refrigeration plants" and also fully applies to other refrigerants.

⚠ Danger

There is a danger to people and products in potentially explosive atmospheres.

► The safety instructions for the refrigerant that is used must be observed for the intended use in potentially explosive atmospheres, installation zones 1 and 2 in accordance with EN 60079-10.

The following:

- standards,
- safety regulations,
- guidelines and sound engineering practice,

listed in these operating instructions must be observed at least!

If the product is used in a country other than Germany, the rules and regulations applicable at the place of installation must be observed and complied with!

The mandatory accident prevention regulations applicable for the respective country and area where the product is used must also be observed.

Failure to observe the safety instructions can lead to danger to personnel and the environment as well as damage to the product.

2.7 Personnel qualification

Qualification

All work explained in this manual (assembly, electrical connection, start-up, operation, etc.) may only be carried out by trained **technical personnel**who observe the relevant technical regulations.

Technical personnel are representatives of the product manufacturer and persons who, as a result of their technical training, experience and personal instruction in training measures, have sufficient knowledge of:

- applicable international and national standards,
- applicable occupational safety regulations,
- applicable accident prevention regulations,
- applicable environmental protection regulations,
- the construction and functioning of the product,
- recognised technical regulations for safe work according to good professional practice.

The technical personnel must:

- be able to assess the work assigned to them, recognise and avoid possible dangers,
- be authorised by those responsible for the safety of the system to carry out the requisite work and activities.

⚠ Caution

No arbitrary changes may be made to the control or other components belonging to the product.

► Maintenance work may only be done by authorised service staff.

Special requirements for the electrical technicians

Work on electrical components and modules may only be carried out by a **trained electrician**in accordance with the electrical engineering regulations. Furthermore the operator has to take care that the electrical systems, tools and fixtures are operated according to the rules relevant to electrical engineering regulations and applicable standards and are serviced properly.

- In principle it is prohibited to carry out work on parts under voltage.
- Fuses may only be replaced and not repaired or bypassed.
- Only the fuses specified in the electrical circuit diagram may be used.
- A two-pole voltage tester must be used to ensure that the parts are de-energised.
- The power supply as well as the product casing must be sufficiently grounded and tagged with a suitable label.
- Deficiencies noticed in the electrical systems/modules/tools and fixtures must be corrected immediately. If an acute danger exists before then, the product must not be operated in the defective condition.

Minimum age

The minimum age for the operation of the product and installation is 18 years. All persons involved in the assembly and installation of the product must get themselves trained at regular intervals or familiarise themselves with the current technical data of the product. The training and instructions is to be conducted at least once a year, unless some other interval has been agreed upon with the manufacturer.

2.8 Protective equipment

Notice

Adherence to the evacuation plan

► Familiarise yourselves with the local evacuation plan before beginning the work.

Should an emergency situation arise despite adhering to the safety regulations, the product must be shut down immediately and isolated from the electrical mains.

The mains cable must be blocked in such a way that it is not possible to restart the unit accidentally and marked as such.

The operator of the complete system has to take care that an isolation device, e.g. a mains switch with appropriate contact rating and an integrated indicator, is pre-installed in the mains cabling on site.

A separate mains cable/feed cable must be laid for the operation of the product.

The mains cable/feed cable must be specially fused and provided with an emergency stop switch.

2.9 Residual risks

⚠ Warning

Despite careful design of the product and the implementation of all safety-relevant regulations, further risks for persons and the product during the lifetime of the product cannot be fully ruled out.

► The additional safety instructions in the individual chapters of this manual must therefore be carefully observed!

The residual risks that were ascertained during the risk assessment carried out for the product according to safety standard EN ISO 14121 - Safety of Machines - are:

- External venting of the secondary refrigerant circuit (see EN 378-1)
- mechanical hazards due to sharp sheet metal edges and projecting parts
- electrical hazards as a result of inadvertently coming in contact with terminals and cables
- thermal hazards as a result of inadvertently coming in contact with heat exchangers and pipes
- exposure to noise
- hazards caused by vibration due to improper installation
- hazards due to working materials and other materials in case of allergies or the like.
- neglect of ergonomic principles
- combinations of various hazards
- unexpected starting, unexpected rotation in case of wrong electrical connections or defects
- shut down, emergency stop when defects are detected
- changes to the rotational speed
- power failure
- failure of the control circuit or control loop,
- incorrect assembly
- fracture during operation
- operating media or objects getting thrown out
- loss of stability
- personnel slipping, tripping or falling
- **danger from mixing of media**

Notice

Danger of media mixture basically exists with damage to evaporators/ condensers (e.g. plate penetration).

This can result in the ammonia transferring onto the liquid side of the heat exchanger and thus causing ammonia to withdraw from the secondary refrigerant side.

► To prevent subsequent damage and possible exposure to ammonia in the hydraulic system on the user side, measures need to be taken on the building side. These may take the form of:

- Separator heat exchangers in glycol systems with copper piping.
- NH_3-sensors in the pipe system close behind the heat exchangers.

Note: There no radiation hazards.

2.10 Emergency measures / procedure (first aid)

The following emergency equipment is to be provided in the case of a plant with a refrigerant capacity of more than 200 kg of refrigerant and also when a special machinery room is available:

- respiratory protection equipment independent of the ambient air
- First-aid equipment
- Emergency shower for eye rinsing.

The respiratory protection equipment must be suitable for that refrigerant. It must consist of at least two independent respiratory protective apparatuses.

First aid equipment, medicine and special chemical preparations as well as protective coverings, etc. must be available and stored outside of the special machine room but near the entrance. Special attention should be given to medicines for the immediate treatment of eye injuries. Medicines and other chemical preparations are to be acquired only in consultation with specialists.

The water for eye rinsing must be regulated with a thermostat (mixed warm/ cold water), in order to avoid cold shock to the injured person.

Notice

The safety instructions provided by the refrigerant manufacturer of the must be observed.

► The safety instructions document for the respective refrigerant is part of the product documentation.

3 Description

3.1 Design

The chillers of the **GEA Blu** product line have a modular design and comprise the following:

- Heat exchanger assembly consisting of a flooded evaporator system with an integrated liquid separator, condenser (optional), oil separation system, and expansion device
- Compressor package with Driveline and oil management
- Low-voltage installation with frequency converter and control device
- For outdoor installation of the GEA BluAir (duo) only: weather and soundproof enclosure with gas warning system, heating, and ventilation

The modular design of the GEA BluAstrum has been optimised for maximum compactness, ensuring very small dimensions while delivering high performance.

The chillers are supplied, as a standard, ready for connection, fully piped and wired. For the condenser version (R), the products are delivered in such a way that only a site-supplied air-cooled condenser or evaporative condenser needs to be connected on-site.

The heat exchangers are designed according to the parameters of a project, taking into account a maximum energy efficiency on the evaporator and the condenser side.

The standard version of the chillers is equipped with a freely programmable control. All operating and fault signals as well as the process variables can be read from a display (Touch Panel). The control is operated via a Touch Panel.

The chillers are delivered without refrigerant. They are filled with dry nitrogen (0.2 bar ... 0.5 bar overpressure).

By agreement with the customer, filling with refrigeration machine oil after factory acceptance testing on the test bench (FAT "wet") is possible (depending on the version, not available for all Blu products).

Notice

The specific design of a Blu chiller is project-specific and tailored to customer requirements.

► Details can be found in the project-specific specifications or the order drawings.
► The following sections of this operating manual provide a detailed specification of the main components of the product as well as a general functional overview.

3.1.1 Scope of delivery

Notice

The **GEA BluAstrum** is manufactured and delivered according to technical specifications.

► Optional design variants based on the standard equipment can be considered.

Standard equipment	
Designation	**Design**
Maximum permissible pressure:	Max. 28 bar
Intended environment:	Indoor installation
Ambient temperatures:	+5 ℃ to +40 ℃ (+5 °C to +32 °C with soundproof housing)
Installation altitude:	≤ 1000 m above sea level
Secondary refrigerant - outlet temperature [1]:	-15 °C/ 6 °C/ 18 °C
Electric motor:	Standard scope of delivery
Refrigerant:	R717
Type of oil:	According to order specification. Compare also the technical information on the lubricating oils for GEA packages, chillers and heat pumps. ⚠ **Caution** Deviating types of oil must be agreed with the manufacturer. ► Contact the Design or Technical Customer Service of GEA Refrigeration Germany GmbH.
Oil cooling:	Refrigerant injection
Oil heater:	Standard scope of delivery
Oil filter:	Single stage filter
Spare oil filter:	none
Oil level switch:	none
Pressure sensors:	directly in the pipe
separate push-button switch:	none
Overflow valve HP/LP:	Standard scope of delivery
Safety valve LP:	Double safety valve with change-over valve
Flow monitor:	electronic
Control:	GEA Omni
Communication:	Modbus TCP
Power current panel and frequency converter:	Standard scope of delivery, cable entry from below
Colour:	RAL 5014 (dove grey)
Soundproof housing:	none
Vibration isolators:	none
Approval of pressure equipment:	CE-PED, Module H (piping)
Documentation:	2x paper + 1 piece USB stick or electronic (provided on server)

1 Temperature difference secondary refrigerant maximum 10 K / standard 5 K

Optional equipment	
Designation	**Design**
Spare oil filter:	can be delivered
Soundproof housing:	can be delivered, colour: RAL 7035 (pebble grey)
Oil cooling:	Cooled with liquid or refrigerant
Communication:	Profibus DP ProfiNet
Electric motor:	customer specific design possible on request
Subcooler:	available
Flow monitor:	mechanically (paddle)
Vibration isolators:	available
Approval of pressure equipment:	CE-PED, Module H1 (complete chiller)

3.1.2 Location of the product identification (name plate)

The nameplate contains the most important technical data of the product. This data and the contractual agreements define the limits of designated use.

As standard, the nameplate is fixed to the switching cabinet (deviations of the location are possible).

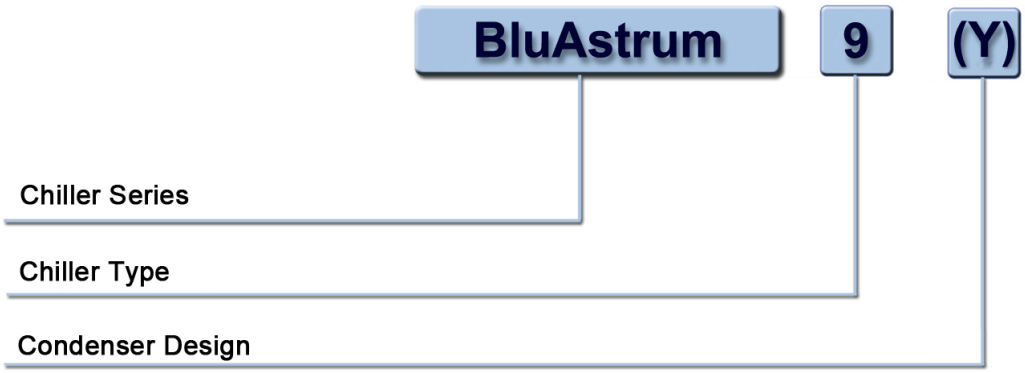
Fig.2: Location of the product identification (name plate)

Nameplate data	
Designation	**Description**
GEA Refrigeration Germany GmbH	Contact data of the manufacturer
Type:	Type designation of the product
Serial no.:	Serial number of the product
Year of manufacture:	Year of manufacture of the product
Tare weight:	Tare weight of the product
Refrigerant:	Details of the refrigerant used
Maximum permissible pressure:	Information about maximum permissible pressure PS high pressure side Information about maximum permissible pressure PS low pressure side

The standard languages are English and German.

3.1.3 Product designation chillers with screw compressors

GEA BluAstrum series



Product code description

Code	Description
BluAstrum	Chiller series
9	Capacity of the chiller in kW related to cold-water operation 12 °C / 6 °C
Y	Condenser version

BluAstrum = Chiller series

9 Capacity of the chiller at 4500 min^{-1} in kW related to cold water operation 12 °C / 6 °C

Compressor frame size	Output in kW
D	400
G	500
H	800
L	900
M	1000
N	1500
R	1800

(Y) Condenser version

Code	Description
(W)	Water-/liquid-cooled plate heat exchanger (completely welded), chiller for indoor installation
(R)	Evaporating or air-cooled condenser [2] Chiller for indoor installation

2 Not in the scope of delivery for GEA Refrigeration Germany.

Example of designation

Example	Description
BluAstrum 1000 (W)	Chiller with screw compressor, flooded evaporator with integrated separator **(BluAstrum)** Capacity of the chiller 1000 kW **(1000)** Design of evaporator and condenser as completely welded plate heat exchanger, chiller for indoor installation **(W)**

3.1.4 Main components

3.1.4.1 Compressor

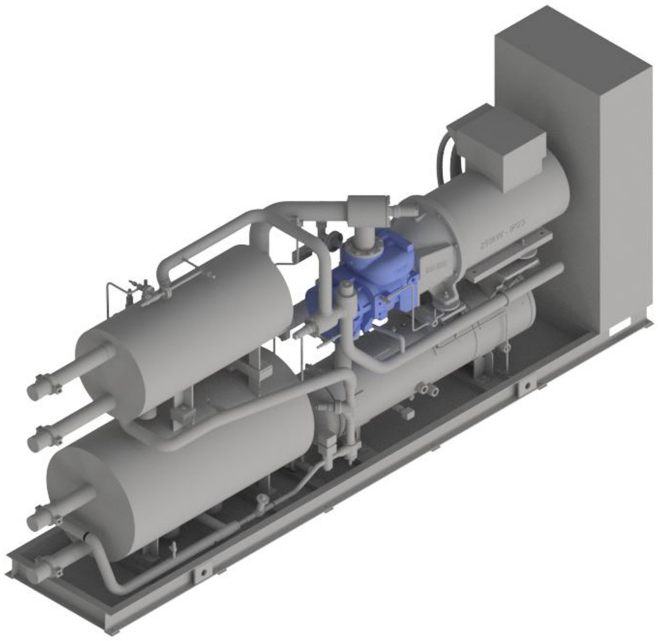


Fig.3: Arrangement of the compressor

The screw compressor is characterised by a compact design, high reliability, high-quality components and ease of maintenance.

Screw compressors are dual rotor positive displacement machines that work according to the displacement principle and are operated by oil injection.

The screw compressor is operated with ammonia (NH_3) as the refrigerant.

Specific machine oils are recommended depending on application. These can be found in the specifications or can be determined using a limited selection in the product configurator.

⚠ Caution

Different types of oil that are not indicated in the specification must be agreed with the manufacturer.

► Contact the design or service department of GEA Refrigeration Germany GmbH.

Various series and frame sizes of screw compressors are available for different fields of application.

The screw compressor is driven directly by the motor via a coupling.

The documentation for the screw compressor (installation instructions, part lists, drawings) is an integral part of the product documentation.

3.1.4.2 Motor

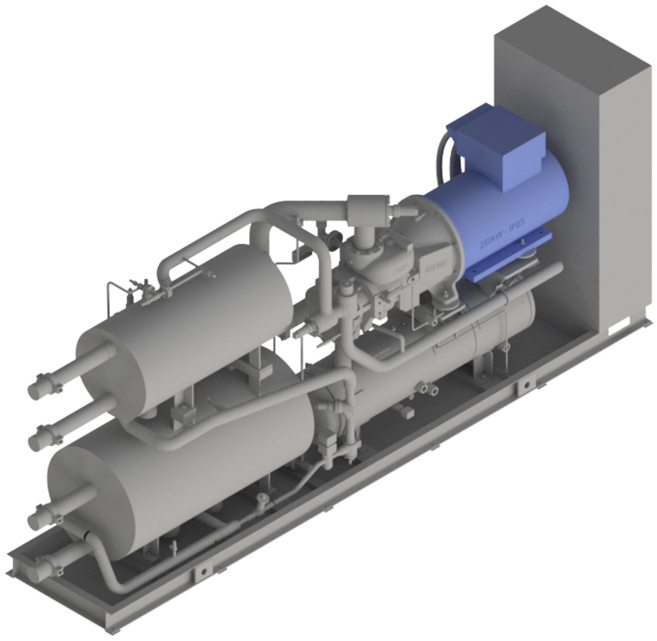


Fig.4: Position and arrangement of the motor:

Standard: The compressor is driven by an air-cooled 2-pole electric motor IP23 with an operating voltage of 400 V; 50 Hz using a coupling.

The motor speed is controlled using a frequency converter (optional equipment with chillers of the FX P and FX P duo series).

The maximum speed range is at 1000 rpm ... 4500 rpm, but is limited in both directions depending on the product and application.

The technical specifications provide information about the permissible speed range. Depending on the application, foot motors as per design IM B3, flange motors as per design IM B5, or a combination (design IM B35) are used.

Option: Other manufacturers, operating voltages, frequencies, protection and efficiency classes, additional monitoring sensors and anti-condensation heaters, products without motor are available (to be supplied by the customer). Others on request.

The documentation for the electric motor (operating manual) is an integral part of the product documentation.

Notice

The use of an anti-condensation heater should be considered if there is a risk of condensation forming on the motor/product at the installation site, especially if high humidity levels above 60% and/or large temperature fluctuations are expected (especially motors that are at a standstill in humid environments).

► Whether this technical design is necessary must be decided by the customer/operator based on the actual system.

3.1.4.3 Coupling

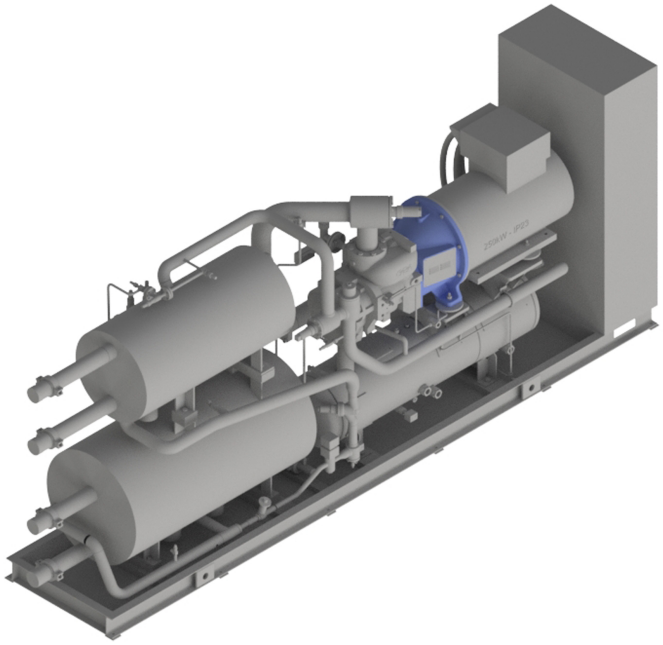


Fig.5: Arrangement of the coupling

The coupling helps in transmission of torque between compressor and compressor drive motor. The design of the coupling brings about decoupling from otherwise disturbing influences such as axial or radial forces, vibrations or offset.

Speed fluctuations and speed shocks are damped and cushioned, while torsional vibrations are reduced.

The documentation of the coupling (operating manual) is a part of the product documentation.

3.1.4.4 Evaporator

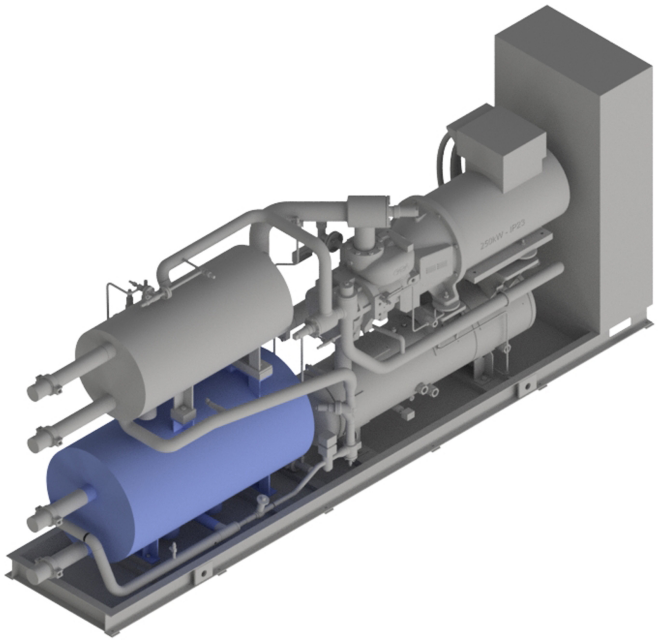


Fig.6: Arrangement of the evaporator

In the evaporator heat is absorbed from the secondary refrigerant (which is thereby cooled) by way of evaporation of the refrigerant. The evaporator works by the principle of overflowed evaporation.

Liquid drops are effectively separated in the liquid separator integrated into the evaporator.

In the case of external condensing systems (design variant (R) of the condenser), a maximum level indicator is installed in the level sensor vessel to provide additional protection against overfilling. The suction pressure and secondary refrigerant outlet temperature are monitored to provide reliable protection against freezing.

Design, manufacture and acceptance of the evaporator with integrated liquid separator comply with the requirements of the Pressure Equipment Directive.

The documentation of the evaporator (operating and maintenance instructions, acceptance certificate) is a part of the product documentation.

3.1.4.5 Condenser

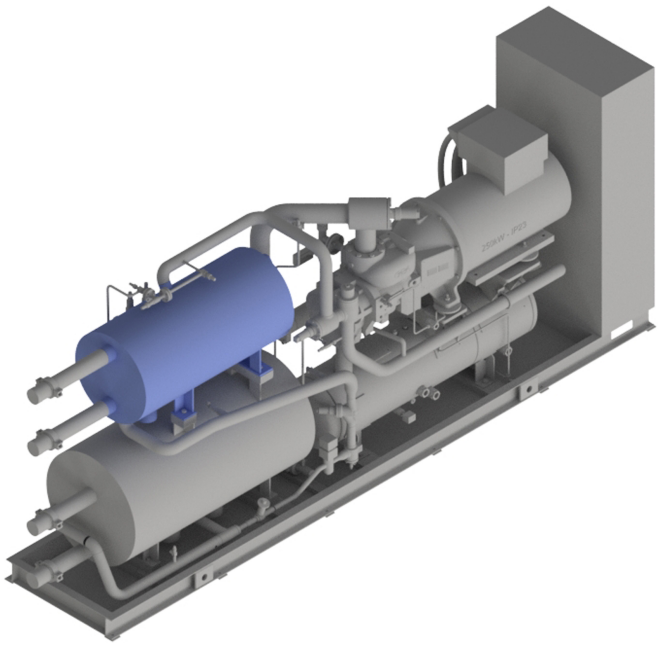


Fig.7: Position of the condenser

In the condenser the compressed refrigerant vapour is desuperheated and liquefied by dissipating the energy absorbed in the evaporator and compressor to the cooling medium (heating).

Design, manufacture and acceptance of the condenser comply with the requirements of the Pressure Equipment Directive.

1. Condenser designed as a plate heat exchanger (included in the scope of delivery)

   The documentation of the condenser (operating and maintenance instructions, acceptance certificate) is a part of the product documentation.

2. Condenser design type (R):

   Client-provided air-cooled condenser (not a part of scope of delivery)

   Client-provided evaporative condenser (not a part of scope of delivery)

Notice

The use of several GEA BluAstrum with only one common condenser is not permitted.

► When operating with an external condenser (type GEA BluAstrum (R)), a separate condenser must be available for each GEA BluAstrum!

3.1.4.6 Oil separator

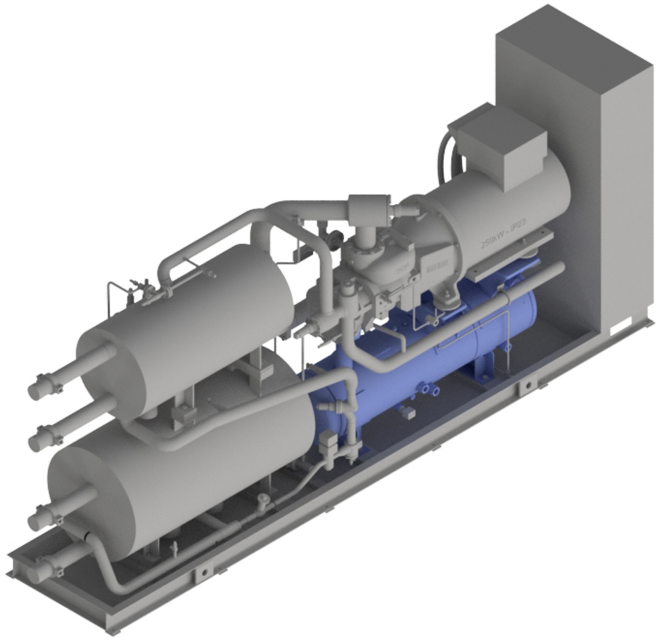


Fig.8: Arrangement of the oil separator

The design of the oil separator is standardised and it is characterised by low oil carry-over.

The oil separator is installed horizontally.

The documentation for the oil separator (operating and maintenance manuals, acceptance certificate) is an integral part of the product documentation.

Oil heater

Electric oil heaters are built into the oil separator to heat the oil-refrigerant mixture in the oil separator when the product is at a standstill. The oil heater prevents condensation of the refrigerant into the oil and, thus, any foaming of the oil during start-up.

To prevent overheating, the radiator is fitted with a correctly dimensioned overheating protection and a temperature control (in case of a fault, e.g. boil-dry protection, permanently set to 170 °C).

Notice

The oil heater may only be switched on when installed and used for heating the oil in the oil sump of the oil separator.

► For more information about handling the oil heater, please refer to the function description, commissioning, operation and control chapters.

The documentation for the oil heater (operating and maintenance manuals, acceptance certificate) is an integral part of the product documentation.

3.1.4.7 Oil cooler (optional)

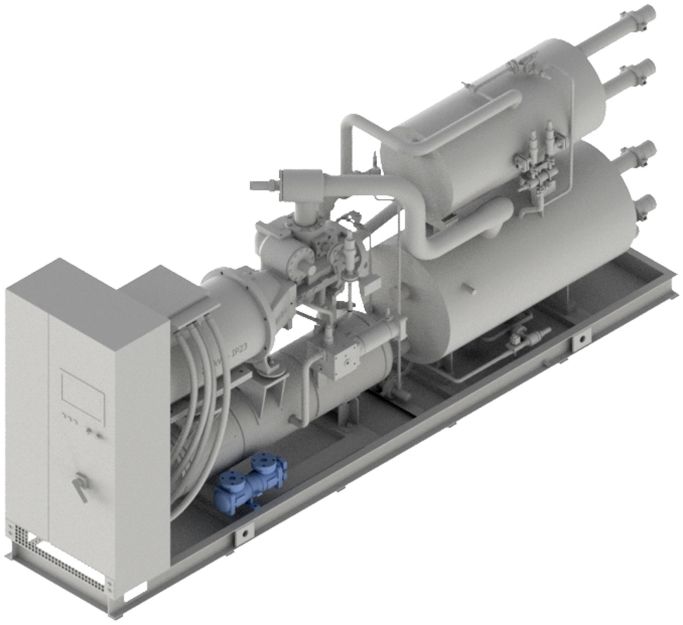


Fig.9: Arrangement of the oil cooler

The oil cooler is used for cooling the oil heated in the compressor in order to ensure sufficient oil viscosity for supplying to the compressor.

As standard, minimum oil temperature is maintained by oil temperature control using a 3-way valve. Unless otherwise specified, the oil cooler has all the pipelines on the coolant side.

Depending on the product/application, the oil cooler is an optional component and is replaced with the injection of refrigerant into the compressor to cool the compression process.

For heat pumps and applications with heat recovery, a type of liquid cooling is used in which the oil cooler releases the oil's heat to a liquid medium (cooling medium/heat carrier).

The documentation for the oil cooler (operating manual, acceptance certificate) is an integral part of the product documentation.

3.1.4.8 Oil filter system with OMC-block (oil management centre) screw compressor

After cooling, the oil passes into the oil filter which holds back solid particles from the full oil flow.

Due to its large surface, the oil filter has a high absorbing capacity and thus a long operating lifetime. Depending on the application, the relative filter fineness is between 10 and 25 µm.

An additional coarse filter with a relative filter fineness between 40 and 80 µm may be installed upstream depending on the application.

The OMC block includes the oil distribution system of the oil circuit. Necessary control and shut-off fittings are integrated in the OMC block. Connections for temperature and pressure sensors as well as service ports are available. The OMC block is combined with a standardised filter system and oil pump units (if present) and forms the central control and regulation unit within the oil circuit.

Optionally, the OMC block can be equipped with a 3-way valve element (to ensure a minimum oil temperature when starting the compressor, not available as standard for all applications/products).

The documentation for the OMC block (operating manual, acceptance certificate) is an integral part of the product documentation

Notice

The OMC cannot be used under certain conditions (such as applications with high oil volume flows of more than 340 l/min and all products with a maximum permissible pressure higher than 40 bar).

► In this case, all of the parts that are usually integrated in the OMC are installed separately in the oil circuit.

3.1.4.9 Oil pump

The oil pump is an essential component of the oil circuit. It is used for pumping and distributing refrigerator oil and ensures that the oil is distributed to the individual lubricating points (e.g. radial bearings, balance piston and the stuffing box of the compressor).

Under certain conditions, products based on the screw compressor of the GEA Grasso M series can or must be operated without a pump. In this case, the pressure difference between the suction and discharge sides of the compressor is used to ensure the oil supply.

The documentation of the oil pump (operating manual, acceptance certificate) is a part of the product documentation.

3.1.4.10 Suction filter combination (screw compressor)

The suction filter combination contributes substantially to the high working reliability of the components and the overall product.

The suction filter combination prevents dirt particles carried by the suction flow from entering the screw compressor. The flow through the suction filter element is from the inside to the outside. It is designed such that monitoring is not required. The filter element can be cleaned.

The default integrated check valve prevents pressure compensation to the suction side after switching off. Depending on the design, it is closed with a spring or by a hot gas pulse when switched off.

The documentation of the suction filter combination (operating manual, acceptance certificate) is an integral part of the product documentation.

Compressor frame sizes C to N are equipped with a suction filter check valve integrated in the compressor as standard.

3.1.4.11 Refrigerant injection for chillers with screw compressor

Before it is returned to the compressor for use, the oil heated up in the compressor has to be cooled down to a temperature at which it has sufficient viscosity.

This can be guaranteed by refrigerant injection.

In case of refrigerant injection, the refrigerant is injected at a defined point on the compressor. The injection point is selected so that there is no loss of output on the compressor.

3.1.4.12 Control cabinet with control

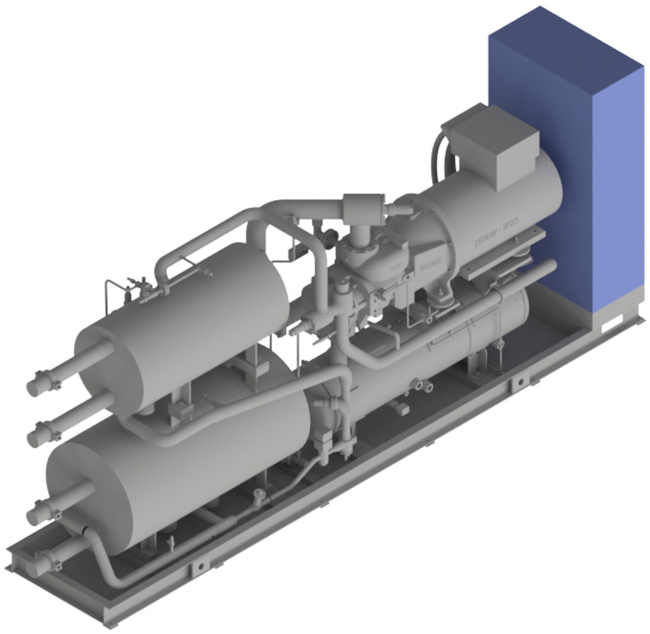


Fig.10: Position of the control cabinet

The product is equipped with a GEA Omni control as standard.

The switching cabinet and control device consists of the control with operating and display unit, indicator lights for “Operation”, “Warning” and “Fault”, EMERGENCY STOP button, coupling elements as well as the casing.

For motors with an output power of up to 450 kW, the control cabinet with the control is directly mounted on the product.

For certain product series, the control cabinet can be optionally removed from the scope of delivery. In this case, only the GEA Omni control is mounted in a control cabinet on the product.

If the product operates with variable speed (standard for the GEA Blu chiller and GEA Red heat pump series), the frequency converter is integrated in the control cabinet.

Notice

Depending on the motor size, the frequency converter (FC) must be installed in a separate cabinet. Depending on the application, the complete control cabinet is mounted in a different configuration than the one shown, or the FC cabinet is supplied separately.

► Details can be found in the project-specific specifications or the order drawings.

More details on the functional scope of the control can be found in the separate chapter concerning the GEA Omni.

The documentation for the control (operating manual, circuit diagram, parameter list, communication guideline) is an integral part of the product documentation.

Notice

The communication guideline offers detailed information about communication of the controller.

► The communication guideline can be made available before a planned installation.

3.1.4.13 Soundproof housing

Fig.11: Soundproof housing, view

As an additional option, GEA Refrigeration Germany GmbH offers sound insulation for your machine room using a newly developed housing.

The double-walled and down-closed housing construction with insulating material reduces the sound pressure level measured outside by approx. 4 dB (A), thus achieving a significant reduction in noise.

In addition, the soundproof housing also serves as protection against physical contact.

An ventilation system keeps the temperatures in the interiors within limits and simultaneously prevents heat losses on the system.

Individual wall elements can be quickly and easily dismantled so that access for maintenance work is ensured. Alternatively, the entire soundproof housing can be removed completely by loosening a few screws in the base frame.

Last but not the least, the filigree design combines the functional requirements with modern, high-quality optics.

3.1.4.14 Fittings

The term 'fittings' generally designates a control element of the product. Among other things, the term 'fittings' is also used for valves if they are used for the control and regulation of fluid flows in the pipes.

Furthermore, all kinds of installations in pipes, such as sight glasses, measurement apertures, filters and similar, are also designated as fittings. Therefore, fittings also include all kinds of valves, such as

- Stop valves
- Check valves
- Safety valves
- Throttle valves

Each fitting has its own field of use, according to the pressure or temperature in the pipe, the size of the pipe, the sealing requirements for the fitting, the reduction and direction of the flow of liquid, as well as the medium itself.

The safety fittings are used to limit the pressure in systems which are under pressure.

Each fitting is designed for the specific application. The fittings can be operated manually or by motor, e.g. by gear motors, or pneumatic or hydraulic cylinders. In reset fittings, the flow of fluid in the pipe causes automatic closing of the valve.

Depending on the model, different closing elements (e.g. valve discs, flaps, washers) close the pipe connected to the fitting.

The documentation of the fittings (acceptance certificate) forms part of the product documentation.

3.1.4.15 Safety devices

The product is equipped with a comprehensive software safety chain preventing excessive pressures, temperatures and the hazard of freezing.

A suction as well as condenser pressure control and a rated current limitation control will adjust the speed if the set limit values are exceeded.

Due to the applicable laws and regulations, various certifying bodies require a vast range of auxiliary equipment with independent safety devices.

The following safety equipment is included, if the chiller is delivered with CE label according to EN 378:

- Overflow valve (on the compressor) from discharge to suction side,
- Dual safety valve with blow-out connection, installed on the low pressure side of the product,

Notice

Correct installation of the blow-out connection.

► The contractors must guarantee that the pressure relief connection is safely operated to the outside.

- Safety pressure limiter via 2 switching positions with manual internal and external reset (one switching level may be enough for some applications)
- Pressure relief device for each closable container which can contain liquid refrigerant.

  This applies to all vessels in accordance with the requirements of the Pressure Equipment Directive.

The scope of delivery does not include the following safety devices in relation to escaping ammonia:

- Protective equipment (health and industrial safety)
- Gas warning device / gas warning sensors (included in the GEA BluAir and GEA BluAir duo series as standard)

In case of delivery according to EN 378 with CE label, all parts of the documentation mentioned in the regulation are also supplied in the national language.

All other approvals have to be agreed upon separately.

3.1.4.16 Safety devices for pressure limitation

The safety devices for pressure limitation of the product comply with EN 378-2.

The overflow valve for the protection of the compressor is designed according to EN 13136.

The blow-off pressure of the safety device is set to a pressure ≤ the maximum permissible pressure of the system.

The blow-off pipe has been calculated according to EN 13136.

The electromechanical safety switching devices for pressure limitation comply with EN12263 and are type-tested. The settings correspond to the specifications of EN 378-2.

If electronic safety switching devices are used for pressure limitation, the setting may deviate from the standard specifications (see EN 378-2) due to the increased precision.

Notice

When using safety valves for pressure relief, the operator is responsible for:

► the calculation of the dimensioning of the blow-off pipes upstream of the safety valve,
► the safe discharge of refrigerant when the pressure relief device responds.

The safety equipment for pressure limitation according to EN 378-2 represents the minimum requirements. Therefore, before commissioning, the specifications from the national operational safety regulations must be compared with those of EN 378-2.

For the safe function of the safety devices for pressure limitation, the specified test intervals must be observed. These result from the respective industrial safety regulations.

3.1.4.17 Components installed by the client

⚠ Warning

GEA Refrigeration Germany GmbH does not assume any liability for arising damages or for the violation of the safety regulations resulting from the use of unsuitable materials or a modification to the product that is not included in the original safety concept.

► The material properties of components and system parts provided by and monitored by the customer, in particular in the secondary refrigerant and heat carrier or coolant circuit as well as in the oil circuit, must be suitable for the fluids flowing there. Furthermore, in the event of modifications to the product by the customer, the effects upon the safety devices must be checked.

3.1.5 Information and safety labels on the product

Danger

Danger to life by failure to observe and follow the labels on the product!

► Be sure to observe and follow the safety-relevant labels on the product!

3.1.5.1 Labelling of the pressure and temperature sensors, heater (safety labels)

Fig.12: Safety labels of the pressure and temperature sensors, heater

Importance of the labels:

Before replacing pressure and temperature sensors without dip tube, it must be ensured that the components into which the sensors are mounted are not pressurised. This can be achieved by closing the shut-off valves before the sensor to be replaced.

Before replacing oil heater it must be ensured that the oil separator into which the oil heater is screwed in is not in an oil-free pressurised state.

Not applicable to oil heaters of the HLP type series.

3.1.5.2 Marking the safety valves

(safety labels)

Fig.13: Marking the safety valves

Importance of the labels:

The safety valve must be connected to a blow-off line that leads to the outside.

3.1.5.3 Label of the oil pressure regulating valve (if present)

(Safety labels)

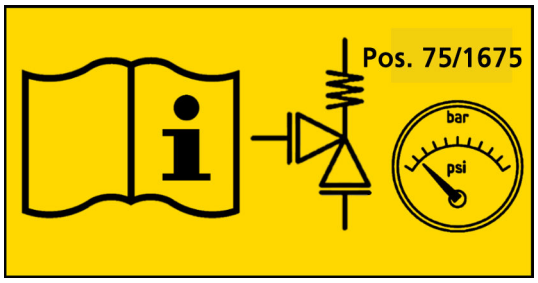


Fig.14: Label of the oil pressure regulating valve

Importance of the labels:

The oil pressure regulating valve limits the oil differential pressure between the pressure side of the oil pump and the discharge pressure.

The oil pressure regulating valve is integrated as standard in the OMC block. The oil pressure regulating valve is separately mounted for special operating conditions and when using an external oil filter.

Notice

Setting value: see parameter list under setting values and P+I diagram

► The parameter list and P+I diagram are part of the documentation for the control.

3.1.5.4 Label of the control valve injection line

(Safety labels)

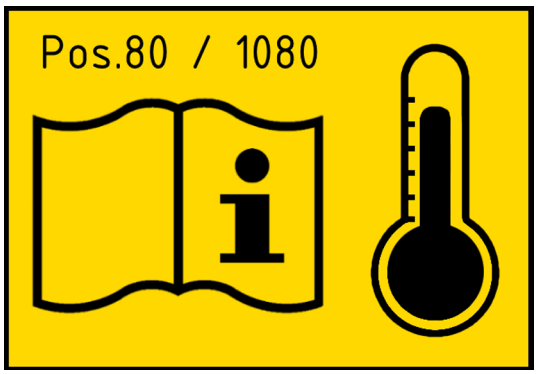


Fig.15: Label of the control valve injection line

Importance of the labels:

The amount of injection oil and the oil temperature directly influence the discharge temperature of the compressor. The amount of injection oil is adjusted under project conditions through the injection oil control valve.

Notice

Setting value: See parameter list under setting values

► The parameter list is part of the documentation.

3.1.5.5 Label of the control valve oil return

(Safety labels)

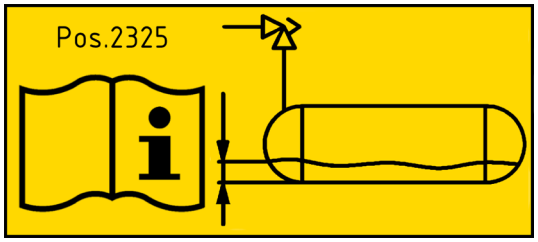


Fig.16: Label of the control valve oil return

Importance of the labels:

The amount of the oil return from the oil separator is adjusted by the control valve under projection conditions.

Starting with the valve closed, the valve is set with active oil return.

Setting value: max. 1.5 revolutions (see operating manual, Chapter 7.5 - First Start - Commissioning Process, section Adjustment of Oil Return Control Valve)

3.1.5.6 Marking the control valve on the control line of the check valve, suction side

(Safety labels)

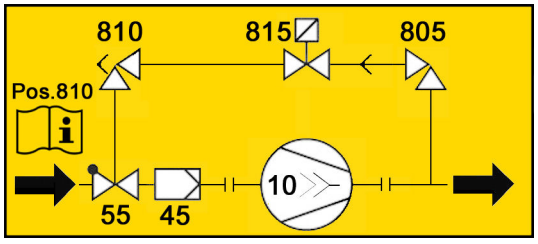


Fig.17: Marking the control valve on the control line of the check valve, suction side

Importance of the labels:

The closing process of the check valve is supported by a hot gas impulse while switching off. To ensure a low-wear closing process of the check valve on the suction side, the valve pos. 810 can be closed in increments of 1 1/2 revolutions.

Notice

No reverse rotation must occur when the compressor is switched off.

► The valve must not be closed entirely.

3.1.5.7 Labels of the screwed connections with cutting ring (handling instructions)

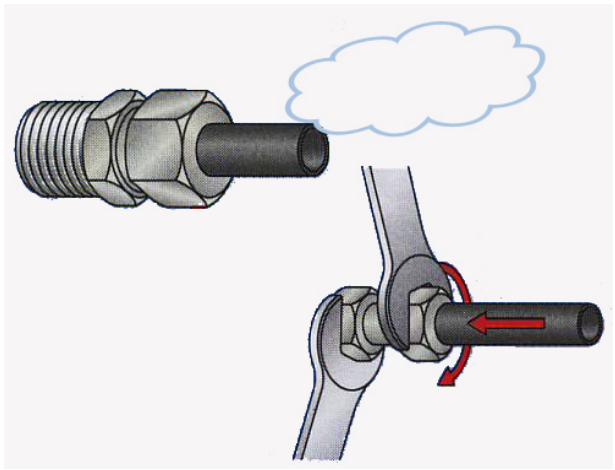


Fig.18: Labelling of the screwed connections

The informative label for all screwed connections with cutting ring (handling instructions) is attached to the oil separator in a clearly visible manner.

Importance of the labels:

If leakage occurs at a screwed connection (escaping gases or liquids), the screwed connection must be tightened:

Counter-hold the screw socket using a spanner. Tighten the union nut by about $^1/_4$ to $^1/_3$ of a turn beyond the point where the increase in force is felt.

→ The leakage is remedied.

3.1.5.8 Labels of the pipelines (information plate)

Pipelines in plants must be labelled as follows (DIN 2405):

- Refrigerant
- Direction of flow
- State of phase

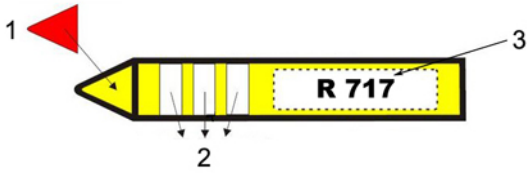


Fig.19: Labels of the pipelines

1	Arrow head (indication of the direction of flow)
2	Compression level
3	Information field (label of the refrigerant)

3.1.5.9 Marking of direction of rotation of the compressor drive motor (information plate)

Fig.20: Marking of direction of rotation of the compressor drive motor

The direction of the arrow indicates the direction of rotation of the compressor drive motor

The compressor’s direction of rotation is cast into the compressor (coupling side).

3.1.5.10 Label: The product is under pressure

(Safety labels)

Fig.21: Label: The product is under pressure

Importance of the labels:

Before working on the product, the protective gas filling must be completely drained.

3.1.5.11 Label for transport

(Handling instructions)

Fig.22: Label for transport

Importance of the labels:

Adherence to all guidelines and information on the transport instruction.

The transport instruction for the respective product can be called up as separate document at GEA Refrigeration Germany GmbH.

3.1.5.12 Label of the change-over valve

(Handling instructions)

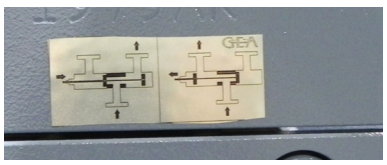


Fig.23: Label of the change-over valve

Importance of the labels:

Representation showing which valve setting is active.

3.1.5.13 Labelling of the control / control cabinet

(information plate)

- Label on the rear side of the control unit of the control system (visible after opening the switching cabinet):
  - Project name
  - Build number of the product
- Label on the inside of the switching cabinet:
  - Test verification for the control system

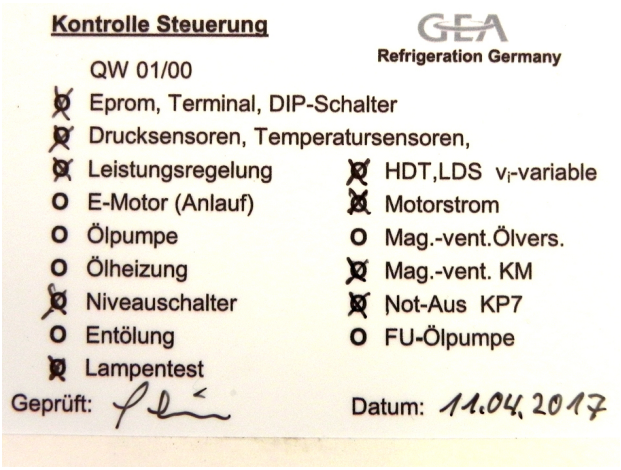


Fig.24: Test verification for the control system

3.1.5.14 Designation of the earthing connection

Safety labels

Fig.25: Designation of the earthing connection

Importance of the labels

Ensure that the product is properly grounded before start-up. Connect the earthing connection. The necessary mounting hardware and cables are **not** included in the scope of delivery.

See general assembly drawing for the position of the earthing connections.

Notice

The cross-section of the ground wire must be at least 10 mm². Alternatively, two separately installed and separately connected ground wire must be used, ensuring the minimum cross-section in the sum.

► The grounding must be carried out according to current regulations and is the operator's responsibility.

3.1.5.15 Installation and labelling of parts delivered separately (Handling instructions)

Mounting of the designation: on the evaporator

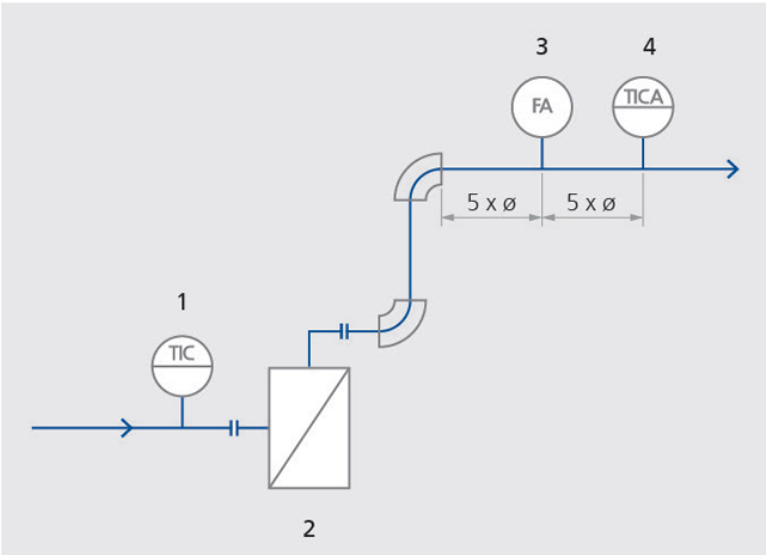


Fig.26: Labelling of the parts delivered separately

1	(2045) Resistance thermometer - secondary refrigerant inlet temperature
2	(2000) Evaporator
3	(2050) Flow monitor
4	(2040) Resistance thermometer - secondary refrigerant - outlet temperature

Importance of the labels

Before start-up ensure that the parts delivered separately are installed in the piping circuit:

1. Remove the parts from the packaging.
2. Install the components according to the figure.

Notice

The delivery includes additional parts for the heat carrier or cooling medium circuit. These parts must then be used accordingly.

► Note the hints given in the chapter “Start-up/water piping”.

3.1.5.16 Installation and marking of the loose part of the level indicator (handling instructions)

Only valid for the remote version (R).

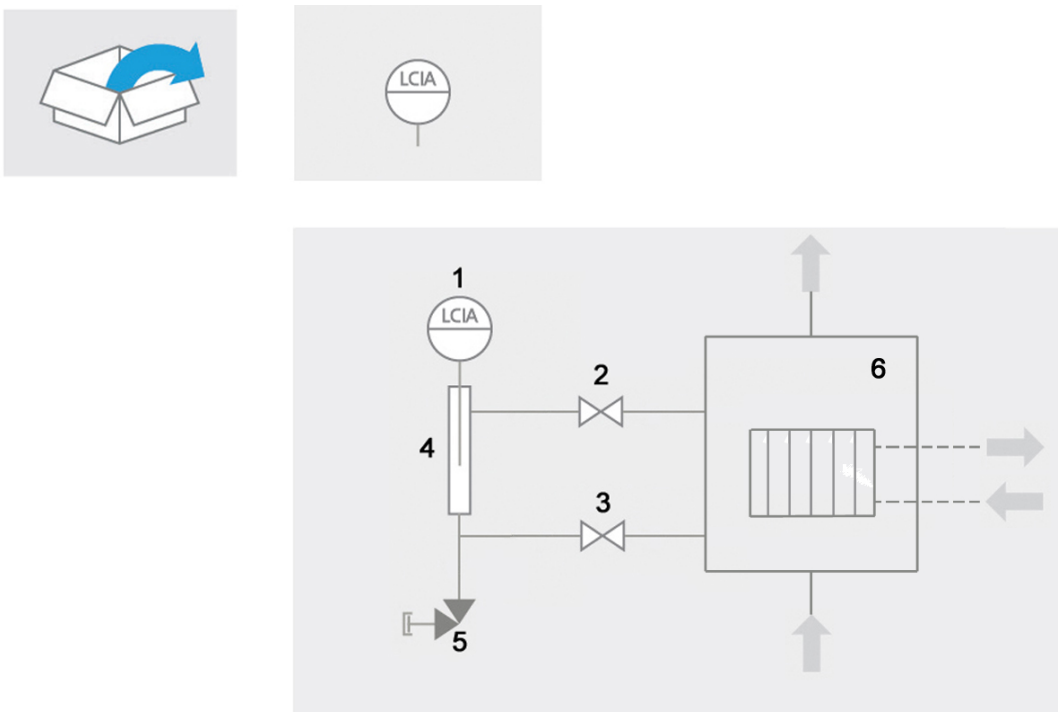


Fig.27: Marking the loose part of the level indicator

1	(2850) Level indicator - separator
2	(2815) Shut-off valve - external chamber
3	(2810) Shut-off valve - external chamber
4	Reference vessel
5	(2875) Shut-off valve - service
6	(2000) Evaporator

Importance of the labels

Before commissioning, make sure that the loose part of the level indicator (1) is mounted in the vessel (4).

Notice

In doing so, follow the instructions given in the manufacturer's documentation for the level indicator in order to ensure proper installation.

► The documentation for the level indicator is part of the product documentation.

3.2 General operating sequence of chillers and heat pumps

Chillers and heat pumps are automatic plants used in circuit processes in which a refrigerant absorbs low-temperature heat (source) and discharges it at a high temperature (sink).

The screw compressor draws refrigerant gas from the liquid separator and compresses it to condensation pressure.

The refrigerant liquefies as it is cooled and discharges its heat to a cooling medium or heat carrier. Before or after condensation, the overheating or undercooling heat can be removed from the refrigerant in an external desuperheater or subcooler. Then the liquid refrigerant is relaxed in the liquid separator.

In the liquid separator, the refrigerant vapour and liquid are separated.

The liquid is led through the evaporator by gravity circulation (thermosiphon principle). As result of liquid refrigerant absorbing heat (flooded evaporation) the refrigerant evaporates and the cooling agent is cooled down. In a cascade variant, an evaporator can be used, which can also be charged with compressed refrigerant from the low-pressure stage instead of a refrigerant. The refrigerant from the process stage process is liquefied in the process.

During the operation of the screw compressor, oil is injected into the working chamber and then separated again from the refrigerant in the discharge side oil separator.

The oil that has heated up in the compressor is cooled in an oil cooler to the inlet temperature.

Despite the oil separation system, oil will reach the low pressure side of the circuit.

A special automatic and maintenance-free oil returning system developed by GEA Refrigeration Germany GmbH returns the oil from the evaporator / liquid separator back to the screw compressor.

This is a basic precondition for fault-free operation of the evaporator system.

The capacity control of the screw compressor is continuously adjusted via the compressor's control slide (optional for the GEA BluAstrum and GEA BluAir product series) and through the frequency converter control of the compressor drive motor (standard equipment in the "Blu" and "Red" product families). In this way, the cooling capacity can be adapted to the effectively required cooling capacity in the maximum range 0% to 100% (the minimum level is > 0 % depending on the application area).

The adjustment of the internal compression ratio to the current operating conditions is done steplessly by the compressor’s Vi-slider. The Vi capacity slide is hydraulically adjusted and activated using 2 solenoid valves. The position of the Vi control slide is displayed on the compressor control.

In partial-load mode, the cold water / saltwater and heating agent flows may be reduced by max. 50% to guarantee efficient transfer of the heat to the heat exchanger systems.

3.2.1 Process flow chart

Notice

The following figure shows an example of the diagram of the closed refrigerant circuit with single-stage compressor subject to project-related, optional features.

For a detailed list of all items, see project-specific customer parts list and P +I diagram!

► The customer parts list and the P+I diagram are part of the product documentation.

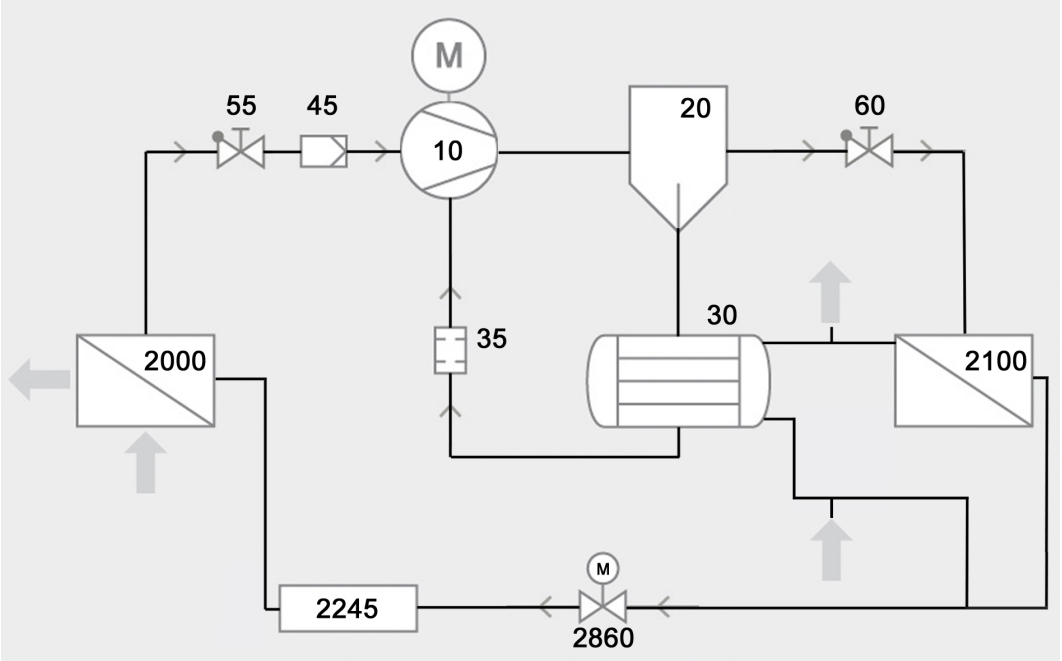


Fig.28: Process flow chart, GEA BluAstrum

10	Screw compressor
20	Oil separator
30	water cooled oil cooler (option)
35	Oil filter
45	Suction filter SFC
55	Check valve - suction side
60	Shuttable check valve - pressure side
2000	Evaporator with integrated separator
2100	Condenser
2245	Injector
2860	Expansion valve

3.2.2 Refrigerant circuit

The screw compressors draw refrigerant gas from the liquid separator and compresses it to condensation pressure.

The refrigerant liquefies as it is cooled and is expanded in the combined evaporator/liquid separator.

Here, the refrigerant vapour and liquid are separated.

The liquid is fed by forced circulation using injection by the evaporator. As a result of the liquid refrigerant absorbing heat (flooded evaporation), the refrigerant evaporates and the secondary refrigerant is cooled down.

During the operation of the screw compressor, oil is injected into the working chamber and then separated again from the refrigerant in the pressure side oil separator.

The oil that was heated in the compressor is cooled to inlet temperature in an oil cooler prior to injection into the compressor by refrigerant injection.

Despite the effective oil separation system, oil penetrates to the low pressure side of the chiller.

A special automatic and maintenance-free oil returning system developed by GEA Refrigeration Germany GmbH returns the oil from the liquid separator back to the screw compressor.

This is a basic precondition for fault-free operation of the evaporator system.

3.2.3 Oil circuit

The screw compressors operate oil-flooded. During the compression process, refrigerating machine oil is continuously supplied to the compressor for lubrication, sealing, noise reduction, and absorption of part of the compression heat. After the compression process, the oil is separated from the refrigerant as far as possible again in the oil separator. In the next stage, the remaining oil content in the refrigerant is fed back from the liquid separator/evaporator.

3.2.3.1 Oil heater

The oil heater on the oil separator is switched on when the product is at a standstill to prevent condensation of refrigerant in the oil separator when the product is at a standstill and to guarantee a minimum oil temperature and sufficient oil viscosity when the product is switched on again. The maximum temperature of the heating rod is restricted.

3.2.3.2 Oil cooling

Before it is returned to the compressor for use, the oil heated up in the compressor has to be cooled down to a temperature at which it has sufficient viscosity.

The following oil coolers are available:

- Refrigerant injection (directly into the compressor without oil cooler tank)
- Liquid cooled (non corrosive media)
  - Water (non corrosive)
  - Propylene-glycol (25%)

- Ethylene-glycol (35%)
- Other cooling media on request

• Thermosyphon (refrigerant-cooled)

Notice

A high pressure receiver is required for a refrigerant-cooled oil cooler that ensures the supply of the refrigerant to the oil cooler in all operating modes.

► The high pressure receiver is not part of the product delivery as standard, and needs to be designed and realised by the customer.

Oil cooling using the thermosyphon principal

If a chiller is operated with an external condenser and there is no cooling medium available for oil cooling (water or water-glycol mixture) then the oil cooling using the thermosyphon principal as shown in the following figure is recommended.

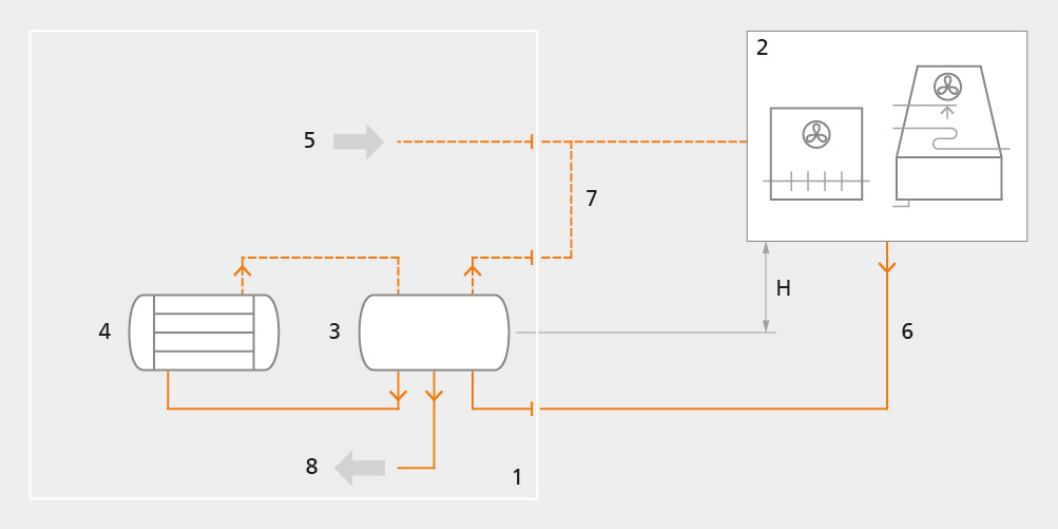


Fig.29: Thermosyphon oil circuit

1	Chiller
2	External condenser (air cooled or evaporative condenser)
3	Collector
4	Oil cooler
5	Hot gas from compressor
6	Pipe 1 (condensate from condenser)
7	Pipe 2 (vapour from receiver)
8	Condensate to the evaporator
H	= H_{min} + 0.5 m, required height of the condenser above the receiver

For the calculation of the minimum height of the condenser above the receiver take into consideration the entire pressure loss in the circuit Condenser – Receiver - Condenser via pipes, fittings, motor valves, condenser and receiver.

$$H_{min} \geq \frac{\Delta p}{\rho \times g} \; [m]$$

Fig.30: Calculation of the minimum height to be kept

Δp	Pressure loss in Pa
ρ	Refrigerant density in kg/m^3
g	Gravitational acceleration

The vapour return line of the oil cooler (7) must be connected to the pressure line as close as possible to the condenser inlet (see figure thermosyphon oil cooling circuit).

Approximate values for the required height difference between receiver and condenser	
Pressure loss of condenser (in Pa)	**minimal required height difference (in m)**
5 000	0.9
10 000	1.9
20 000	3.7
30 000	5.5
40 000	7.3
50 000	9.1

Notice

Maintenance of the minimum height difference between the receiver and the condenser!

► The minimum required height difference between the receiver and the condenser must be adhered to for the functioning of the oil cooling according to the thermosyphon principle!

Recommended velocities		
Line		**Flow speed**
Liquid line	Pipe 1 (6, see figure thermosyphon oil cooling circuit)	0.3 ... 0.8 m/s
Vapour line	Pipe 2 (7, see figure thermosyphon oil cooling circuit)	2.0 ... 6.0 m/s

Notice

The refrigerant vapour line, pipe 2 (7), needs to be constantly ascending above the inlet for the condenser.

► No dead ends may be created!
► Additional fittings (valves) and longer pipework in lines 1 or 2 will increase the height difference.

3.2.3.3 Oil pump

Notice

Depending on the operating conditions, the product is equipped with or without an oil pump. Screw compressors of the GEA Grasso M series can be equipped without an oil pump in refrigeration applications if the pressure difference between the suction and pressure side is sufficient. Heat pump applications are usually equipped with a magnetically coupled and speed-controlled oil pump unit.

► Details can be found in the project-specific specifications or the order drawings.

The oil pump is driven by an electric motor and runs for pre-lubrication and during the entire compressor operation. It provides an oil pressure sufficient for operating the compressor under all permitted operating conditions.

It draws the refrigerating machine oil from the collection chamber in the oil separator, via the the oil cooler and oil filter and pumps it to the bearings, the balance piston, the shaft seal, to the capacity control system and, if fitted, to the compressor's hydraulic Vi adjustment system.

The oil pump may pump more oil than the compressor uses. This surplus quantity of oil is returned to pump suction via the spring loaded oil pressure regulating valve. The oil pressure regulating valve regulates a pressure difference between the pressure side of the oil pump and the discharge pressure of the product according to the specifications in the P+i diagram.

With frequency-controlled oil pumps, the oil pressure is controlled via the pump speed. The oil pressure regulating valve then only serves as a limitation against excessive pressure.

3.2.3.4 Oil supply and injection oil

The compressor is supplied with function and injection oil.

The function oil ensures the oil supply of the bearings, the hydraulic adjustment of the control and Vi-slider (if installed), the balance piston and the shaft seal.

By means of the injection oil, which is fed to the compressor without a pump in the standard version, the required discharge temperature, among other things, is set via a control valve.

Depending on the application, an additional oil injection can be connected.

In special cases and often in heat pump applications, an individual oil injection control is used. Depending on the application, the oil circuit is also insulated and equipped with a trace-heating to prevent NH_3 condensate in the oil circuit at high saturation pressure during standstill.

3.2.3.5 Oil return from the low pressure side

In spite of a very good oil separation in the oil separators, oil will always reach other parts of the plant. For returning the oil from the evaporator, the product is equipped with a special automatic oil return system. The automatic oil return system works with a draining vessel and two valves as standard.

1. **Filling the oil separator tank (2300)**

   A refrigerant/oil mixture is drained from an appropriate point (evaporator or between the evaporator and the liquid separator) and led to the oil separator tank. To this end, a solenoid valve (2305) is opened.

2. **Evaporation of refrigerant**

   The solenoid valve (2305) is closing.

3. **Expelling oil from the draining vessel**

   After the dwell time, hot gas is led via the solenoid valve (2310) into the draining vessel for a short while and this pushes the oil / refrigerant mixture into the suction nozzle of the compressor.

   The oil draining cycle is actuated by the control. The control time parameters for the valves can be set at the control.

Depending on the application, the solenoid valves are replaced by motor-driven valves.

3.2.4 Capacity control of the compressor

The capacity control of the compressor is carried out easily and efficiently by means of a frequency inverter (speed 1000 - 4500 rpm).

According to this speed range and depending on the usage conditions, the compressor can be continuously regulated in the capacity range of approx. 25-100% in accordance with the specifications of the control.

Due to the speed adjustment with frequency inverter, the rotor pair of the compressor is fully charged even during part-load operation. The compressor has a Vi-slider. (A control slider, depending on the type of compressor that is partially available.)

Depending on the back pressure (evaporating temperature), the outlet opening on the compressor is optimally adapted to the respective operating conditions using this Vi-slider.

Notice

For details of the control process, see documentation of the control.

► The documentation for the controller is part of the product documentation.

3.2.5 Expansion and level control

Notice

Level control for products with combined evaporator/liquid separator and expansion using a (motorised) control valve depends on the condenser design.

Control by refrigerant mass flow calculation is made possible by a closed refrigerant circuit with a liquid-cooled condenser (included by default in GEA's scope of delivery).

Level control by means of a separate vessel is used for "remote" units with air-cooled condenser (optional equipment for GEA BluAir series) or evaporation condenser (not included in scope of delivery). Mechanical float expansion (not be available for Blu and Red series) does not require level control.

► Details can be found in the project-specific specifications or the order drawings.

3.2.5.1 Expansion/level control by calculating the refrigerant mass flow rate

The liquid refrigerant is injected into the evaporator via an electronic expansion valve.

Control is by means of mass flow calculation of the refrigerant in connection with pressure loss via the expansion valve and its characteristics.

In addition, the liquid level of the ammonia is evaluated using two level sensors in an inclined pipe downstream of the condenser. If the level drops, the lower sensor sends a signal to the valve to reduce the opening position. If on the other hand the maximum level sensor indicates that the level is too high, the expansion valve opens further.

Notice

Before start-up, the following points must be checked to guarantee correct function of injection control.

► Check the settings: have compressor frame size and the type of expansion valve been selected correctly, have pressure transmitters and position encoders of the compressor frame (LDS) been scaled correctly? (In the case of plants with reciprocating compressor there is no LDS.)
► Check the level displays: are the sensors fitted and wired?
► Check the charging data: has the plant been charged in accordance with the specifications for refrigerant and oil filling? (There must not be any condensable gases e.g. air in the line in order to guarantee correct function of the injection control.)

Notice

Design-related deviations are possible depending on the application.

► If necessary, the electronic expansion control is triggered via a separate vessel with float.
► If necessary, a mechanical expansion device is used.

3.2.5.2 Low-pressure level control with vessel

This type of level control is standard for air-cooled condensers and evaporation condensers (to be supplied and installed by the customer) on all GEA Blu Series remote chillers.

⚠ Caution

The level indicators in the vessel are supplied loose and must be installed in-situ prior to start-up.

In doing so, follow the instructions given in the manufacturer's documentation for the level indicator in order to ensure proper installation.

► The documentation for the level indicator is part of the product documentation.

The liquid refrigerant is injected into the evaporator via an electronic expansion valve. The level in the evaporator is evaluated to control the expansion valve. A vessel with a level indicator is installed on the evaporator for this purpose.

The level is determined with the help of the weight of a rod (measuring body) suspended freely in the liquid refrigerant. The weight of the rod is measured with the help of a spring balance. It is reduced by the uplift (buoyancy). The uplift is a function of the immersion depth of the rod and thus, the level of the liquid present in the evaporator.

If the measuring body hangs in the gas space, it is then not immersed in the liquid. Thus, the uplift is equal to zero and the force measured is equal to the weight of the rod including the chain. The measured value is 4 mA and this is then defined as the 0 % level.

If the upper edge of the measuring body meets the liquid surface or if the upper edge of the measuring body is more or less covered by liquid, the spring balance measures the weight minus the maximum uplift. The measured value is then 20 mA and the level height is defined as 100 %.

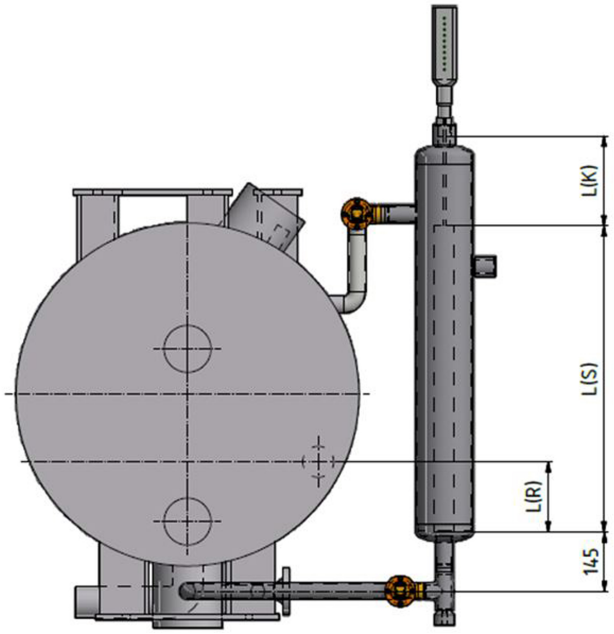


Fig.31: Separator

L (K)	Chain length
L(S)	Length floating body
L(R)	Distance bottom edge floating body to the regulation level

Evaporator frame size	L(R) [mm]	Setpoint [%]	Alarm [%]
4HH	140	19	40
5TH	165	22	46
6HH	195	26	53

The external vessel with the level indicator (floating body) is attached in such a manner that the distance of the regulation level to the bottom edge of the floating body is **at least** 20 % of the total length of the floating body.

The following parameters are pre-set in the PI regulation function of the GEA Omni™ (in brackets for the GSC TP - outdated):

- Amplification factor Kp : 350 (1,5)
- Integral time Ti : 220 (30)
- Neutral zone : 2 % (4 %)
- Maximum level : 40 %

These values must be adapted during start-up in the control for optimising the regulation behaviour, whereby the changes have the following effects:	
Parameter change	**Effect**
Amplification factor Kp:	part of the regulation deviation which is balanced immediately.
Integral time Ti:	time factor for compensating the remaining regulation deviation, which the amplification factor has not balanced immediately.
increase the amplification factor:	large jump at the start smaller remaining regulation deviation for the integral component
decrease the amplification factor:	small jump at the start larger part for the integral component
increase the integral time:	long time for adjusting the residual regulation deviation (slow)
decrease the integral time:	short time for adjusting the residual regulation deviation (fast)
fast regulation:	Amplification factor - large, integral time - small
slow regulation:	Amplification factor - small, integral time - large

As an alternative in special cases, level control can be changed to mass flow control of the expansion valve. To do this, the following parameters must be change in the control:				
Parameters Evaporator 1		**6HH**	**5TH**	**4HH**
Liquid supply “level too low”	%	26	22	19
Liquid supply “level too high”	%	38	33	29
Liquid supply “maximum level”	%	42	37	33
Close	%	53	46	40

If the level in the vessel becomes too low while liquid is supplied, the expansion valve is opened by 50% more than required according to the calculated compressor mass flow.

If the level becomes too high while liquid is supplied, the valve opening is reduced to minimum.

If the suction pressure is too low or the discharge pressure is too high, the valve is opened further. If the liquid supply reaches the “maximum level”, the valve is closed.

Settings at the Siemens Motor Valve MVS661… (can deviate from the factory settings):			
DIL switch no.	**Function**	**ON/OFF**	**Designation**
1	Setting signal	ON	Current [mA]
2	Adjustment range	ON	4...20 mA
3	Setting feedback	ON	Current [mA]
4	Flow nominal value k_{VS}	OFF	100 %

4 Transport and storage

4.1 Personnel qualification for transport and storage

Notice

All work explained in these operating instructions must only be carried out by qualified personnel.

► These operating instructions must be read prior to transport, storage and delivery to the installation site. It is imperative to strictly observe the instructions and information given!

4.2 Safety instructions for transport and storage

⚠ Caution

There is a danger of impacts and tripping against protruding parts on the product (e.g. valve caps). There is also a danger of cut wounds on sharp edges and surfaces. A danger of crushing body parts exists during transport work.

► All activities must be performed with maximum care. Personal protective equipment (work clothing, work boots, gloves) must be worn during all activities on the product.
► Adequate lighting must be ensured during loading and unloading as well as for storage in order to avoid injuries and damage to property.

4.2.1 Safety-conscious work

⚠ Danger

Due to improper handling and incorrect use of the load lifting device and slinging equipment, considerable dangers may arise during transport.

► Before working with the load lifting device and slinging equipment for the first time, read the transport instruction!

Safety rules:

- Commission only trained and instructed persons with the operation!
- Observe the legally stipulated minimum age!
- Make sure personal protective equipment is worn!

- Use only tested lashing and load handling equipment!

Make sure of accident-safe use adapted to the local circumstances. Before each individual start-up, all parts of the load lifting device and slinging equipment must be subjected to a thorough visual inspection for damage, completeness, tight fit and functional safety.

⚠ Caution

Only lashing and load handling equipment may be put into operation that has been checked by professional and qualified persons at regular intervals in accordance with the applicable guidelines of the trade association. The equipment must be within the valid inspection periods.

► The equipment is subject to an annual inspection obligation according to DGUV Rule 100-500 Chap. 2.8 (formerly BGR 500).

The ambient temperature must be in the range of -20 °C to +60 °C.

The load lifting device and slinging equipment with load may only be used properly in lifting gear / crane operation.

Before working for the first time, read the operating instructions of the lifting gear and accessories. The operating instructions supplied with the lifting gear apply.

Notice

Maximum permissible inclination and spreading angles of the slinging equipment must be observed in all cases!

► The permissible inclination angle ß = maximum 45° applies for all transport tasks described in these transport instructions.
► With asymmetric load distribution, the load bearing capacity of the slinging equipment reduces by 50%!

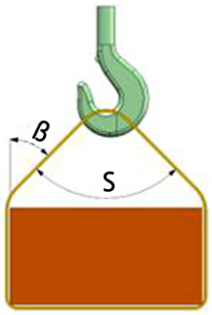


Fig.32: Transport angle

ß	Inclination angle
S	Spreading angle

The following are not permitted:

- exceeding the permissible load bearing capacity,
- lifting of persons or over persons,

⚠ Danger

presence of persons under suspended loads,

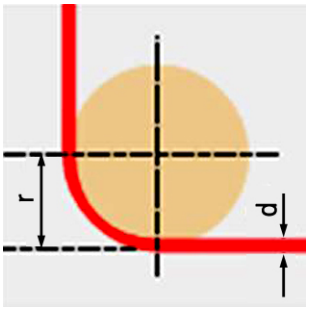
► Do **not** walk under suspended loads

- pulling on loads at an angle,
- separation of loads with the crane,
- introduction of knocks or impacts,
- heat treatment or welding work on the equipment,
- diagonal pulling of the load handling equipment,
- dragging or pulling away using the load handling equipment,
- use in areas with high cleanliness requirements,

⚠ Danger

Load lifting devices and slinging equipment not marked must not be used!
► Labelling obligation for load lifting device and slinging equipment

- removal or disabling of safety devices,
- and working over "sharp edges".



A sharp edge is always present if the edge radius "r" is smaller than the material thickness "d" of the sling. If the load has sharp edges or a rough surface, the textile sling must be equipped with a suitable abrasion protection, protective tubes or fixed coatings. With chains, work can be carried out over a sharp edge if the load bearing capacity is reduced by 20% or if the next largest nominal thickness is used.

4.3 Load lifting devices and slinging equipment

4.3.1 Intended use of load handling equipment (cross-arms, spreaders)

Before each transport, it must be ensured that if, with direct use of slinging equipment (chains, round slings or a combination of both), contact is not made with the product resulting in damage by the lifting procedure! If this cannot be fully ruled out, additional load handling equipment must be used.

Girder cross-arms, H-cross-arms or spreaders (fixed or adjustable) can be used.

Before using the respective load handling equipment, the final, binding dimensions and weights must be obtained from the final drawing documentation of the respective product components!

This applies to fixed or adjustable load handling equipment for selection of the correct load bearing capacity and fixing length. With adjustable load handling equipment, the necessary length / width also has to be set!

Before each use, read the operating manual of the respective load handling equipment to be used and. if required, configure the length accordingly!

⚠ Caution

Obtain the dead weight of the load handling equipment to be used!

► Essential when observing Section 4.3.2, Page 71

examples for possible load handling equipment:

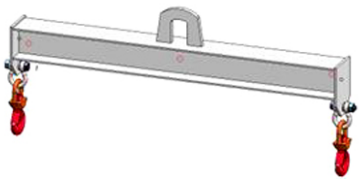


Fig.33: girder cross-arm, fixed

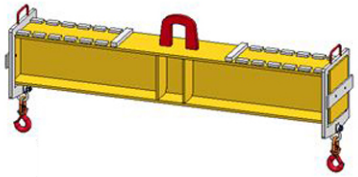


Fig.34: girder cross-arm, adjustable

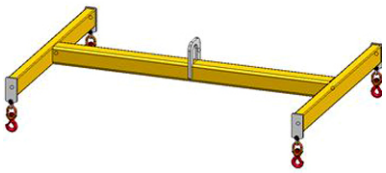


Fig.35: H-cross-arm, fixed

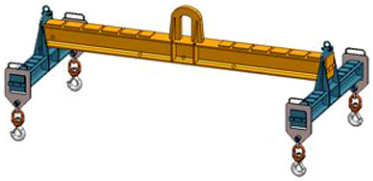


Fig.36: H-cross-arm, adjustable

examples for possible load handling equipment:

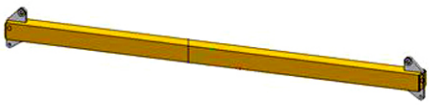


Fig.37: Spreader cross-arm, fixed

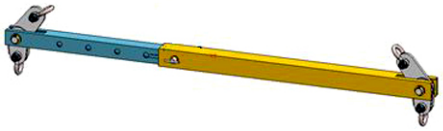


Fig.38: Spreader cross-arm, adjustable

Fig.39: Example - load handling equipment weight marking

Fig.40: Example - cross-arm transport

The load handling equipment must only be used by instructed persons that are qualified and are familiar with the operating manual.

It is forbidden to attach more than the permissible load to the load handling equipment. Load and dead weight of the load handling equipment (plus the dead weight of the slinging equipment) must never exceed the permissible total load bearing capacity of the lifting gear / crane.

To connect the load with the cross-arm using slinging equipment, shackles and swivel hooks are present on the lower mounts of the cross-arms.

Notice

The load bearing capacity of the shackles depends on the temperature.

- ► Temperature range -20 °C to -10 °C - Load-bearing capacity 50 %
- ► Temperature range -10 °C to 0 °C - Load-bearing capacity 75 %
- ► Temperature range 0 °C to 100 °C - Load-bearing capacity 100 %

4.3.2 Intended use of slinging equipment (chains, round slings)

Observe the permissible load bearing capacity of the slinging equipment.

Notice

Maximum permissible inclination and spreading angles of the slinging equipment must be observed in all cases!

► The permissible inclination angle ß = maximum 45° applies for all transport tasks described in these transport instructions.
► With asymmetric load distribution, the load bearing capacity of the slinging equipment reduces by 50%!

⚠ Caution

For the transport of the individual product components with the removable lashing pins, only chains or round slings with the respective load bearing capacity and hook sizes are permissible.

► When using chains, due to the geometry of the lashing pins, a **minimum** hook nominal size of 13 in quality class 10 must be used. The following illustrations show BKG safety hooks from Gunnebo.

⚠ Warning

When using round slings, the support width under load must not exceed the free length of the lashing pins!

► In order to meet the technical requirements, only the round sling Magnum X with a load bearing capacity of 10 tonnes or 20 tonnes from the manufacturer, SpanSet, may be used!

Different configurations of the slinging equipment are possible for transporting tasks:

1. 2 x 2 line chain sling quality class 10, nominal size 13 to 20, useful length 3 metres, 4 metres, with integrated chain shorteners.
2. 2 x 2-line chain sling quality class 10, nominal size 13 to 20, useful length 1 metre, with integrated chain shorteners and 4 x 1 round sling Magnum X, load bearing capacity of 10 tonnes or 20 tonnes, useful length of 2 metres, 3 metres or 4 metres for connection directly to the lashing pins.

   The connection of the round slings with the hook of the chain sling must be carried out using an ExoSet round sling shackle.

   In doing so, the load bearing capacity of the ExoSet round sling shackle must be matched to the round sling Magnum X.

3. 2 x 2-line chain sling quality class 10, nominal size 13 to 20, useful length 1 metre, with integrated chain shorteners and 4 x 1 round sling Magnum X, load bearing capacity of 10 tonnes or 20 tonnes, useful length of 2 metres, 3 metres or 4 metres as well as an additional lifting chain with suspension chains for connection directly to the lashing pins.

   The connection of the round slings with the hook of the chain sling must be carried out using an ExoSet round sling shackle.

   In order to meet the geometric requirements of the round sling Magnum X, the load bearing capacity of the ExoSet round sling shackle must be 25 tonnes.

   The same applies for the connection of the round sling Magnum X with the lifting chain with suspension chains.

Slinging equipment

Fig.41: 2-line chain sling with shortener

Fig.42: Round sling Magnum X
Load bearing capacity 10 tonnes or 20 tonnes

Fig.43: Special lifting chain with suspension chains
Load bearing capacity 10 tonnes

Permitted

1 = load bearing capacity support

Forbidden

⚠ Warning

Before transporting, the weight of the compressor package / chiller may have to be reduced, where applicable, by disassembly of the respective product components.

► The respective weights result according to the possible configurations of the slinging equipment (load bearing capacity, nominal size, useful length). The sum of the load lifting device and slinging equipment weights must be deducted from the existing crane capacity! The result is the maximum possible weight of the compressor package / chiller!

Round sling Magnum X in accordance with DIN 1492-2 Manufacturer: SpanSet		
Designation	**Useful length in m**	**Weight in kg**
Magnum X 10 tonnes	2.0	3.6
	3.0	5.4
	4.0	7.2
Magnum X 20 tonnes	2.0	7.2
	3.0	10.8
	4.0	14.4

2-line chain sling with shortener, quality class 10, weight for 1 metre useful length Manufacturer: Gunnebo						
Nominal size	**Component**	**Designation**	**Article number**	**Individual weight**	**Quantity per sling**	**Total weight**
13	Multiple slinging doubled Type MGD	MGD-13-10	B14703	5.2 kg	1	5.2 kg
	Chain	KLA-13-10	Z802303	3.8 kg/m	2	7.6 kg
	Safety hook type BKG	BKG-13-10	Z1010340	3.0 kg	2	6.0 kg
						18.8 kg
16	Multiple slinging doubled Type MGD	MGD-16-10	B14704	7.9 kg	1	7.9 kg
	Chain	KLA-16-10	Z802304	5.6 kg/m	2	11.2 kg
	Safety hook type BKG	BKG-16-10	Z101042	5.5 kg	2	11.0 kg
						30.1 kg
20	Hanger ring type MF	MF2220-10	B14486	7.3 kg	1	7.3 kg
	Coupling link type G	G-22-10	Z101339	3.5 kg	4	14.0 kg
	Chain	KLA-20-10	Z802305	9.4 kg/m	2	18.8 kg
	Safety hook type BKG	BKG-20-10	Z101091	9.6 kg	2	19.2 kg
						59.3 kg

Special lifting chain with suspension chains, quality class 10, weight for 1 metre useful length (specifically for the colouring in Döllnitz)						
Nominal size	**Component**	**Designation**	**Article number**	**Individual weight**	**Quantity per sling**	**Total weight**
16	Single link form B in accordance with EN 1677-4 Manufacturer: Drakena	XDB 26	B14704	1.9 kg	2	3.8 kg
	Chain Manufacturer: Gunnebo	KLA-16-10	Z802304	5.6 kg/m	1	5.6 kg
	Coupling link type G Manufacturer: Gunnebo	G-16-10	Z100825	1.4 kg	2	2.8 kg
	Round sling shackle ExoSet Manufacturer: SpanSet	Load bearing capacity 25 t	ES.MG.2500	14.3 kg	2	28.6 kg
						40.8 kg

For the configuration of the special lifting chain with suspension chains, instead of the round sling shackle ExoSet, the following components can be used for attaching the round sling Magnum X:

Strap connector

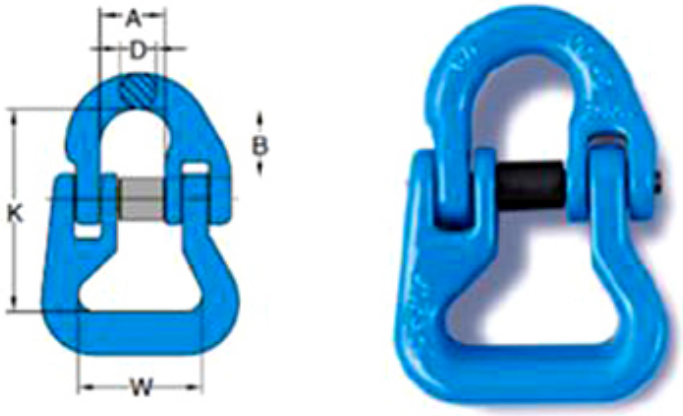


Fig.44: Strap connector type X-016, manufacturer Kettenfabrik Unna

Strap connector								
Article number	**Load bearing capacity**	**Chain diameter**	**Dimensions in mm**					**Weight**
	t	**mm**	**A**	**B**	**D**	**K**	**W**	**kg**
X-016-06	1.4	6	15	17	7	55	38	0.2
X-016-07	2.5	7; 8	18	22	9	62	40	0.3
X-016-10	4.0	10	25	26	11	78	47	0.6
X-016-13	6.7	13	30	35	16	95	53	1.1
X-016-16[3]	10.0	16	36	38	19	115	67	2.0
X-016-20[4]	16.0	20	42	46	22	132	80	3.3
X-016-22	19.0	22	49	59	24	187	125	7.7

3 or round sling Magnum X - 10 tonnes
4 or round sling Magnum X - 20 tonnes

Safety hook with strap connector

Fig.45: Safety hook with strap connector type X-028, manufacturer Kettenfabrik Unna

Safety hook with strap connector type X-028, manufacturer Kettenfabrik Unna								
Article number	**Load bearing capacity**	**Chain diameter**	**Dimensions in mm**					**Weight**
	t	**mm**	**K**	**P**	**W**	**T**	**H**	**kg**
X-028-06	1.4	6	138	29	38	15	19	0.6
X-028-07	2.5	7; 8	169	34	40	20	24	1.0
X-028-10	4.0	10	196	44	47	26	30	1.9
X-028-13	6.7	13	253	52	53	30	39	3.9
X-028-16[3]	10.0	16	305	60	67	36	49	6.9
X-028-20[4]	16.0	20	328	90	80	48	62	11.9
X-028-22	19.0	22	416	80	125	49	63	18.6

The chain components mentioned here offer several combination options with the round sling Magnum X as direct connection. Diverse combinations are also possible under the designated other basic equipment (not shown here) specified in Chapter 1.2.2. All technical safety requirements and specifications also apply unchanged in these combinations.

Notice

Due to the many different products, there are also a high number of different centres of gravity for the transport.

In order to be able to transport the product horizontally, you must vary the lines of the chains in their length for each product.

► The required lengths must be determined accordingly and set using the chain shortener located on the top hanger ring of the chain line.
► These length settings are necessary with all possible use configurations (chain, round sling, Magnum X and special lifting chain with suspension chains)!

The usual operating temperature for chains is between - 40 °C and + 200 °C, without reduction of the load bearing capacity.

The usual operating temperature for round slings made of polyester is between -40 °C and + 100 °C, without reduction of the load bearing capacity.

The load lifting device and slinging equipment must be secured safely to the points intended for this purpose.

The load must engage at the centre of gravity.

The compensation of the overall centre of gravity must be observed when lashing the load with the load handling equipment.

When travelling with the crane, it must be ensured that the load does not swing or make contact.

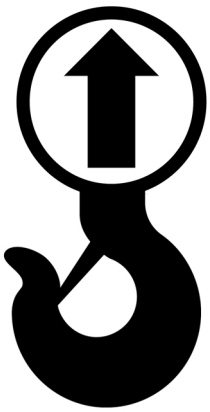
The surroundings of the workplace must always be kept clean and orderly.

The load lifting device and slinging equipment must be stored in a safe manner so that the storage cannot result in new dangers or defects (deformation, cracks, damage to the markings). For this purpose, use the transport and storage locations in all cases!

⚠ Warning

Correct use of load lifting device and slinging equipment!

► Serious dangers may result if used for other purposes or non-observance of the operating instructions!



Do not use any other lifting points than those specially provided for this purpose. The lifting points are marked!

4.3.3 Removable lashing pins

On all frame types (U160, U200, U240, U300 or U400), the same handling procedure must be carried out on the carrying consoles.

Location of the lashing pins

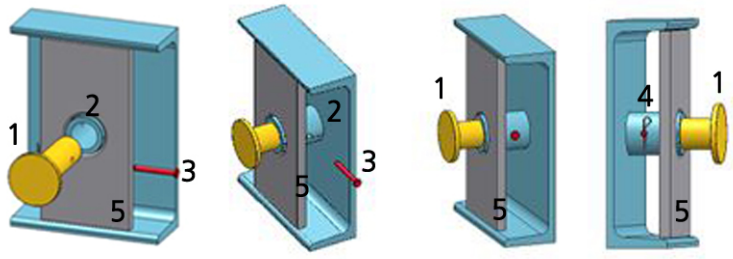


Fig.46: Location of the lashing pins

1	Lashing pin
2	Lashing support
3	Securing pin
4	Cotter pin
5	Carrying console

Installation and removal of the lashing pin

First the lashing supports (2) on the frame for the lashing pins must be checked for soiling and if present, cleaned. For easier assembly of the lashing pins (1), apply a coat of commercially available spray grease to the lashing supports (2). Then push the lashing pin (1) into the lashing support (2).

In doing so, make sure that the borehole in the pin shaft aligns with the axis of the lashing support borehole.

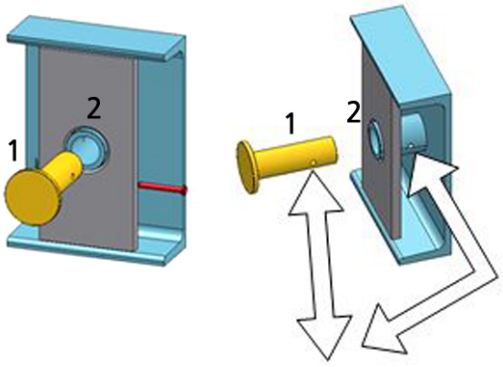


Fig.47: Lashing pin installation

1	Lashing pin
2	Lashing support

Then push the securing pin (3) through the boreholes and secure against slipping out using the cotter pin (4). This procedure must be carried out on the carrying consoles (total of 4 pieces) of the base frame.

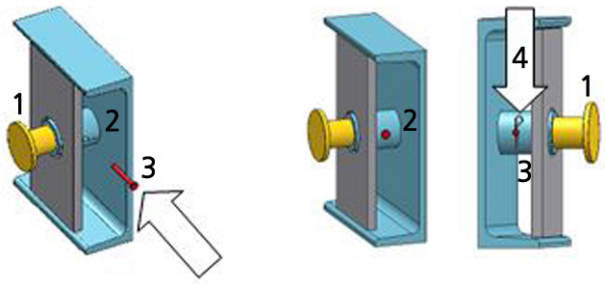


Fig.48: Securing the lashing pin

1	Lashing pin
2	Lashing support
3	Securing pin
4	Cotter pin

Proceed in the reverse order to remove the lashing pins.

The slinging equipment used (chain, round sling or lifting chain with suspension chains according to the description of the individual product components) must move freely!

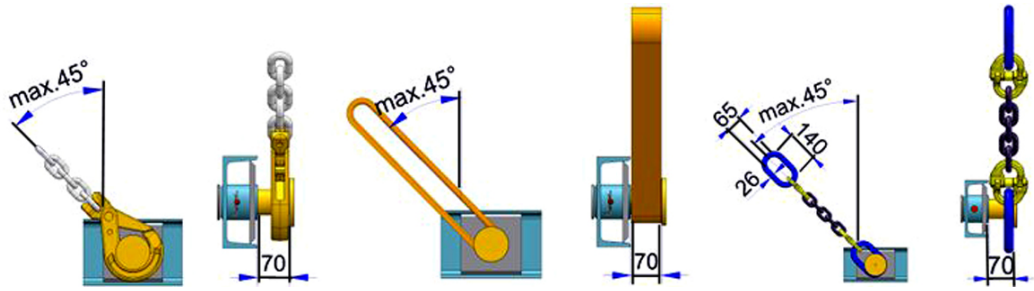


Fig.49: Slinging equipment moving freely

⚠ Caution

When using the lifting chain with suspension chains, observe the assembly order of the lashing pins!

► Before pushing the lashing pins into the lashing support, first the oval ring (XDB 26 from Drakena) of the lifting chain must be pushed onto the lashing pins.

More information about the individual products can be obtained in Chapter 2 of the original transport instructions or the product-specific transport instructions delivered with the product by GEA Refrigeration Germany GmbH.

4.4 Transport (crane transport)

Transport with a forklift truck is not intended!

The product is a high-quality product which must be handled with extreme care during transport. Protect the equipment from impacts and put it down carefully.

When transported by crane, the product must always remain in the same position as during operation (frame downwards). Do not use any other lifting points than those specially provided for this purpose. The lifting points are marked!

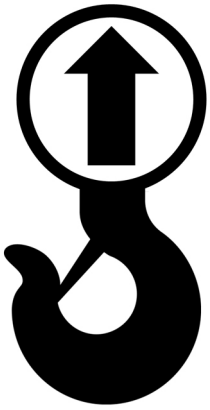


Fig.50: Designation of the lifting points

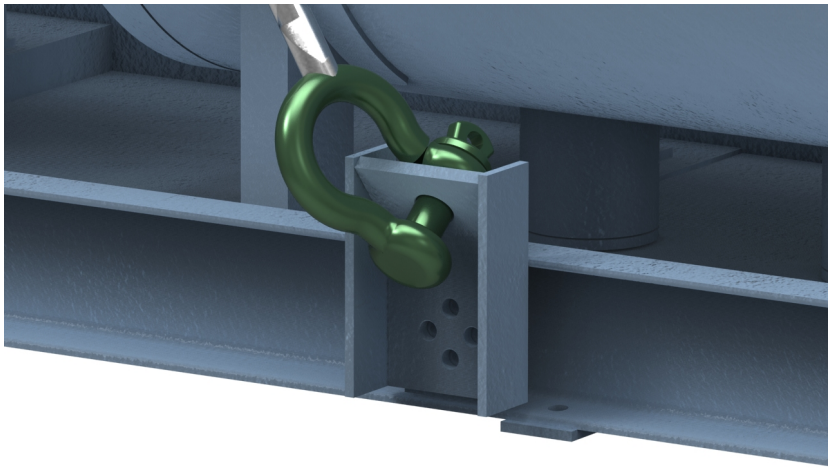


Fig.51: Attachment to the limit point (symbolic image)

⚠ Caution

Avoid damaging the product during transport!

► It is prohibited to strap the product to any fittings or pipes or to the eyebolts/lugs on the compressor, electric motor, vessel or switching cabinet.

Take special care not to attach the ropes to small nominal diameter pipes or insulation and not to cause damage to them. Use spacers if necessary.

The limit points are possibly not arranged on one plane. The ropes must be longer than 3 m. The height differences between individual lifting points must be compensated by suitable extensions.

Make suitable arrangements (timber or underlay made of insulation material) to avoid damage to the surface.

Shackles must be used.

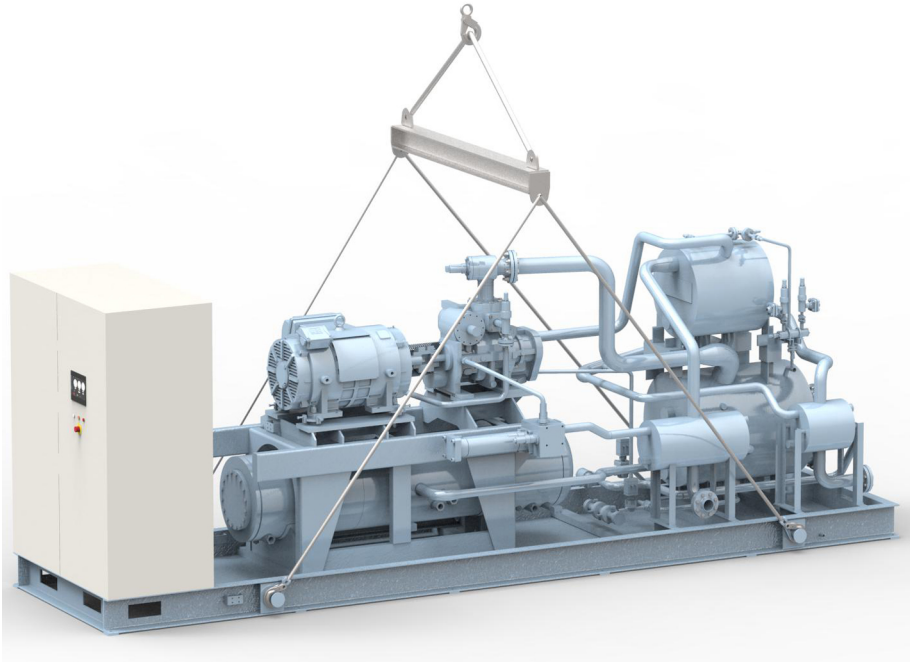


Fig.52: Transport (symbolic image, example product)

Danger

Danger to life when standing beneath a suspended load!

► Make sure there are no persons under the suspended load during crane transport!

Position the product on the transport vehicle so that it is prevented from sliding, tipping over or falling down. Loads shall preferably be secured by lashing to the specified points. The pipes and equipment parts must not be stepped on. Components must be secured against vibrations. The competent staff member or the company is responsible for ensuring transport safety.

Warning

The product must be adequately protected from external influences during transport.

► Transport packaging (optional): plastic wrap

The plastic wrap must not be removed until immediately before erection in the machine room at the intended location for installation. Until this point in time, the plastic wrap serves to protect the product against exposure to the elements.

Notice

As a matter of principle, all regulations and instructions as described in the Transport Instructions for the respective product series of GEA Refrigeration Germany GmbH must be complied with.

The current version always applies. The transport instructions apply to internal transport and transport to the client, including the loading and discharging operations required in transit.

The customer's contribution may be subject to additional and different regulations which are not the responsibility of GEA Refrigeration Germany GmbH.

► GEA Refrigeration Germany GmbH accepts no liability for damage caused by deviation from the transport instructions described, e.g. the use of unauthorised lifting equipment.

4.5 Disposal of packaging material

The generation of waste should be avoided or minimized wherever possible. Surpluses and packaging materials not suitable for recycling should be disposed of through an approved waste disposal company. Packaging materials not suitable for recycling must always be disposed of in accordance with the requirements of environmental protection and waste disposal legislation as well as the requirements of the local authorities.

Packaging materials suitable for recycling should be reused or reprocessed.

4.6 Store up conditions

When the chillers are delivered, check for possible transport damage and report any damage to the manufacturer in writing.

The storage area of chillers shall be roofed, plain and paved and secured against access of unauthorised persons. The chiller is to be protected against knocks and impacts.

Notice

Chiller units must be adequately protected from external influences (humidity, frost, extreme heat) during storage. This usually concerns prolonged standing times out of doors before installation and start-up of the refrigeration plant.

► The manufacturer recommends the use of plastic sheeting to cover the whole product.

► ***For products without sound or weatherproof housing: It is important to cover the ventilation slots of the electric motors!***

Storage temperature: 5 °C ... 40 ℃

The composition of the paint on the chiller is designed for installation in the machine room (indoor installation). Contact with water (including water spray) must be avoided.

Notice

At the time of delivery, the chiller is filled with protective gas.

► Check the protective gas filling once a week and recharge to the specified overpressure of 0.2 bar if required. Dry air (dew point below -40°C) is to be used for this purpose.

Notice

Condensation on the surface of the product must be avoided.

► Regular ventilation of the packaging of the chiller must be ensured!

⚠ Warning

Danger of cuts and crushing injuries.

► Protective equipment must be worn whenever works are carried out on the product.

5 Technical data

5.1 Technical specifications

The products of GEA Refrigeration Germany are designed and produced for special applications. For technical specifications, see the following:

- Technical specifications,
- list of parameters,
- general assembly drawing,
- P+I diagram,
- panel data report.

5.2 Basic terms

Refrigerant	circulating in a plant (liquid or gas), which by means of their change of state of the package withdraw heat from another medium (secondary refrigerant or cooling medium) or can dissipate heat to this medium.
Secondary refrigerant	Fluids that can absorb the heat of a system and dissipate it to a refrigerant (reversible process) and are used for the cooling of a system (industrial process)
Type of cooling medium	Media (liquid or air), which transport and emit the heat absorbed in the cooling agent. If water is used as the cooling medium, the terms warm water or cooling water are also used.
Performance test	Factory acceptance test (FAT „wet“ = Factory Acceptance Test), test run of the chiller under defined conditions (depending on the secondary refrigerant or cooling medium, ambient temperature) at the plant's test bench. Request test bench specification! Alternatively or additionally, a visual inspection is carried out by the customer, possibly with an inspector, along with a review of the documents, which does not necessarily have to take place on the test bench (FAT "dry").
Function test	Function test (EOL “wet“ = end-of-line test), start-up of the heat pump and passing through the entire speed band for which the motor is designed. By default, a final inspection "EOL dry" is performed without the presence of the customer. This includes leakage, pressure, and weld seam testing, as well as software inspection and a system check against the order specification.

5.3 Operating media

5.3.1 Refrigerant

The product is exclusively operated using ammonia as the refrigerant. All components of the product are designed for the use of ammonia as the refrigerant.

Notice

The safety data sheet for the refrigerant used must be observed.

► The safety data sheet is part of the product documentation.

5.3.2 Refrigeration machine oils

Recommended oil types according to the order specification or the technical information "Lubricating Oils for Units, Chillers, and Heat Pumps."

⚠ Caution

To ensure sufficient load-bearing capacity of the plain bearings and to secure the service life of the rolling bearings, a minimum oil viscosity of 7 to 10 cSt before the compressor is required, depending on the application. A suitable oil must be carefully selected in consideration of the operating conditions.

► The selection criteria and selection tables are summarised in the technical information "Lubricating Oils for Units, Chillers, and Heat Pumps." This technical information is part of the product documentation.
► GEA Refrigeration Germany GmbH can provide assistance in the selection of a suitable refrigeration machine oil on request.
► Please contact the manufacturer in case of other types of oil.

5.3.3 Secondary refrigerant

- Water, non corrosive, maximum 150 ppm Cl
- other approved fluids:
  - Ethylene glycol based
  - Propylene glycol based
  - Tempering
  - NH_3 solution
  - Alcohols (e.g. ethanol)

Notice

For all refrigerants, compatibility with the materials used must be ensured under the operating and standstill temperatures that occur.

► Recommendation: Consultation by GEA Refrigeration Germany GmbH in the specific application.

5.3.4 Type of cooling medium

- Water, non corrosive, maximum 150 ppm Cl
- other approved fluids:

- Ethylene glycol based
- Propylene glycol based
- Temper

Notice

Prior to their use, compatibility with the materials used must be ensured for other cooling media.

► Recommendation: Consult with GEA Refrigeration Germany GmbH in specific use cases.

If brines are used as the cooling medium in the condenser, it must also be checked whether the contained inhibitors remain thermally stable at the desired temperatures.

⚠ Caution

Note the water quality

► Since the water quality can vary considerably, we recommend that each user consult a corrosion protection specialist for his particular case.

⚠ Warning

Prevent the boiling of the cooling medium in the condenser!

► The operating pressure of the cooling medium must always be above the respective boiling pressure of the cooling medium which corresponds to the medium temperature. This temperature or pressure is determined by the inlet temperature on the ammonia side of the condenser.

Example	
Parameter	**Value**
Cooling medium water:	Inlet temperature 30 deg. C Outlet temperature 35 deg. C
Screw compressor:	T_c = 37 °C
Inlet temperature of refrigerant gas in the condenser:	95 deg. C
Operating pressure to be complied with on the water side:	1.0 bar abs.

5.4 Materials used in heat exchangers

In order to assess corrosion behaviour of the components that are in contact with the secondary refrigerant or with the cooling medium, the plate material used for the heat exchanger plates is instrumental (standard plate material is AISI 316). Their type is designated in the “Technical Specifications” for the respective order.

5.5 Application limits

The chillers of the series **GEA BluAstrum and GEA BluX** for flooded evaporation can be operated within the specified application limits according to the respective specifications under diverse work conditions. The application limits listed below are based on the operating principle of the screw compressor, thermodynamic relations, containers and safety devices used as well as practical operat-

ing conditions. The appropriate compressor model should be selected for the particular operating conditions.

Application limits				
Parameter		Unit	Value	
Refrigerant				NH_3
Speed	n	min^{-1}	min	1000
			max	4500[5] 5200[6]
suction pressure	p_0	bar (a)	min max	1.9 7.3
Outlet temperature of water as secondary refrigerant	t_{WA}	°C	min max	+ 2.5 + 18
Outlet temperature with frost-resistant secondary refrigerants	t_{WA}	°C	min max	- 15 + 18
Maximum permissible pressure	PS	bar (a)	min max	7.3 22.5
Condenser inlet temperature of cooling medium	t_{Kwe}	°C	min max	12 45
Condensing temperature	t	°C	min max	15 54
Discharge temperature at compressor outlet	t_1	°C	min max	50 100
Pressure ratio p_c/p_0)	π	-	min	> 1.5
Pressure difference (p_c-p_0) [7]	Δp	bar	min	3 [8]

5 GEA BluAstrum
6 GEA BluX
7 The given pressure difference ensures reliable compressor operation. Furthermore, allowance must be made for the pressure difference necessary for the control valves fitted in the refrigerating plant.
8 To comply with the minimum pressure difference, we recommend customer to provide a water-side 3-way valve.

Notes

- When considering a specific application, all the conditions specified in the table must be taken into account and adhered to.
- If the specified limits are exceeded for a specific application, the manufacturer must be consulted.
- In addition to the application limits given in the tables, consider the operating conditions which must be observed for the compressor (e.g. start-up regime, oil pressure, oil quantity, type of oil etc.).
- The oil temperature at the compressor inlet must be least 18 °C.
- The specified data refer to the operating conditions of a cooling or air-conditioning system.

  During downtime or start-up, the limiting values may be exceeded or fallen short of for a short (never long-term) period of time.
- The operating parameters of the order confirmation apply for an agreed performance test.

5.6 Monitoring and display of process values

The following operating parameters are continuously monitored and displayed by the control:	
Designation	**Remark**
Suction pressure	Suction pressure in bar (a) and the corresponding evaporating temperature in °C
Discharge pressure	Discharge pressure in bar (a) and the corresponding condensation temperature in °C
Oil pressure	Oil pressure in bar(a)
Oil diff. pressure	Oil differential pressure in bar
Oil filter pressure [9]	Oil filter pressure in bar (a)
Oil filter diff pressure[9]	Oil filter differential pressure in bar
Suction temperature	Suction temperature in °C
Discharge temperature	Discharge temperature in °C
Oil temperature	Oil temperature in °C
External temperature	Secondary refrigerant - outlet temperature in °C
KT-Inlet temperature[9]	Secondary refrigerant - inlet temperature in °C
PS-Position[9]	Position of the control slide in %
Motor current	Motor current in A
Motor speed	Motor speed in rpm
Cooling medium inlet temperature [9]	Cooling medium inlet temperature into the condenser in °C
Cooling medium outlet temperature[9]	Cooling medium outlet temperature from the condenser in °C
Operating hours	Running hours
Slide to minimum	Slide to minimum time in sec, remaining time for control slide for reaching the minimum position
Auto start delay[9]	Remaining time for auto start delay in sec.
Auto stop delay	Remaining time (auto) for auto stop delay in sec.
Start to start	Start to start, remaining time between two starts of the compressor in sec.
Compulsory break	Compulsory break timer, remaining time in sec.
Ambient air temperature [9]	External temperature in °C

9 optionally available

5.7 Water quality requirements, parameters

All water bearing components of the manufacturer provide optimum performance and maximum protection from corrosion, if all recommended limiting values of VDI 3803 issue 2010-02 (Tab. B3) for non-corrosive water and adequate water conditioning are met.

Notice

If the limits specified in VDI 3803 are not adhered to, the manufacturer cannot provide any warranty regarding the water-conducting parts of the delivered components.

► All components are designed for use with non-corrosive water. Water and glycol brine analysis is essential in protecting system components. Analyses prior to start up will prevent corrosion.

Following are shown required limiting values of VDI 3803, for use of carbon steel components in non corrosive water systems.

Water quality requirements, parameters			
Parameter		**Value**	**Unit**
Appearance		clear, without sediment	
Colour		colourless	
Odour		none	
pH-value at 20 °C		7.5 - 9.0	
Electrical conductivity	LF	< 220	mS/m
Soil alkali	Ca^{2+}, Mg^{2+}	< 0.5	mol/m³
General hardness, for stabilization	GH	< 20	°d
Carbonate hardness without hardness stabilizer	KH	< 4	°d
Chloride (see also following information)	Cl	< 150	g/m³
Sulphur	SO_4	< 325	g/m³
Active biological components	KBE	< 10,000	per ml
Thickness factor	EZ	2 - 4	

The use of carbon steel and cast iron required in the most of applications water conditioning with corrosion inhibitors.

The use of stainless steel requires very special monitoring of water in apply to Chloride contents (risk of stress crack and pitting corrosion).

Notice

Recommend for use of plate heat exchangers

► < 100 ppm Cl for the use of 1.4301 (AISI 304) and maximum 40 °C wall temperature in the plate heat exchanger

► < 200 ppm Cl for the use of 1.4401 (AISI 316) and maximum 100 °C wall temperature in the plate heat exchanger

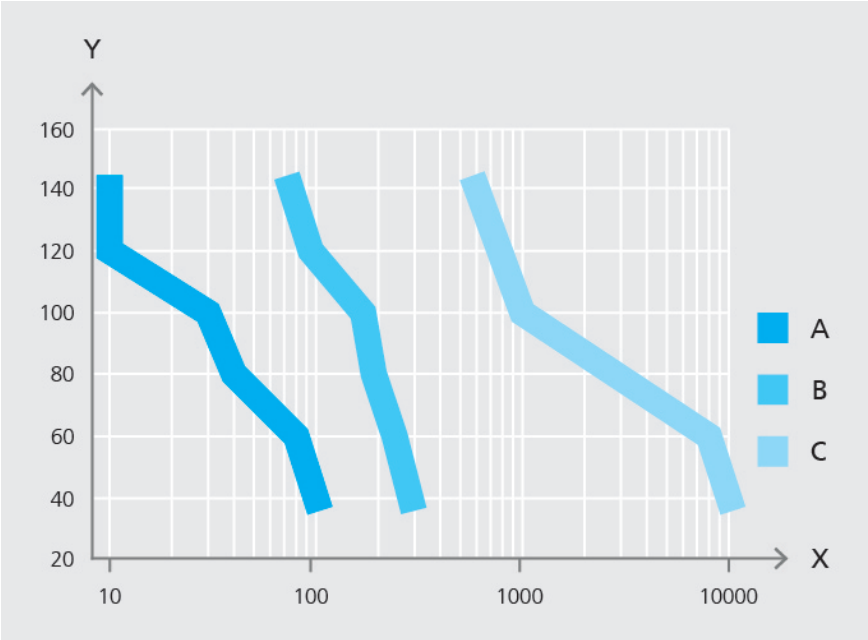


Fig.53: Corrosion resistance in presence of chlorides

X	Chloride ion concentration ppm Cl^-
Y	Wall temperature heat exchanger in °C
A	AISI 304
B	AISI 316
C	SMO 254

Notice

Manufacturer recommendation: Use uncontaminated cooling agents and cooling media, in particular in chillers / heat pumps and the use of plate heat exchangers.

► The media quality needs to be assured through an appropriate filter on the inlet to the heat exchanger. The mesh for these kinds of filters needs to be ≤ 0.9 mm!

► Should the system need to remain in operation during filter cleaning, double filters need to be used. Pressure loss through the filter need to be taken into consideration on the building side when configuring the pump.

The manufacturer will inform you on request about qualified specialist companies that can support you in the water analysis and the derived measures.

5.8 Information on noise emissions

The noise information provides approximate parameters and applies to the installation without any secondary noise protection measures.

The information has a tolerance of ±3 dB(A).

The precise data depend closely on the emission values for the motors, which are manufacturer dependent.

Should the local conditions require adherence to noise limits, a calculation should be made in individual cases with specific motor data.

For any person spending extended time in rooms with running chillers, the wearing of personal ear protection with sufficient sound insulation is recommended.

⚠ Caution

According to EU Directive 2003/10/EC, the permitted exposure threshold regarding the level of daily noise exposure is 80 dB(A).

► Should noise levels rise above this threshold, the system operator must provide the operator with information on exposure to noise and personal hearing protection and ensure that this is also worn (2003/10/EC Article 6).

Measuring-surface sound-pressure level Lp (A) @ 1 m (without soundproof housing)							
Motor size at 40 °C Pe in kW	**Lp in dB(A) @1 m mains operation 400 V/ 50 Hz [10] Chiller Type GEA BluAstrum ...**						
	400	**500**	**800**	**900**	**1000**	**1500**	**1800**
110	82	-	-	-	-	-	-
132	83	-	-	-	-	-	-
160	-	83	83	-	-	-	-
200	-	-	84	84	84	-	-
250	-	-	86	86	86	-	-
315	-	-	-	88	88	89	-
355	-	-	-	-	90	91	92
400	-	-	-	-	-	92	93
500	-	-	-	-	-	-	96

Notice

The values in the table are verified by actual measurement. If no values are specified, these are not yet available or not applicable for the chiller size.

► Noise emissions from external condensers are not taken into account.

► Reduce the measuring-surface sound-pressure level (1m) by 4 dB(A) for BluAstrum with sound insulation housing.

10 at a distance of 1 m from the machine surface (A-close range sound level at open air conditions on reflecting surface)

6 Assembly and installation

6.1 Personnel qualification and training

Personnel working on and with the product must have the respective qualification. The area of responsibility, competence and the monitoring of the personnel must be regulated precisely by the operator. If personnel do not have the necessary knowledge, this must be trained or instructed. If required, this may be carried out by the manufacturer/supplier on behalf of the operator of the product. Moreover, the operator must ensure that the content of the operating manual has been fully understood by the personnel.

6.2 Safety Instructions

6.2.1 Electrical connection

⚠ Danger

Contact with live components is prohibited.

► Produce the earth connection according to the designation in the general assembly drawing. See chapter "Designation of the earth connection".

Before starting work, make sure that all parts to be connected are de-energised, e.g. by removing the main fuse in all phases or installing a jumper wire.

The insulation resistance of the electrical tools and fixtures and wiring is to be checked. The connection may only be undertaken if this value lies in the permissible range.

All electrical connections must be established and all electrical consumers/ sensors must be connected according to the circuit diagram.

6.3 Requirement and information on installation

⚠ Caution

During installation make sure that leaking operating materials do not reach the soil, groundwater or surface water.

► Follow the legal regulations applicable at the site of installation (e.g. for Germany, Water Management Act, WHG).

All foundation calculations, the selection of materials and the soil analysis are the responsibility of the project engineer or the owner.

Prior to installation, a plan must be created for proper and professional installation. Electrical connections and connections for operating media must be made. In addition to the installation surface of the product, it must be ensured that sufficient space is available during maintenance work on the pipes as well as for operation.

Install the chiller on a level surface. The difference from the horizontal must not be more than 0.3 %. Provide enough space for maintenance work.

The ventilation opening on the noise protection cabinet (if available) may not be moved!

Due to its own weight, the product stands securely on the installation surface. Ribbed rubber plates are provided between the installation surface and frame or machine base frame of the product for cushioning. In the version without sound-proof housing, level mount elements are provided for damping (optional scope of supply).

If greater cushioning is required (installation on a floor ceiling or on the roof), vibration dampers must be provided. In this case, the suitable type of vibration damper must be determined and realised. The pipes for the secondary refrigerant must be decoupled using expansion joints where vibration dampers are used.

After welding work done by the customer or owner on pipe line connections and flanges, the welding seams must be inspected in accordance with the Pressure Equipment Directive.

6.4 Preparing for assembly

6.4.1 Information regarding installation in the machine room

The chiller has to be installed in the closed machine room and on a level surface. Provide enough space for maintenance work.

Unless other order-related limitations have to be taken into account, the permissible ambient temperature in operation is +5 °C to +40 °C.

Notice

The relevant regulations must be observed when designing the machine room and the safety equipment.

► see EN 378-1, EN 378-2, and EN 378-3

Special features for installation with noise insulation housing (option).

The soundproof housing functions as a design cover to reduce noise.

The sound insulation housing is not a machine room as defined in DIN EN 378-3, but merely serves to reduce noise and as protection against contact.

The ventilation of the motor is carried out both on the intake and outlet glands in the side walls and via the roof of the soundproof housing.

Notice

The intake and outlet glands may not be moved!

► Minimum free space above upper edge of the soundproof housing roof: 300 mm

Access to the components of the chiller during maintenance work shall be provided through the completely removable side walls.

Notice

The side walls of the soundproof housing may only be removed when the product is shut down!

► Dist. for removal side wall: 1 m

6.4.2 Rigid installation

The frame of the product is placed on foundation bolts on a prepared foundation. The frame must be levelled with suitable shims such that the coarse alignment (radial and angular misalignment ≤ 0.25 mm) at the coupling is attained again. Then tighten the foundation bolts.

6.4.3 Anti-vibration mounting

The frame of the product shall be aligned with the levelling bolts until the coarse alignment (radial and angular misalignment ≤ 0.25 mm) at the coupling is attained again.

Before tightening the mounting screws of the isolators, check that the isolators are free over the spring (predominantly made of rubber) and not lie on the foundation.

6.4.4 Outdoor installation, weather protection

If the product is intended for outdoor installation, it must be provided with a suitable housing for sound insulation and weather protection by the customer. The weather protection must provide the product with adequate protection against the climatic conditions at the installation location.

Notice

The product is not intended for unprotected outdoor installation.

► Protection against external influences, especially dirt, dust and moisture (wetness), is essential.

The manufacturer will not accept liability for damage due to incorrect outdoor installation.

7 Start-up

7.1 Special personnel qualification

⚠ Warning

The start-up of the product must be only be carried out by technical personnel who are familiar with the contents of the operating manual for the product.

► The safety regulations for refrigeration plants must always be observed to prevent damage to the product and injury to the operating staff.

Technical personnel are representatives of the product manufacturer and persons who, as a result of their technical training, experience and personal instruction in training measures, have sufficient knowledge of:

- applicable international and national standards,
- applicable occupational safety regulations,
- applicable accident prevention regulations,
- applicable environmental protection regulations,
- the construction and functioning of the product,
- recognised technical regulations for safe work according to good professional practice.

The **technical personnel** must:

- be familiar with all legal regulations in Section 2.6, Page 21 and be able to act according to them in a conscious manner,
- be able to assess the work assigned to them,
- be able to recognise dangers and avoid them,
- be authorised by those responsible for the safety of the system to carry out the requisite work and activities.

7.2 Important information for start-up

⚠ Warning

Contact with live components is prohibited.

► Produce the earth connection according to the designation in the general assembly drawing. See chapter "Designation of the earth connection".

Notice

The customer service department provides comprehensive support for the start-up of the product.

► For contact details, see chapter "Technical customer service".

The following points must be observed before commencing with the start-up:

- Check of the external condition of the product (check of insulation, transport damage, protective gas filling,...).
- Check that all electrical work has been carried out in accordance with the standards (e.g. protective earth, insulation, shielding, covers). If necessary, an earthing connection must be provided.
- The area around the product in which the start-up is carried out must be marked and secured against the access of unauthorised persons. Sufficient lighting of the working area must be ensured to prevent personal injury and material damage.
- Operating and functional capability of the machine room equipment (suction and ventilation).
- Personal protection gear (work clothing, work boots, gloves) must be worn during all work on the system. There is a danger of impacts and tripping against protruding parts (e.g. valve caps). There is also a danger of cut wounds on sharp edges and rough surfaces. All activities must, therefore, be carried out with particular attention.
- Suitable hearing protection must be worn in order to protect against damage to hearing or deafness.
- Thermal hazards resulting in injury due to burns or freezing may occur on contact with parts of the system which are at a very high or very low temperature. Personal protective equipment must be worn.
- Suitable tools or special tools must be used.
- The direction of rotation of the drive motor must be checked.
  - Before start-up, i. e. before you connect the voltage supply, check that the coupling between the drive motor and compressor is disconnected. Otherwise, the coupling intermediate piece must be removed in accordance with the assembly instructions.

    Both coupling hubs must be push back so that they cannot inadvertently mesh during the rotation direction test. Check tight seating of the coupling hubs on the shaft ends.
  - It is essential to ensure that the compressor drive motor cannot be started inadvertently.
  - The required direction of rotation must be controlled in correspondence with the rotational arrow at the compressor or the specifications in the compressor documentation.
  - In “Manual” operation mode, the compressor drive motor is started completely and is then switched off.
  - Change the direction of rotation of the motor if this is not correct!
  - The electrical switchgear must then be secured again to prevent it from being switched on inadvertently. Mount the coupling while following the instructions of the separate documentation.

Danger

Start-up must not be carried out unless the coupling protection is fitted.

► Solid mounting of the coupling protection must be checked.

- Pipes and pipe sections must be secured to ensure sufficient mechanical strength. The pipes and equipment parts of the product must not be stepped on.
- Operating media (nitrogen, oil, refrigerant) can escape. Preventive measures must be taken to collect and dispose of them in an environmentally responsible manner (e. g. using an oil pan). Personal breathing protection must be kept ready in the event of a refrigerant leak. The safety data sheets of the oil and refrigerant used must be read prior to commencing start-up work. Familiarise yourself with the evacuation plan of the installation location.

Notice

Check the protective gas filling (a positive pressure ≥ 0.2 bar must be present)

► If defects are found, notify Service and proceed according to their instructions.

► See chapter "Customer Service".

7.3 Basic settings

Notice

The Customer Service department of GEA Refrigeration Germany GmbH offers comprehensive support for the start-up of the product.

► For contact details, see chapter "Technical customer service".

The products are tested and accepted at the factory. By the time these products are delivered to the customer, the following work will have been carried out:

- Complete installation of the cooling system and in particular:
  - Cleaning and drying of the refrigerant and oil circuit,
  - Leak test with air,
  - Evacuation of the refrigerant circuit and filling with protective gas to a pressure of 0.3 to 0.5 bar (above atmospheric pressure),
- Electrical wiring and testing,
- Factory setting of the setting values on the control cabinet,
- Factory setting of the safety and monitoring devices,
- Works trial runs (at the request of the customer).

7.4 Basic and further steps

The compressor must only be switched on when the complete product has been correctly connected and charged with operating materials.

The activities described in this chapter "Start-up" must be carried out in the prescribed sequence.

The product is operated via the control panel (Touch Panel) of the control.

After the setpoints have been entered, both automatic and manual operation are possible.

The software of the controller and operation via the terminal are described separately in the operating manual for the control system.

7.4.1 Connecting the product

⚠ Caution

All mechanical connections must be made according to the P+I diagram which is valid for the project.

► The P+I diagram is part of the product documentation.

⚠ Caution

All electrical connections must be made according to the circuit diagram which is valid for the project.

► The circuit diagram is part of the product documentation.

Check that components which have been removed for transport, separately supplied components and components provided by the client are firmly attached.

Check that all locating screws are tight.

7.4.1.1 Connecting the pipes

The protective gas filling of the product must be purged by opening the vent valves on the suction side before the connection of the pipes.

⚠ Caution

Take special care with products that have been subjected to a factory acceptance test (FAT).

► There are always small residual amounts of NH in these products$_3$ and oil.

► Products posing a corresponding hazard are identified with a yellow sign indicating: Warning inert gas filling on refrigerant side: N_2 0.5 bar(ü) with residual ammoniac + oil (test run).

► These products can also be filled with the operating oil quantity, depending on the customer agreement. (Labelled in an appropriate location, e.g., on the oil filter or oil cooler, with the corresponding oil type.)

All pipe connections must be made in such manner that the transmission of thermal expansion and vibration to the chiller is limited as far as possible.

Bellows-type expansion joints made of steel, or flexible metal hoses can be used for refrigerant and oil lines, bellows-type expansion joints made from rubber can be used for water connections.

Provide all pipe connections with fixed points arranged immediately at the product.

- Connection of:
  - Secondary refrigerant
  - Cooling medium (if installed)
  - Ammoniac lines (design variant remote condenser)
  - Safety valves to blow-off line
- For products with TÜV approval: Shut off safety valve on the blow-off line.

⚠ Caution

The product requires a constant flow of cooling agent and heating agent for smooth functioning.

► Volume flow changes must be mentioned in the contract specification.

Notice

All the connections must be made in accordance with the P+I diagram applying to the respective project.

► Attach the pipes to the product in such a way that it does not impose any additional static or dynamic loads.

► All the pipes and systems to be connected must be checked for leaks when the work is complete.

7.4.1.2 Water pipes

The chiller is mounted on vibration isolators which means that the connections of the water piping must be flexible.

Charging and draining must be possible.

Notice

Check the water quality.

► See chapter "Water quality requirements, parameters".

The pipes must be flushed before connecting. This is carried out to remove soiling, foreign particles and welding residue from the system.

- **Cooling agent system**

  After the chiller has been aligned, its cooling agent side can be connected up. The piping system for the cooling agent connections must be installed on site by the plant engineer. Please refer to the drawing in the supply documentation for the dimensions and position of the water connections to the evaporator.

  The evaporator must be connected to a closed cooling agent circuit on the pressure side of the pump.

  Arrange a dirt collector immediately upstream of the evaporator (recommended mesh size 0.9 mm).

  The volume flow of cooling agent should be kept at a constant level.

The temperature sensors item 2040 and item 2045, which are used to measure the inlet temperature of the cooling agent are supplied separately along with the welded sleeve and must be installed – like the flow monitor item 2050 – in the pipe system by the system erector.

The flow switch can only be installed in a horizontal pipe, or a vertical pipe with a flow running in an upward direction. The flow switch must be installed in a distance of 5 to 10 times of pipe diameter behind the previously flowed curve or valve. The outlet run must equal 3 to 5 times the pipe diameter.

If an electronic flow sensor is installed in a horizontal pipe, this must be carried out laterally. In the case of installation from above, the pipe to be monitored must be completely filled. In the case of installation from below, contaminant deposits will falsify the measurement.

Follow the manufacturer's installation instructions when installing the flow monitor.

Between the cooling agent outlet from the evaporator and the thermal sensor item 2040, at least 2 m of pipe should be provided and two 90-degree directional changes by pipe elbows or fittings. If the thermal sensor item 2040 is installed directly downstream of the flow switch item 2050, a distance of 5 to 10 times the pipe diameter must also be kept here.

The cabling of the temperature sensor and flow monitor must be carried out with an additional cable length of 6 m measured from the outlet point of the chiller.

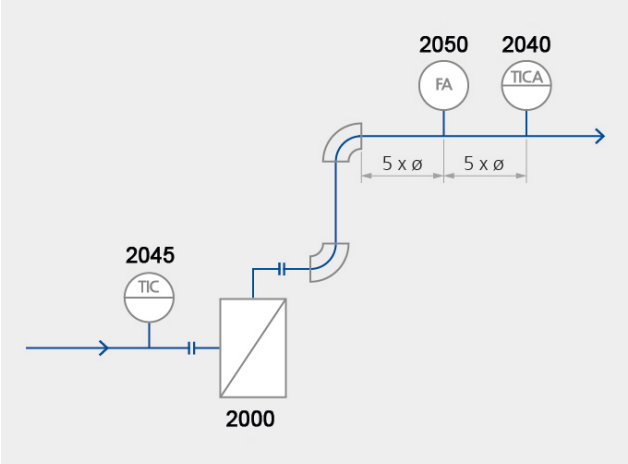


Fig.54: Cooling agent system

2000	Evaporator/liquid separator
2040	Resistance thermometer - cooling agent outlet temperature
2045	Resistance thermometer - cooling agent inlet temperature
2050	Flow switch

- **Cooling medium system**

  The size and position of the water connections for the condenser are indicated in the drawing contained in the order documentation.

  Install the condenser on the pressure side of the pump.

  Arrange a dirt trap immediately upstream of the condenser (recommended mesh size 0.9 mm).

Analogue to the secondary refrigerant system, temperature controllers are used to measure the cooling medium inlet temperature (item 2145) or cooling medium outlet temperature (item 2140). The temperature controller including the welded sleeve are delivered separately and the installer will install them in the pipe system.

Check the water quality.

- **Water treatment**

  Industrial water usually contains dissolved or solid matter that causes corrosion or dirt layers to develop or encourages the growth of algae. The water for the condenser and evaporator circuits should be treated chemically to minimise such undesirable effects. In order to avoid increased maintenance costs due to additional expenditure for the removal of dirt layers or the replacement of corroded components, a specialist water treatment company should be used.

7.4.1.3 Electrical connection

⚠ Danger

Contact with live components is prohibited.

► Produce the earth connection according to the designation in the general assembly drawing. See chapter "Designation of the earth connection".

The chiller has been designed for plug-in and reliable automatic operation.

All connections must be carried out according to the current installation regulations.

Connections to the chiller must be flexible and free of loads.

Dimensioning of the inlet pipe cross-sections must be according to DIN VDE 100 Part 520.

Before starting work, make sure that all parts to be connected are de-energised, e.g. by removing the main fuse in all phases or installing a jumper wire. The insulation resistance of the electrical tools and fixtures and wiring is to be checked. The connection may only be undertaken if this value lies in the permissible range.

Connections and almost all external connections are pre-wired at the factory.

The electrical consumers and sensor must be connected according to the circuit diagram. All electrical connections must be made according to the circuit diagram, e.g.

- Compressor drive motor
- Compressor control supply
- Oil heater

Notice

Only loosely supplied parts must be installed (sensors for secondary refrigerant and optionally for cooling media, level sensor R-phrases).

► The connection of electrical drives/fittings provided by the customer is the customer’s responsibility.

Some external components, such as the second EMERGENCY STOP switch, the ammonia sensor and the fans of the machine room, must be connected by the system erector on site.

Check that terminal screws (in the switching cabinet) are tight.

7.4.2 Paint and insulation

Damage to the paint and insulation during transport and installation must be carefully repaired.

Painting

Coating system S 2.15 acc. to EN ISO 12944-5 for environmental conditions C2 acc. to EN ISO 12944-2.

Designed for room temperatures of 5 °C up to 40 °C.

Colour of chiller: RAL 5014 pigeon blue

Colour of control cabinet: RAL 7035

Colour of soundproof housing (optional): RAL 7035 light grey

Insulation

Standard insulation with soundproof housing for suction line and evaporator in 19 mm Armaflex.

Standard insulation without soundproof housing for cold system components in PUR/Alu.

The insulation is basically designed for an ambient temperature of 20 °C and a humidity of 70%.

7.5 First start - Start-up procedure

The following procedures should be completed in the sequence in which they are described:

7.5.1 Checking the electrical connection

⚠ Danger

Contact with live components is prohibited.

► Produce the earth connection according to the designation in the general assembly drawing. See chapter "Designation of the earth connection".

Check that all electrical work has been carried out in accordance with the standards (e.g. protective earth, insulation, shielding, covers).

7.5.2 Leak test

⚠ Warning

Hazard due to ammonia!

► For plants with FAT, please observe the chapter "Measures during downtimes"!

The maximum permissible pressure (if relevant, low and high pressure) is stated on the nameplate.

The necessary safety precautions should be taken before performing the leak test. In particular, steps must be taken to ensure that the area can only be accessed by trained personnel and that the pressure increases are carried out from a safe position.

The systems passed a leak test that was performed after production, as confirmed in the documentation. It is particularly important to test for leaks at those points of the products that were disconnected for transportation and reassembled on site. If system parts are insulated, they need to be tested separately.

The leak test is performed by means of a suitable method and may also be conducted at pressure levels below the allowed permissible pressure. Suitable test methods are described e.g. in the EN 1779. Requirements pertaining to leak-free integrity are defined in the EN 378.

It is beneficial to split the test into several independent pressure sections by closing the shut-off valves to raise the sensitivity of the leak detection method. To this end, the valve settings must be configured for the pressure test so that only those pressure sections that need to be examined are connected to one another.

There are examples of leak detection methods outlined below. The product is placed under positive pressure with dry air or nitrogen in the test. The test is performed up to 1 bar under the maximum permissible pressure of the product section of the entire product with the lowest permissible operating pressure (example: high pressure side 40 bar(g), low pressure side 23 bar(g) --> test pressure 22 bar(g)). If there are any leaks, gas will escape through these points and can be detected. Lower test pressure levels are allowed in accordance with EN 378, if the required detection limit is observed.

Possible testing methods:

The products have a modular design and comprise the following main modules:

- Indicative test (with foaming agents)

  The pressure is increased in several stages (e.g. 5 bar) until the test pressure stated above is reached. During pressurization in particular, steps must be taken to ensure that there is no risk to any persons in the event that the construction fails. The points that need to be examined are tested with a leak-indication method at each pressure level. A foaming agent (e.g. a leak detection spray) can be used to identify any leaks. Identified leaks must be remedied.

  If no leaks are detected at the final test pressure, perform the pressure loss test

- Pressure loss test

  The test is conducted at the test pressure stated above. During pressurization, steps must be taken to ensure that there is no risk to any persons in the event that the construction fails. If there are any leaks, the pressure in the system will decrease over time. This pressure loss is measured and is used to state the product leakage rate. Manometers of a precision class and with a display accuracy that are suitable for the measuring task must be used for the measurement process (e.g. at a test pressure of 22 bar Manometer 0 … 25 bar(g) with a precision of 0.5 % and a display resolution of 0.01 bar).

Temperature changes during the test have a considerable impact. A record of the leak test including hourly recordings of the pressure and temperature must be drawn up.

Any remaining temperature changes must be compensated using the formula below.

$p_1 = p_2\ T_1 / T_2$

p_1 = Test pressure at the start of the measurement process.

p_2 = Test pressure at the end of the measurement process.

T_1 = Ambient temperature at the start of the measurement process.

T_2 = Ambient temperature at the end of the measurement process.

If the test is failed, indication methods are used to search for leaks.

⚠ Caution

Do not damage the gasket in the valve insert!

► To prevent damage to the gasket in the valve insert, the plant must be vented on the low pressure side after the pressure test or the valve must be completely open during the pressure test and venting.

► Where the control is in working order (GEA Omni), the valve can be opened via the service menu.

7.5.3 Drying, vacuum

After the pressure test has been completed, the system must be evacuated and undergo a vacuum test for 3 hours. Evacuation is used to remove air and moisture from the installation.

A vacuum pump must be used for evacuation.

The permissible increase in pressure is 6.66 torr over a period of 3 hours.

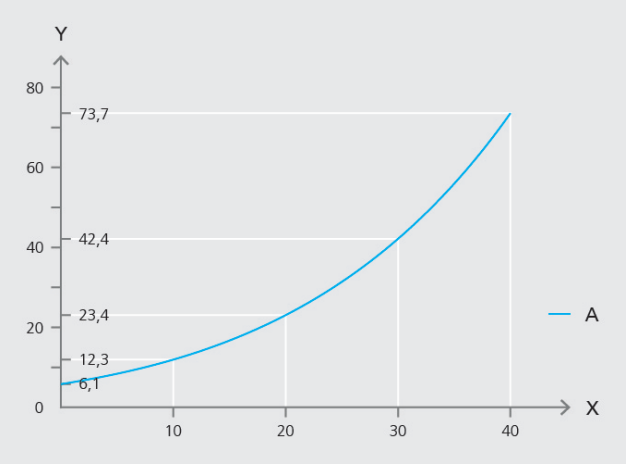


Fig.55: Vacuum required to remove moisture from refrigerating plants

X	Room or Wall temperature in °C
Y	Vacuum in mbar
A	Vacuum required to remove moisture from refrigerating plants

Measured values have to be checked and recorded hourly after reaching the required vacuum. After the vacuum pressure, the temperatures in the machine house and the outdoor temperature in shade must be entered in the log. After the vacuum test, the pressure compensation must be carried out with NH_3.

The existing vacuum can be used to draw in the oil (if not already filled).

⚠ Warning

If present, block when evacuating the oil pump!

► See also Section "Evacuation on refrigerant side" in Chapter "Maintenance".

7.5.4 Operating position of valves

For the positions of the manually controllable fittings for the operation of the product, see P&I diagram.

The layout and symbols used in the P+I diagram comply with the specifications of EN 1861, July 1998 Issue.

⚠ Caution

Enable smooth operation of the product!

► The valves must be in the operating position prior to the start-up of the product.

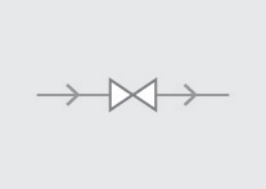


Fig.56: Stop valve open

Stop valve ***open*** during normal operation

Fig.57: Stop valve closed

Stop valve ***closed*** during normal operation

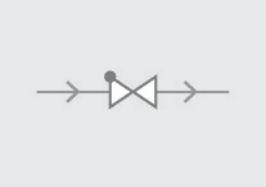


Fig.58: Check valve

Check valve during normal operation

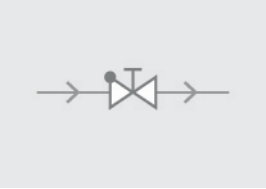


Fig.59: Combined stop/check valve

Combined stop/check valve ***open*** during normal operation

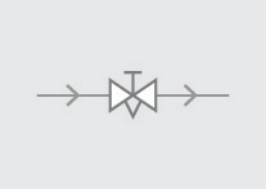


Fig.60: Control valve

Control valve***adjusted*** during:

- Start-up
- when operating conditions change

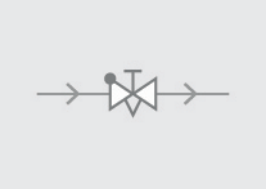


Fig.61: Combined stop/check valve with integrated control function

Combined stop/check valve with control function ***open*** during normal operation

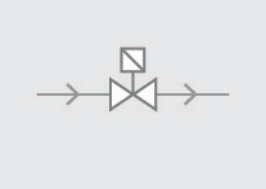


Fig.62: Solenoid valve

Controlled by the control (e.g. GEA Omni)

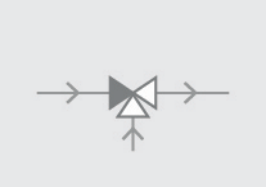


Fig.63: Change-over valve

Change-over valve (3-way valve), opened from below in arrow direction

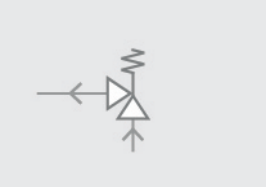


Fig.64: Oil pressure regulating valve

Operating position: **adjusted**
Δp x,x ± x bar control pressure to be set vis-à-vis reference pressure (see P+I diagram)

⚠ Caution

Oil pressure which is set too high or too low may result in serious compressor damage or even total breakdown of the compressor after even a short period of operation!

► See chapter "Adjustment of oil pressure"

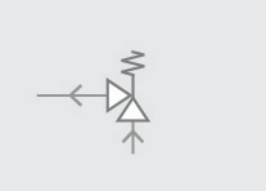


Fig.65: Overflow valve, safety valve

Overflow valve, safety valve

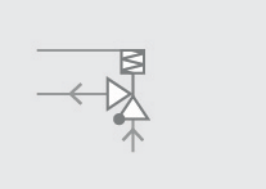


Fig.66: Pressure controlled check valve

controlled self-sufficient

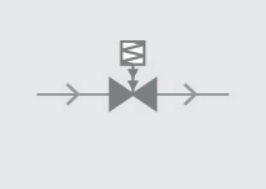


Fig.67: Quick acting valve, spring-loaded

manually operated if necessary

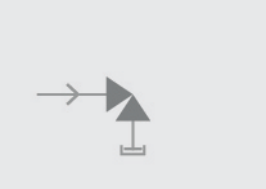


Fig.68: Charging valve, drain valve

- ½” connections
- with cap

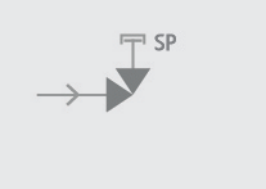


Fig.69: Service valve

- Connection Rp ¼”
- For pressure gauge and pressure transmitter

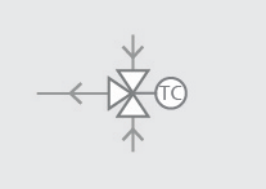


Fig.70: Thermostatic 3-way valve

controlled autonomously using control element

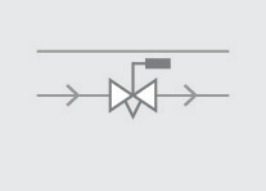


Fig.71: Temperature controlled control valve

Autonomous control via sensor

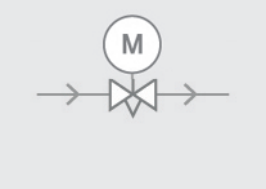


Fig.72: Motor-driven control valve

Control by signals from temperature, pressure or other sensors, or control by mass flow or level control
(e.g. for use as expansion valve)

7.5.5 Oil filling

⚠ Caution

Check the oil grade to be filled!

► See contract/project or recommendation of GEA Refrigeration Germany GmbH.

The vacuum present in the chiller before pressure compensation may be utilised for charging the package with oil. A separate oil pump is required after the pressure compensation and for refilling with oil.

Before filling with oil, move all valves to the operating position.

Initial filling

The connection of the service valve (90) must be connected with the oil charging container.

Close stop valve (65).

Open the service valve (90) until the oil level has reached the top third of the sight glass assembly in the oil separator.

Then move the stop valve (65) back into the operating position and close service valve (90).

Note: in operation, the normal oil level must only come up to the lower third of the sight glass.

Topping up with oil

The connection of the service valve (275) can be additionally used for topping up with oil. See the section initial filling for the oil levels to be filled.

⚠ Caution

Due to the use of selected components, the refrigerator oils tend to absorb more moisture.

► Therefore, when charging a chiller, the oil should be allowed to come into contact with air for a short time only. The contents of an opened drum have to be used up within one working day, provided the drum is properly closed between charging.

7.5.5.1 Pressure equalisation with the cooling system

Re-establish vacuum. Carry out pressure equalisation via the shut-off valve Service (285).

After filling with oil, a vacuum must be drawn again on the sealed part of the product (oil separator, compressor, oil cooler, oil filter) to ensure that no air has entered the system during filling. Only then should the pressure be equalised.

7.5.6 Checking the fault monitoring

1. Disconnect the incoming feeder of the compressor driving motor from the mains supply for checking the safety devices (e.g. remove LV/HBC fuse links).
2. Apply voltage to the control.
3. Check limit values.

   Limit value = see parameter list
4. Set the motor current limitation acc. to nominal motor data. See parameter list!

7.5.7 Checking the direction of rotation of the drive motor

⚠ Warning

Avoid damaging the motor and compressor when checking the direction of rotation of the drive motor!

► The coupling may not yet connect the motor and compressor when checking the direction of rotation of the drive motor.

- Secure the electric switchgear so as to prevent the compressor drive motor from being switched on accidentally.
- For chillers of the GEA BluAstrum 1800 frame size:

  With the control slide in the MIN or MAX position, it should be possible to rotate the compressor shaft easily and smoothly by hand.
- When checking the direction of rotation of the compressor drive motor pay attention to the conditions for switching the compressor on.

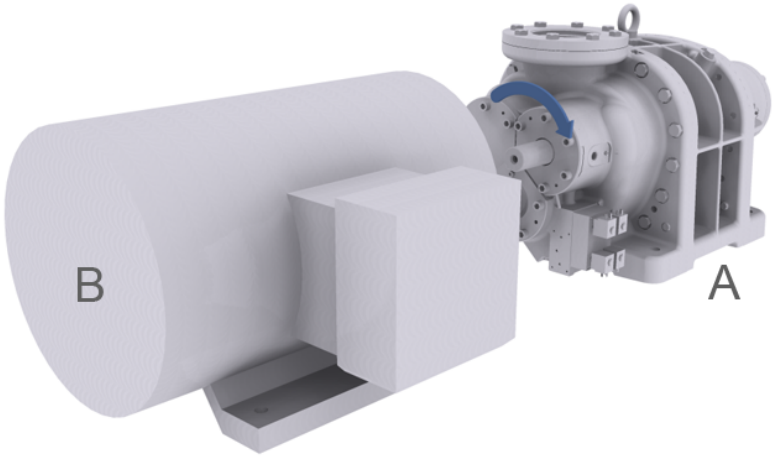


Fig.73: Motor direction of rotation (schematic representation GEA BluAstrum 1800)

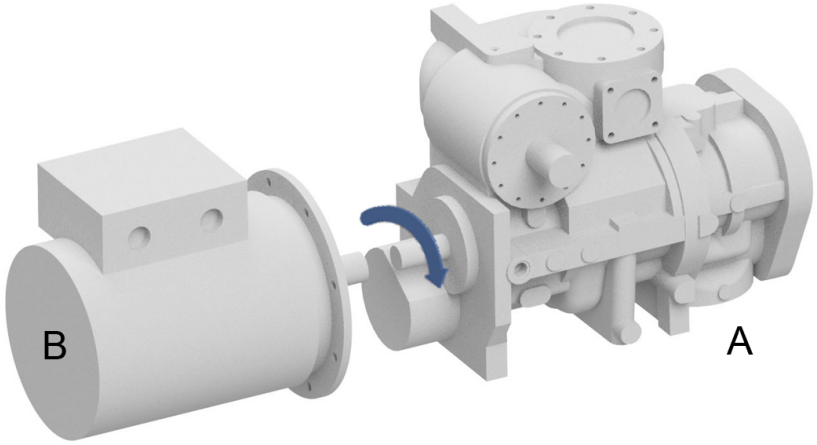


Fig.74: Motor direction of rotation (schematic representation GEA BluAstrum and GEA BluAir 400 -1500)

A	Compressor
B	Motor

- The compressor drive motor is started directly and then switched off again by forcing the digital outputs.

  Before starting, check the tight seating of the coupling hub (motor side). It is not required to increase the speed for checking the direction of rotation.

Notice

Before commissioning of the compressor drive motor, be sure to check the manufacturer information, e.g. for lubrication of the motor.

► The manufacturer information is part of the product documentation.

- If the direction of rotation of the motor is wrong, it should be corrected while the electric switchgear is secured to prevent the motor from being switched on accidentally. Then the motor must work at least 1 hour unencumbered and free from errors. This is important in order to dry out residual moisture in the motor (caused during transport or storage).
- The coupling protection must be in place during this start-up period as required by the labour safety regulations.

- After checking the direction of rotation of the drive motor, the coupling may be connected with the motor.

7.5.8 Adjustment of oil pressure

The correct oil pressure must be set in the “Parameters” menu of the control before the compressor drive motor and the chiller may be started.

Setting value = see parameter list

⚠ Caution

Maintaining the correct oil pressure!

► The oil pressure being set too high or too low may result in serious compressor damage or even total breakdown of the compressor after even a short period of operation!
► The parameter list is part of the product documentation.

7.5.9 Mounting the coupling

- The electric switchgear is secured to prevent it from being switched on accidentally.
- Mount the coupling while observing the instructions of the separate documentation.

⚠ Caution

Avoid rotating the compressor!

► No pressure compensation on the product must be carried out while working on the coupling.

- The values for radial and angular deviations given in the coupling documentation must be observed in all cases. The axis distance between the compressor drive motor and the compressor must be checked. (not applicable with motor/compressor connection by compressor housing)
- The real values have to record at data sheet of coupling documentation. Please send back a copy of the completed data sheet to:

  GEA Refrigeration Germany GmbH

  Holzhauser Straße 165

  13509 Berlin

  Fax: +49 (0)30 - 43 592 759

⚠ Caution

Re-grease the coupling at the prescribed intervals if scheduled in the maintenance instruction for the coupling!

► Read and observe the maintenance instructions!

7.5.10 Checking the water circuits

Check that the cooling and cold water pumps are running and the shut-off fittings in the circuit are in their operating positions.

If a cooling water controller or heating agent controller is installed, this must be set under project conditions so that the condensing and oil temperature lies within the allowable range.

⚠ Danger

Compliance with the maximum permissible pressures and temperatures specified by the manufacturers of the heat exchangers.

► The operator must ensure that the maximum permissible pressures and temperatures of the heat exchangers (e.g. oil cooler, condenser, evaporator) are not exceeded.

7.5.11 Charging refrigerant

⚠ Warning

In order to charge the refrigerant, the compressor must be ready for operation!

► Check whether the compressor is ready for operation.
► The national safety regulations for ammonia plants must be met and the plant must have been approved by the notified body.
► Safety devices, such as machine area ventilation and ammonia detection system, must be operational.
► The secondary refrigerant system must be operational.
► The rated amount of refrigerant filling must not be exceeded under any circumstances. (see specification for the order)

1. Connect the refrigerant reservoir to the filling valve.
2. Draw on the hose on the refrigerant draw-in valve (for delivery of a complete chiller / heat pump valve pos. 2060).
3. Open the charging valve.

⚠ Caution

Do not carry out any work on the coupling during the charging process! The coupling protection must be installed.

► The pressure compensation between the parts may cause rotation of the compressor shaft.
► Check that the coupling is secured before start-up.

4. Carefully open the container valve and perform a pressure compensation. (only gaseous!)
5. Close the valve.
6. Check the system again for leaks.
7. Start the compressor. (if necessary)
8. Open the container valve.

   Fill refrigerant according to manufacturer's instructions (scale). If it is not possible to fill the entire amount of refrigerant until pressure compensation (refrigerant plant / heat pump refrigerant cylinder), the procedure must be repeated from point 6.

9. Draw refrigerant into the circuit at a low compressor capacity.

   Make sure that the pressure in the plant is first lowered below the cylinder pressure. The temperature of the secondary refrigerant must be lowered enough to prevent the refrigerant from flowing back into the cylinder.

10. Close the reservoir valve when the suction pressure nears the required values. When reaching the rated values, the superheating temperature should be 0.5 ... 1.0 K. Refill refrigerant in small increments to prevent overfilling. Let the compressor continue to run until the refrigerant has been completely distributed in the circuit. Based on the values, you can now assess whether additional refrigerant has to be charged or not.

11. With separate refrigerant circuit for the oil cooler (thermosyphon oil cooler is not present as standard for heat pump applications):

    Keep the injection valve into the compressor closed to increase the discharge temperature during the filling process in order to better assess the refrigerant quantity in the oil circuit.

12. After the charging process has been completed, close the charging valve and cylinder valve.

13. Drain and dismantle the charging line.

7.5.12 Initial start-up

After carrying out the aforementioned works, the product can be commissioned in accordance with the operating manual of the control device.

1. Turning on the control voltage.
2. Remedy and acknowledge existing fault messages.
3. Select the operating more for initial start-up, see controller operating manual.
4. Switch on the product.

7.5.13 Check the setting of the control slide (if fitted)

1. System is running.
2. Select operating mode.
3. When pressing the “Increase capacity” pushbutton, the maximum end position must be reached and signalled.

   (100 %)

4. When pressing the “Decrease capacity” pushbutton, the minimum end position must be reached and signalled.

   (0 %) - Depending on the application, minimum end positions > 0% may be set.

5. Vent the adjusting device by moving the control slide backwards and forwards about ten times.

7.5.14 Checking the control slide adjustment times

⚠ Caution

Adherence to the control slide adjustment times!

► Only adjustment times between 30 and 60 seconds are permissible.
► See the Installation and Maintenance Manual for the screw compressor.

The throttle valves of the solenoid valves are adjusted in the factory in such a manner that they ensure an optimal adjustment time of the control slide between 30 and 60 seconds.

During operation at operating temperature, determine the adjustment times needed when the control slide is continually moved from the maximum end position to the minimum end position and back. For the automatic system to run smoothly, the adjustment times in either direction must be approximately the same.

The adjustment time can be adjusted using the throttle valves DS5 and DS6.

7.5.15 Checking the oil cooler

Refrigerant injection (standard):

Check the discharge temperature, reference value 65 °C, maximum permissible value is monitored automatically via the control.

Water-cooled oil cooler (option):

The oil cooler is connected to the condenser on the cooling media side. Check the stop valve in the supply line (2110, 2115) at operating position open.

Check the oil inlet temperature in the compressor, reference value 60 °C, maximum permissible value is monitored automatically via the control.

Refrigerant cooled oil cooler (only for operating on an external condenser):

The oil cooler is connected to the high pressure reference vessel on the cooling media side. No regulation possible.

Check the oil inlet temperature in the compressor, reference value 60 °C, maximum permissible value is monitored automatically via the control.

7.5.16 Measurement of the number of voltage crossings on the shaft.

Carry out the measurement of the number of voltage crossings on the shaft only for motors that run on the frequency converter.

This measurement of possible spark erosion on the motor bearings, as a possibility of the correct synchronisation of the system motor, frequency converter and wiring, is carried out during commissioning.

Suitable measuring equipment must be used for this purpose.

GEA Refrigeration Germany GmbH recommends measuring with a hand-held measuring device, for example the SKF TKED 1.

This measuring device can be obtained from GEA Refrigeration Germany GmbH.

Fig.75: Hand-held measuring device from SKF

The measurement of possible spark erosion should be carried out at least once a year.

GEA Refrigeration Germany GmbH recommends a maximum upper limit.

10 measurements of 30 seconds each (preferably under full load conditions) on **both** bearing sides - DE (drive side) and NDE (driven side)

- then calculate the mean value of the measurements
- maximum 500 breakdowns can be tolerated

  < 500/min voltage crossings - installation motor / frequency converter is ok

  > 500/min voltage crossings - check electrical motor / frequency converter, in particular check the mandatory use of the Common Mode filter

7.5.17 Oil return – Adjustment of control valve position 2325

The hot gas valve (2310) is opened, directing the oil and any refrigerant through the return line, control valve (2325), and sight glass (2180) into the suction line.

This process returns the oil to the compressor.

The control valve (2325) should be adjusted so that, during oil return, the final temperature (120) does not decrease by more than 2 K. The oil return process must be completed within the oil return time.

This is to be monitored via the sight glass (2180).

The first de-oiling cycle starts 15 operating hours after first-time commissioning.

7.6 Handing over to the operator

Shipment is made in the type of packing stipulated in the order. The product is generally supplied without packing.

The product has an inert gas filling in the refrigerant circuit.

The media connections are closed.

⚠ Warning

The product compressors, are, unless specified otherwise, **not** filled with oil, therefore the product must not be started directly after delivery!

► The start can be carried out only after proper mounting, installation and start-up!

7.6.1 Design with condenser (water cooled)

GEA Blu chillers with liquid-cooled condensers are supplied ready for connection and fully piped and wired as standard.

An electronic injection valve is used as expansion valve.

Fully welded plate heat exchangers are used as standard condensers.

The chiller is equipped with a refrigerant injection system. Alternatively or additionally, a liquid-cooled oil cooler is available as a heat recovery option.

7.6.2 Design without condenser (“remote”)

In this design, the condenser is not part of the scope of delivery of the GEA Blu chillers. The air cooled condenser or evaporation condenser are connected on site. The modules are connected on site (split installation).

An electronic injection valve is used as expansion valve.

The chiller is fitted as standard with an oil cooler cooled by refrigerant or with a refrigerant injection system. To ensure the reliable operation of the refrigerant-cooled oil cooler and the refrigerant injection, the chiller is equipped with a high pressure header (can be deselected from the GEA scope of delivery).

7.7 Restarting

7.7.1 Start-up after long standstill period

1. Inserting the main fuse
2. If necessary, open valves or set them to the operating position.
3. Switching on the control unit according to the operating manual.
4. Switching on the oil heater 12 hours before restarting.
5. Check all parameters on the display of the control. See parameter list.
6. Checking the settings of all control and safety devices.

7.7.2 Restarting after approx. 1 year standstill

1. Change the oil filter inserts (see maintenance manual).
2. Switch on the oil heater at least one hour before starting the product.
3. Open the stop valve on the suction side and the pressure side (or check valves which can be shut off).
4. If fitted: open the stop valve (or lockable check valves) in the suction line of the economiser (not included as standard for heat pump applications).
5. If fitted: Open refrigerant to the thermosiphon - oil cooler (not included as standard for heat pump applications).
6. If fitted: Open the manual shut-off valve of the refrigerant injection.
7. Remove all non-condensable gases are removed by venting. To this end, check the condensing pressure and temperature (see parameter list).
8. Switching on the oil heater 12 hours before restarting.
9. Check the oil collection sump and empty if necessary.
10. Switch on the compressor and observe the operating instructions of the electrical switchgear. Make a compressor package/ chiller function checkout for testing the sensor and actor technologies (ready for operation and indicating precision).

8 Operation and control

8.1 Personnel qualification - Important information for the operator

The product must be only be operated by trained and qualified personnel who are familiar with the contents of the operating manual for GEA products.

The safety regulations for GEA products must always be correctly complied with in order to prevent injury of the operating personnel and damage to the product.

Notice

The product is operated via the control panel of the control unit.

► If the control unit is contained in the scope of delivery (standard), the operating personnel must have knowledge of the contents of the complete documentation for the control.
► The control documentation is part of the product documentation.

8.2 Safety Instructions

Dangerous situations during operation can be avoided by safety-conscious and forward-looking conduct of the personnel.

The following principles apply during operation:

- Monitor the product during operation.
- Safety devices must not be changed, removed or decommissioned. Check the safety devices at regular intervals.
- All covers and hoods must be mounted as intended.
- The installation location of the product must always be sufficiently ventilated.
- Design modifications to the product are not permissible. Immediately report any changes to the product to the responsible person.
- The danger areas must always be kept clear. Do not position any objects in the danger area.
- Check the proper functioning of all of the EMERGENCY OFF equipment at regular intervals.

8.3 Description of the control elements

8.3.1 Requirements for switching on

The product has been designed for automatic operation; the control controls the switching of the compressor and its capacity adjustment.

There is no need for constant adjustment and observation of the product in automatic operation. The necessary steps for switching on the product are given in the documentation of the control.

If the product is controlled manually, it must be operated from the refrigerator room. In particular, the repair and maintenance instructions must be complied with.

The following prerequisites must be fulfilled for switching on the product:

- The main current must be available and switched on.
- The product must be sufficiently filled with refrigerant and oil.
- The valves must be in their operating positions.
- The oil level in the oil separator must be within the allowable range.
- The cooling and cold water pumps must be in operation, the medium flows through the heat exchangers.
- The supply of cooling water or refrigerant to the oil cooler must be ensured.
- The oil must be sufficiently heated by the oil heater.

Notice

The oil heater can be energised when the product is shut down.

► It is then automatically switched off when the product is started and switched on when it is shutting down. If the ambient temperature is below 5 °C, the oil heater must be switched on at least one hour before the product is switched on.

- The rated current limitation has been set according to the motor rating.

→ The product can be switched on according to the operating manual of the control.

8.3.2 Compressor control

Possibilities of compressor control:

- Manual control
- Automatic control
- Remote control via contacts
- Remote control via a network connection

Notice

Control parameters with a description of their function are shown in the GEA Omni operating manual.

► The GEA Omni operating manual is part of the documentation of the control.

8.3.3 Setting of setpoint and limit values as well as safety devices

⚠ Caution

Correct setting of all setpoint and limit values!

► The correct setting of all setpoint and limit values is a prerequisite for the safe operation of the product.

The specifications (work steps) in the operating manual of the control and the project-related data are decisive for the setting of the setpoint and limit values.

The program-based setpoint and limit values as well as the setting values of the safety device are given in the project-based **parameter list**.

The parameter list is part of the documentation of the controller.

Adaptations must be made to the local conditions on site.

8.4 Operating and using the plant

⚠ Caution

Read closely the control documentation.

► Contact the technical customer service for GEA Refrigeration Germany GmbH if you need help.

The chiller is operated via the control. (Standard: GEA Omni)

The control is mounted directly on the product as standard. As an option, it can be located in a control centre.

The control is made up of the control unit with operating and display unit (Touch Panel), indicator lights for "Operation", "Warning" and "Alarm", the EMERGENCY STOP button, the coupling elements as well as the housing.

All switching, operating and control actions are carried out via this touch panel. The touch panel is the interface between the operator and the product.

The control performs the following functions as standard:

- Display of all important physical and technical parameters, e.g. pressure, temperature, motor current, capacity, number of run hours, operation mode and status signals,
- Automatic start up and shut down of the product and capacity control dependent on the relevant parameter for the application (e.g. suction pressure or an external temperature),
- Monitoring of all operating parameters,
- Compressor capacity limitation if the measured discharge pressure, suction pressure, cooling agent temperature or motor current indicate an overload,
- Fault memory with date and time,
- Wire failure detection for all analogue input signals,
- Password protection to prevent unauthorised access to important parameters,
- Non-volatile saving of program on CFast card,
- Possibility of communication with master controller via Modbus TCP, Ethernet/IP.

  (optionally via Profibus DP, ProfiNet)

9 Cleaning

9.1 Special personnel qualification

The personnel who clean the product components must have the respective qualification for this work. See also Section 6.1, Page 94 for this purpose.

9.2 Safety Instructions

Notice

Avoid turning off the system unintentionally.

► The obligation for signage to prevent unintentional switch-on of the system during cleaning and repair must be observed.

9.3 Clean

9.3.1 Mechanical cleaning

Mechanical cleaning is a maintenance measure in order to ensure continuous safe operation of the product.

Product components (e.g. suction filters) can be removed for manual mechanical cleaning. To do so, follow the instructions listed in the corresponding component documentation. After completion of the cleaning work, correctly mount the component and check it for leakages.

9.3.2 Chemical cleaning of the heat exchanger

Chemical cleaning has to be carried out only if the heat transfer is significantly deteriorated.

The cleaning agents used must be suitable for the stainless steel surfaces (AISI 316L) at the temperature used.

The ammonia side must be drained before using warm cleaning solutions.

The chemical cleaning of the heat exchangers must only be carried out by an experienced specialist company. At the same time, the manufacturer's instructions must be observed.

10 Maintenance

10.1 Personnel qualification - Important information for service personnel

The following chapter is primarily intended for the maintenance and service personnel of the product.

- Heed all safety instructions in this operating manual.
- Familiarise yourself with the local conditions of the product installation site.
- Adhere to all legal and local regulations of health, work and fire protection, the safety regulations for refrigeration systems as well as the regulations which must be heeded concerning the gases to be compressed.
- Read this operating manual carefully and completely prior to working on the product.
- Familiarise yourself with the special features of the product.

⚠ Caution

There is an increased danger of slipping due to contact of operating media with the floor!

► Correct handling of operating media!

The product must be serviced by appropriately trained operating staff only. For all maintenance work, the maintenance instructions must be complied with.

The maintenance manual is part of the product documentation.

During the guarantee period, the maintenance work performed requires documented evidence.

This documented evidence is also a requirement for any warranty claims put to GEA Refrigeration Germany GmbH.

The responsible certified specialist company must be informed if any repairs are required.

All maintenance and service tasks have to be carried out with care to preserve the functionality of the product. Guarantee claims will not be valid if the customer failed to follow the maintenance instructions.

10.2 Safety Instructions

Notice

Avoid turning off the system unintentionally.

► The obligation for signage to prevent unintentional switch-on of the system during maintenance and repair must be observed.

10.3 Preparation for maintenance

10.3.1 General instructions

⚠ Danger

Contact with live components is prohibited.

► Produce the earth connection according to the designation in the general assembly drawing. See chapter "Designation of the earth connection".
► Maintenance work on the running product is not permissible.

Work involving intervention in the refrigerant circuit must only be carried out by qualified engineers in accordance with the guarantee conditions.

The product must always be switched off before being dismantled. Before beginning the work, ensure that all components subject to maintenance/servicing are de-energised (e.g. by removing the main fuse or installing a jumper wire).

The refrigerant must be removed from the relevant parts of the system. This work must be carried out with great care, taking into account the safety regulations, so that the maintenance personnel are not injured by the refrigerant or by the refrigerator oil present in the system.

Parts of the system under pressure must be completely drained before opening. While carrying out the repair, always ensure that there is complete pressure compensation between the relevant pressurised spaces and the surrounding air.

During cleaning, repair or maintenance work, the product or its components must be protected against the entry of moisture in order to prevent impairment of the function of the components.

The chief principle must be to keep air and moisture entering the product to an absolute minimum. Any foreign substances must be kept away or eliminated, including

- welding residues,
- sealing remnants,
- auxiliary materials such as grease, oil or solvents.

Welding and soldering work may only be performed with the operators consent.

The welder must be in possession of the corresponding permission!

The requisite protective measures must be defined. These include:

- Personal protective measures during the opening of the respective part of the system,
- complete draining of the respective part of the system,
- Cleaning with the appropriate cleaning agents,
- Concentration measurements,
- Ensuring sufficient ventilation and venting,
- Performance of all welding work with the use of forming gas.

If lines that carry gas have to be opened for maintenance work, these lines must be in a gas-free state.

New inspection and approval is required after pressure vessels that are subject to approval have been serviced or changed.

10.3.2 Maintenance intervals

The product must be serviced by appropriately trained operating staff only.

⚠ Caution

The maintenance intervals defined in the maintenance instructions must be observed.

► The maintenance manual is part of the product documentation.

These maintenance instructions contain all maintenance instructions for the first 10 years of operation of the product.

Maintenance work performed during the warranty period must be documented.

We recommend performing all maintenance work throughout the entire service life of the product.

Notice

Please observe the maintenance instruction given in the manufacturer's technical documentation for individual components!

► The documentation for the main components is a part of the product documentation.
► The service and maintenance work and maintenance intervals are directly matched to the components used.
► The manufacturers' instructions are binding and must be observed by the customer to safeguard the guarantee provided by GEA Refrigeration Germany GmbH!
► If the manufacturer does not specify any special maintenance instructions, the details given in the maintenance instructions and the maintenance manual apply.

We advise you to sign a long-term service agreement with a qualified company authorised by GEA Refrigeration Germany GmbH to carry out the necessary service and maintenance work. Our service department is available for this or can help you to find a suitable partner.

10.4 Maintenance work

10.4.1 Maintenance of the screw compressor

Maintenance work are to be periodically carried out on the screw compressor.

The maintenance work and intervals are listed in the maintenance manual. Detailed descriptions for the maintenance work on the screw compressor are listed in the installation and maintenance manual of the compressor.

Notice

The defined maintenance intervals on the screw compressor must be adhered to.

► The maintenance manual is part of the product documentation.
► The maintenance work on the screw compressor is described in the installation and maintenance manual of the compressor.
► The installation and maintenance manual for compressors is part of the product documentation.

Depending on the use and operating conditions, a general examination of the screw compressor must be carried out by the manufacturer at a specific point in time. Contact Customer Service in this regard.

10.4.2 Oil filter replacement

Notice

Follow the manufacturer's instructions concerning the correct maintenance of the oil filter.

► See component documentation.

1. Decommissioning the product.
2. If the oil filter is very dirty, it may be necessary to replace it outside the normal maintenance schedule.
3. To change the oil filter element, close the following valves in accordance with the P+I diagram and the oil filter documentation:

   Separate oil filter:

   - Close stop valve - item 65 (before oil filter).
   - Close stop valve - item 220 (before thermostatic control valve/oil filter).
   - Close stop valve - item 65 (after thermostatic control valve/oil filter).
   - Close stop valve - item 135 (option).

   Oil filter in the OMC:

   - Close stop valve 65.
   - Close stop valve 220.
   - Close stop valve 70.

   Oil filter integrated in compressor:

   - Close valves according to compressor documentation.

4. Close stop valve - item 90 carefully (filter under pressure) and drain oil.
5. Remove the cover of the oil filter.
6. Remove the oil filter element and properly dispose of it if it is highly soiled.
7. Carefully insert a new oil filter element.
8. Close the cover of the oil filter.
9. Reopen valves in accordance with point 3.
10. Draw vacuum via the service valve 135 onto the filter housing.

10.4.3 Maintenance of suction filter combination

10.4.3.1 Changing the filter element

The maintenance interval for changing the filter element is specified by the manufacturer.

The contamination level and mechanical condition of the filter element must be inspected at least once a year.

Before opening the filter, always make sure the filter housing is not under pressure.

⚠ Caution

Oil may leak when opening the filter.

► Pay attention to the respective safety data sheets for any protective measures.

Suction filter integrated in the compressor

The required steps for the filter change are described in the installation and maintenance manual for GEA Grasso screw compressor in the chapter “CLEANING, MAINTENANCE, REPAIRS” (part of the product documentation).

⚠ Caution

When carrying out maintenance, always inspect the sealing ring (O-ring) of the cover for mechanical damage.

► If the sealing ring is damaged, it must be replaced.

Oil filter integrated in an external fitting

To remove the element, proceed as follows:

1. Unscrew the cover.
2. Pull out the cover with the filter element.
3. Remove the spring wire clamp.
4. Twist the element away from the cover to release the bayonet catch.
5. Detach the element from the cover.

6. Allow the element to drain off into a suitable container.

⚠ Caution

When carrying out maintenance, always inspect the gasket (O-ring) of the cover for mechanical damage.

► If the sealing ring is damaged, it must be replaced.

7. Reassemble all parts with the new or cleaned filter element following the same procedure in reverse order.

10.4.3.2 Cleaning the filter element

The metal-gauze element used in the filter can be cleaned and reused several times before it has to be changed.

Manual cleaning

The contaminated metal fabric filter element is to be submerged into a fat-dissolving, clean liquid. Then it is blown inwards using compressed air. It is important that a cylindrical part - possibly wrapped in corrugated cardboard - is placed in the element so that the debris precipitate on it.

⚠ Caution

Avoid damaging the filter element

► Never use wire brushes for cleaning.

► To avoid fatigue failures of the metal gauze, strainer elements should be replaced with new, original filter elements after being cleaned 4 – 5 times.

10.4.4 Oil draining, oil filling, oil change

10.4.4.1 Importance of oil change

Aged oil demonstrates a loss of lubricity. Because of this, all rotating components of the compressor are endangered. The oil filter elements become prematurely clogged and must be cleaned and replaced at shorter intervals.

The oil in the product requires changing

- if the operating time of the oil fill has reached the technically specified oil change interval.

⚠ Warning

Observing the intervals for oil analysis and oil change!

► Oil analysis when using ammonia as the refrigerant after 5000 operating hours or at the latest after 1 year.

- if the oil becomes unacceptably contaminated due to a major accident (e.g. water penetration into the refrigerant circuit).

The degree to which oil in the products has aged must be checked by analysis and comparison of the data with those of fresh oil.

Oil ageing can also be judged from the darkening of the oil colour and the deposits found in the oil filters. If the degree of ageing cannot be assessed reliably by laboratory analysis and the results of visual examination, it is advisable to change the oil at the following intervals (see maintenance instructions).

The assessment of the condition of the refrigerator oil by means of a general visual inspection (contamination) or laboratory analysis must be carried out:

- after 5000 operating hours

  or

- at the end of one year's operation

  or

- after remedying major damage

  or

- in case of extreme darkening of the oil colour or opacity of the oil.

10.4.4.2 Oil change, maintenance work

Take oil samples for analysis and comparison with the fresh oil data at regular intervals. Check the colouration of the oil visually and assess the degree of contamination.

Depending on the results, the user must decide whether to approve the postponement of filling the oil until the next assessment date or whether to have the oil changed.

Oil with impermissibly high water content must be removed from the product immediately.

10.4.4.3 Changing the oil

1. The product must be operated for at least half an hour to reach its operating temperature before the oil can be changed.
2. First shut down the product as described in the operating instructions.
3. Close the pressure gas valve, then the stop valve in the bypass line, the check valve on the suction side and the suction-side stop valve to compensate the pressure between the compressor and the suction line. Then re-close the stop valves bypass and suction-side stop valve. Otherwise the pressure can be reduced by opening the vent valve on the suction filter and then disposing of the refrigerant as specified by law.
4. The pressure is further reduced by extracting the refrigerant via a disposal device to approx. 0.5 bar (g). Carefully open the oil drain valves (oil separator, oil cooler, OMC, oil-carrying lines) to drain the oil and dispose of it properly (hazardous waste).
5. Otherwise depressurise the product by opening the vent valve - suction filter, taking into account the safety rules for refrigeration plants.

⚠ Caution

Observe the safety instructions for the refrigerant ammonia.

► The safety instructions for the refrigerant ammonia are part of the product documentation.

6. Then re-close the drain plugs and valves.
7. Replace the filter element of the oil filter or suction filter element in the compressor and/or clean the filter element of the SFC suction filter combination.
8. Evacuate the product using a vacuum pump.

   Shut off the oil pump! (if present)
9. Pressurise the product with a slight overpressure via the stop valve bypass check valve on the pressure side.
10. Then check all components for leakages. Then perform a complete pressure compensation with the pressure line followed by a repeated leakage test. The oil charge oil and start-up of the product must be accomplished in accordance with the operating instructions.

10.4.4.4 Used oil

Refrigeration machine oil drained from the circuit is no longer suitable for use in products. It has to be stored or transported in appropriately labelled containers in accordance with the legal provisions. The operator is responsible for its proper disposal.

10.4.4.5 Draining the oil

It may be necessary to drain the oil:

- to inspect or repair the compressor

  and

- if there is too much oil in the circuit.

The oil must be drained in accordance with points 1 to 6 of the chapter "Carrying out an oil change". The oil must be drained through a filling hose and into a container suitable for waste oil.

10.4.4.6 Oil level check

The oil level is checked visually via the sight glasses of the oil separator. Depending on the oil separator version, the fill level lies between the upper edge of the sight glass indicator MIN (N10a or N10b) and lower edge of the sight glass indicator MAX (N10b or N10c).

For oil separators with a flanged sight glass indicator, the fill level is in the upper third of the sight glass. A drawing of the oil separator with respective details of the sight glass indicator is a component of the product documentation.

If the oil level is too low, top up with oil. The amount which is topped up must be recorded.

10.4.4.7 Filling with oil, topping up with oil

See chapter "Start-up, charging with oil".

Notice

Oil removed from the compressor must not be re-used. Use only fresh oil from closed tanks! You must rule out mixing different types of oil.

► For permissible types of oil, please refer to the *Technical specifications* or to the technical information *Lubricating oils*.

10.4.5 Maintenance oil pump (if present)

Assuming correct installation in accordance with the conditions of use and correct fitting, gear pumps have the design prerequisites for a long and fault-free operation.

The gear pumps require minimum of maintenance which, however, is indispensable for a fault-free operation, since experience has shown that a high percentage of the faults and damage which occur are attributable to the ingress of dirt and inadequate maintenance.

The maintenance intervals have been defined in the maintenance manual (part of the product documentation).

An oil leakage of up to one drop/minute is required for the lubrication of the shaft seal and is permissible.

The shaft seal is maintenance-free. If the oil leakage is too much, replace it according to the oil pump documentation.

Depending on the application, a magnetically coupled oil pump without shaft seal.

Notice

Early detection at an early stage!

► The regular examination of all operating data, such as pressure, temperature, power consumption, degree of filter fouling, etc. helps in the early detection of potential failure!

10.4.6 Changing the fine oil separation cartridge on horizontal oil separators

(only for GEA BluAstrum 1500 and GEA BluAstrum 1800)

The fine oil separation cartridges must be changed according to the intervals specified in the maintenance instructions. The maintenance instructions are an integral part of the product documentation.

Irrespective of the maintenance interval, this may be necessary earlier if the oil carry over of the system increases considerably (oil refilling at unusually short intervals).

1. Close the pressure (1) and suction side shut-off fittings.
2. Pressure compensation by opening the service valve (2) to bypass the existing integrated check valve (3), if fitted.
3. Drain refrigerant. Evacuate compressor unit/ liquid cooling unit.
4. Check the pressure on the display of the control unit or by connection of a test pressure gauge.
5. Dismantling the cover on the oil separator.
6. Remove self-locking hexagon nut (4).
7. Loosen the hexagon-head screw (5) and the fixing cover with O-ring (6) for fixing the fine oil separation cartridges.
8. Remove the cartridge(s) (7).
9. Mount the new cartridge. The cartridge must be inserted into the oil separator with the O-ring first.

   Assembly by carrying out steps 1-7 in reverse order.

⚠ Warning

It is essential to apply self-locking hexagon nut (4) again and secure it against turning backwards!

► Max. tightening torque = 15 Nm

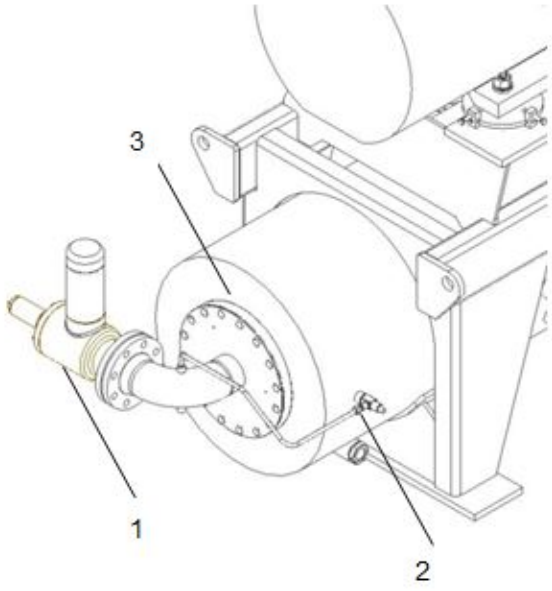


Fig.76: Suction shut-off fitting, service valve and integrated check valve

1	Pressure shut-off fitting
2	Service valve
3	integrated check valve

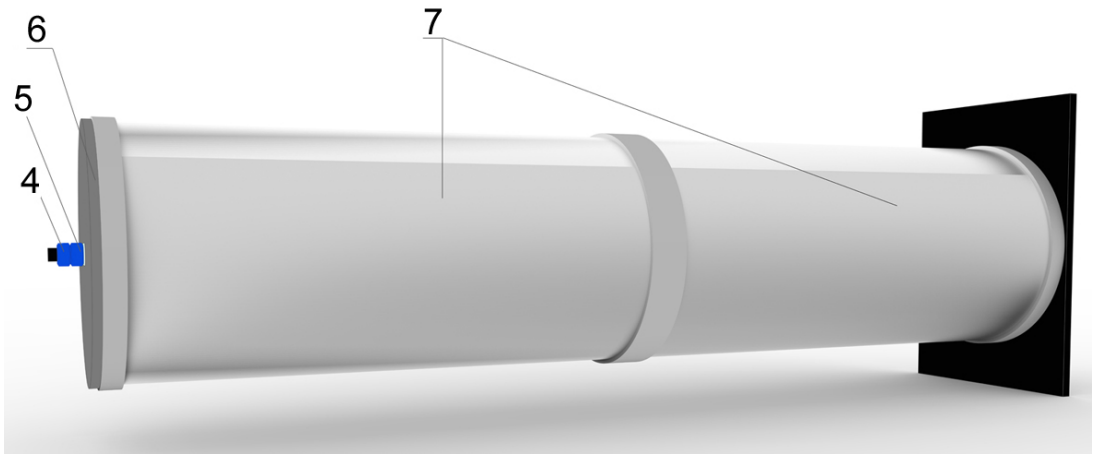


Fig.77: Operating position of the fine oil separation cartridges

4	Self-locking hexagon nut
5	Hexagon-head screw
6	Fixing cover with O-ring
7	Cartridge(s)

10.4.7 Tightening screw fastenings

Screw connections of components may become loose by vibration and movements. Screw connections must therefore be checked periodically for tight seating, and retightened if necessary.

Tightening screw connections must be done only in accordance with the maximum tightening torques.

Unless otherwise stated on labels attached to the products, the tightening torque must be chosen depending on the size and strength of the screw connection.

10.4.8 Checking the function of check valves

In order for a check valve to be effective it is important to perform function checks at regular intervals.

A control takes place by checking the noise behaviour of the valves during operation. An error function on the suction side appears due to lengthy turning back of the compressor after switching off the product. An error function on the pressure side leads to an increase of the standstill pressure in the product to the pressure level of the pressure side of the system.

10.4.9 Searching for leaks on the refrigerant side / leak test

The product will only function properly if it is sealed correctly. Leaking parts or connecting elements will lead to the loss of refrigerant and oil as well as the penetration of air and moisture into the low pressure side. The site of the leak must therefore be located and remedied if there is:

- Loss of the inert gas charge (delivery state),
- Loss of the entire refrigerant charge

  or
- underfilling.

Lower refrigerant levels in the containers are due to loss of refrigerant as a result of leaks. For this reason, all pipes, connections and valve glands should be checked regularly, especially in the initial period of assembly or start-up.

The most striking feature if there is a leak in the filled refrigerant circuit is the smell of refrigerant. The odour threshold of ammonia in the air is approx. 5 ppm and therefore well below the permissible MAK values.

Methods of leak detection:

- Regular visual inspections.
- Smudges/dirt stains indicate leaking refrigerant/oil mixture.
- Leak tests with nitrogen with a max. of 0.5% ammonia by volume, an elapsed time of more than 3 hours and application of a foaming agent to all the joints with a brush. Oil-filled compressors or circuit sections must only be charged with nitrogen – not air – to generate pressure.
- Use of an NH_3Leak detector.
- Ammonia produces the following colours when leak tests are performed:
  - Red litmus paper turns blue,
  - Blotting paper impregnated with phenolphthalein turns red (moisten).

⚠ Caution

Explosion risk

► Never use oxygen to build up pressure!

Generate a test pressure in the refrigerant circuit that meets the intended operating pressure for the leak tightness test to determine leaks on the refrigerant side, e.g. in the case of escaped inert gas or refrigerant. When system parts are individually tested, the maximum permissible pressure indicated on the respective system part for the corresponding pressure chamber must not be exceeded. The use of foaming agents gives the best results at test pressures < 5 bar.

If leaks are determined, these must be sealed immediately. Release the test pressure before beginning repair! Evacuate the system after repairs are complete and after rechecking for leaks.

The supplier is not liable for losses of refrigerant caused by a lack of or improper maintenance!

10.4.10 Venting the refrigerant circuit

When air penetrates into the refrigerant circuit, this makes itself felt in a fall-off in system performance, and the on the discharge side of the compressor indicates a higher pressure. Leakage points must be fixed properly. In extreme cases, air in the circuit may interrupt the flow of the refrigerant and cause the oil cooling to fail.

A sure sign of air or other inert gases is that the temperature difference between condensing temperature (from condensing pressure) and cooling medium/heat carrier outlet increases. Contamination of the circuit with air or other gases can be traced back to careless working during evacuation, filling oil or contaminated refrigerant

If this gas impairs further operation:

- Stop the product
- Close the pressure valve
- Lower the refrigerant level in the liquid line to the height of the stop valve by manually opening the injection valve
- Close the stop valve
- Drain air/NH_3 mix into vessel filled with water (proper disposal)
- Evacuate condenser
- Open valves

There are several ways of venting the system. The air or the NH_3 air mixture is let off via the vent valves of the suction filter into water-filled vessels when the system is shut down. If air is contained in the mixture, the venting NH_3 is absorbed by water.

Notice

Continuous venting is recommended.

► We recommend using a GEA Grasso Purger.

10.4.11 Refrigerant side evacuation

Note: Shut off the oil pump (if present) during evacuation!

The purpose of evacuating the system is to remove air and moisture from the refrigerant circuit.

Evacuation is required:

- after intervention in the refrigerant circuit and elimination of leaks,
- before start-up/restarting.

Evacuate the product using a vacuum pump. The compressor must not be used for evacuation.

During evacuation, all affected parts of the circuit should be at least at room temperature as cold parts hinder the removal of moisture.

If there is still any moisture in the product, this will lead to a rise in pressure. Evacuation must continue until the pressure no longer increases. For a pressure compensation, it is necessary for the ambient temperature to remain constant.

10.4.12 Draining refrigerant circuit

In spite of a very good oil separation in the fine separation parts of oil separators any oil is is reaching other parts of the plant. For returning the oil from the liquid separator, the product is equipped with a special automatic oil return system.

In addition service ports are available for manual draining at evaporator.

Open the stop valve (2330) **carefully** to drain any existing oil out of the evaporator.

⚠ Danger

Pay attention to the safety rules of working with the refrigerant ammonia!

► Keep the safety equipment handy (protective breathing mask)!
► Working only together with a 2nd person!

10.4.13 Charging and draining of refrigerant

Charging refrigerant

Liquid filling is carried out:

- after the leak test and evacuation of the product

  or

- for recharging.

The refrigerant is introduced in liquid form via the system's refrigerant draw-in valve. The vessel containing the refrigerant should be fixed to the charging valve by means of the charging line. Ensure that there is no air in the filling hose (e.g. by using the line for the evacuation). The refrigerant is drawn in after slowly opening the refrigerant draw-in valve and the cylinder valve.

Once the circuit has been charged, the cylinder and refrigerant draw-in valves should be closed tight. The refrigerant charging line and the refrigerant cylinder must be removed. The system is now in normal operation.

If the refrigerant level has subsided (loss of refrigerant blown off by safety valves or leaked out during repairs), the refrigerant must be topped up with the system running. This should only be done if the system is in operation and free from leakages.

Draining the refrigerant

⚠ Caution

Refrigerant may escape.

► Protective clothing must be worn (eye protection and protective gloves).

The refrigerant must be drained:

- if the plant is overfilled,
- if the refrigerant or oil circuit is dismantled and repaired,
- for maintenance work on the oil circuit,
- if foreign gases are detected in the plant.

The liquid refrigerant can be filled into refrigerant cylinders in liquid form, or suctioned off as refrigerant vapour using an extraction device.

If liquid refrigerant is drained into refrigerant cylinders, special recycling cylinders must be used for this. This prevents contaminated refrigerant from reuse.

The cylinders into which the refrigerant is filled should be evacuated and cooled in advance. A sufficient number of cleaned, dry and sub-cooled cylinders must be made available ready for use before starting to drain the refrigerant. The weight of the empty refrigerant cylinder must be determined.

The filling line is firmly screwed to the drain valve (item 2965) and the other end fixed firmly connected to the closed refrigerant cylinder. The drain valve is opened slowly. The valve on the refrigerant cylinder is then also opened slowly. Due to the hazards involved, you should take care to avoid spilling any refrigerant.

The refrigerant is weighed with a scale, remembering that the cylinder should only be filled to 80% of the capacity. If this percentage is not reached and there is still refrigerant in the system, the pressure in the cylinder can be reduced by venting the cylinder. When the cylinder is filled to 80%, the refrigerant draw-in valve and the cylinder valve are closed and the next cylinder is connected. Repeat this procedure until all of the refrigerant is bottled. Only one cylinder must be filled at a time.

The quantity of refrigerant filled must be documented in an appropriate log. When the refrigerant has been filled into cylinders, the charging valve should be closed.

The remnants of refrigerant are suctioned out of the system until it is completely drained. The pressure must no longer increase after the compressor has been turned off.

Connections for draining refrigerant

Draining the refrigerant circuit or parts of the circuit can be carried out via the service valves provided (see P+I diagram).

10.4.14 Maintenance of the compressor drive motor

Notice

Maintenance of the compressor drive motor must be carried out in accordance with the "Motor documentation".

► The motor documentation is part of the product documentation.

The maintenance of the compressor drive motor includes the following activities:

- Lubrication of the motor

  Lubrication intervals and amounts according to the "motor documentation" or "nameplate".

- Cleaning the motor (externally)

  Selection of a suitable cleaning agent according to the motor documentation.

10.4.15 Checking the operating parameters

Notice

The checking intervals recommended in the table must be observed.

► The control of the operating parameters is carried out via a Touch Panel. The project-related setting values and limits are given in the parameter list.
► Inform the GEA Refrigeration Germany GmbH technical customer service if the parameters are outside of the allowable limits.

Checking the operating parameters				
Parameter to be checked	**Every 24 to 72 hrs**	**Weekly**	**Monthly**	**Remark**
Discharge temperature	**X**			The minimum superheat temperature must not be less than 25 K. Maximum discharge temperature 100°C in individual cases (e.g. heat pump applications) also in consultation with the manufacturer.
Oil temperature	**X**			See parameter list! The viscosity must not be less than 7 cSt at max. speed (rpm).
Oil pressure	**X**			See project value (parameter list). The minimum oil differential pressure depends on the compressor series, the conditions and the oil pump.
Compression discharge pressure	**X**			See project value (parameter list). Determine the superheat temperature on the pressure side by comparison with the final discharge temperature.
Oil level in oil separator	**X**			An oil level must be visible in the sight glass at all times. If the oil level is below the bottom third of the sight glass, recharge oil.
Oil heater			**X**	When compressor is shut down, the heater must automatically start. If the thermostatic cutout (limiter) switches off the heater, this may be an indication of an oil shortage.
Setting the safety devices			**X**	See the set values in the parameter list.
Number of operating hours		**X**		See maintenance manual for maintenance work to be carried out according to the number of operating hours.

10.4.16 Maintenance of the switching cabinet

⚠ Warning

Contact with live components is prohibited.

► Disconnect the switching cabinet from electricity before starting maintenance!

Terminal screws must be checked for tightness and if necessary tightened at regular intervals (every 5000 operating hours or at least once per year). Check the contactor contacts for burnup.

10.4.17 Checking the earthing connections

Check the function of the earthing connections frequently (see the general assembly drawing and the indications on the product).

Only a specialist company must be commissioned to carry out such checks.

10.4.18 Insulation

Check the insulation (if present) on components, tanks and pipes for damage.

Damaged insulation must be replaced. The insulation thickness should be selected in accordance with the temperature and humidity at the point of installation. Details on the insulation are included in the P+I diagram.

⚠ Caution

No screw connections must be used under the insulation if pipes are insulated.

► It must be possible to remove the insulation and the pipes must preferably be welded.

10.4.19 Checking the tightening torques at the adjusting elements.

The tightening torques vary depending on the strength and size of the screw used. The values for tightening torques are to be taken from the applicable DIN, unless otherwise specified.

Notice

The tightening torques for the adjusting elements should be obtained from the data sheet.

► The data sheet forms part of the product documentation.

11 Alarms

11.1 Special personnel qualification

The personnel for troubleshooting / repair must have the respective qualification for this work. See also Section 6.1, Page 94 for this purpose.

11.2 Safety Instructions

Observe the following safety instructions for eliminating faults:

- Have repair work carried out by authorised and qualified technical personnel.
- Always de-energise the product before troubleshooting.
- Even when the power supply is switched off, contact with electric components may cause an electric shock.

  Before touching electric components, disconnect the power supply and wait at least four minutes.
- Always depressurise the product before troubleshooting.
- Always allow the product to cool down before troubleshooting.
- It is essential to secure the product against being switched back on unintentionally.
- After completing the work: reattach and activate all protection and safety devices.
- Make sure that all parts can be mounted without being damaged.

11.3 Special dangers

11.3.1 Shut-down in the event of dangerous situations

The safety equipment of the product complies with EN 378.

By means of automatic monitoring of the individual operating parameters, the control detects hazardous situations in good time and automatically switches off the product.

The cause of the fault is then displayed on the control and can then be corrected.

Among other things, the concept of the product is also based on low maintenance, sealed refrigerant circuits. However, there are still residual risks, in particular those through arising possible leaks or escaping refrigerant or through rotating driving components.

Notice

Switching off the product

► The EMERGENCY STOP switch in the switching cabinet is used to switch off the compress package quickly whenever necessary.

Leaking refrigerant can be detected with a gas detector (not included in the standard scope of delivery). This detector can be integrated into the automatic safety chain.

Please consult the safety regulations within this documentation for information about what to do in the case of leaking refrigerant.

11.4 Instructions regarding malfunctions, their causes and remedies

The products manufactured by GEA Refrigeration Germany GmbH are highly advanced, automatic and extremely efficient systems. Faults can occur nevertheless and impede continuous working of the system or cause a failure of a part or of the entire system.

Table of malfunctions		
Fault	**Cause**	**Remedy**
The suction pressure is too low, capacity is reduced and superheat is too high.	Slow loss of refrigerant through leaks in the refrigerant circuit.	Check the entire system for leaks. Remove leakage, possibly refill refrigerant.
	Pressure sensor defective.	Replace pressure sensor.
	Defective capacity control device on the compressor.	Check capacity control devices, connections for solenoid valves.
	Suction filters are clogged	Clean or replace the filter insert.
The suction pressure increases, the compressor frosts with an undue magnitude or makes noise, which indicate liquid (refrigerant) in the compressor.	The compressor is sucking in wet steam or liquid when started up. The safety device to prevent a too-high liquid level is not responding.	Check the filling of the system, drain any refrigerant, repair safety device. Check for superheat.
The condensation pressure is too high.	There is air or other non-condensible gases in the refrigerant circuit.	Vent the refrigerant circuit.
The compressor does not start after switching on or switch off again immediately after the start.	The electrical circuit is interrupted by a device in the safety chain.	Switch on the power supply, check the pressure switches and replace or set properly as appropriate.
	No oil pressure builds up in the product. The oil circuit is disturbed by clogged oil filters or leaks.	Exchange or clean oil filter elements, eliminate leakage and replenish oil.
The compressor does not adapt to the required capacity.	The capacity control device is malfunctioning due to disturbances in the oil circuit or mechanical influences.	Check the oil circuit. The compressor should only be repaired by experts. Check the position sensor of the compressor control slide.
The compressor is shut off very frequently when the discharge pressure is too high.	The condensation pressure is too high.	See above.
	The maximum pressure governor is defective or set wrongly.	Remove the maximum pressure governor, repair it, set it correctly or replace it. Check the heat carrier circuit / cooling medium circuit. R-phrases: check condenser and additional fittings/motor valve
The compressor is shut off very frequently when the suction pressure is too low.	The suction pressure is too low.	Open all valves on the suction side of the compressors.
	The sensor is defective.	Remove the minimum pressure governor, repair it, set it correctly or replace it. The pressure sensor (B100) may be defective or calibrated improperly. Check the refrigerant circuit. R-phrases: check liquid line and additional fittings/motor valve
	The heat transfer capacity of the evaporator decreases.	Check the evaporator for elevated oil concentration, possibly drain oil
The product is extremely noisy in operation.	The compressor or the drive motor is defective.	Please call customer service for more information

Notice

If the product is a GEA Red Series heat pump with cascade evaporator that uses the waste heat of an existing refrigeration plant, trouble-free operation of the refrigeration plant must be guaranteed.

► Any faults during the operation of the heat pump may possibly also be caused by faults in the operation of the refrigeration plant and the resulting lack of supply of NH_3 condensate from the refrigeration plant to the cascade heat exchanger.

11.5 Repairs

Repair work may only be carried out by qualified persons or persons with suitable training with the manufacturer's consent and must strictly comply with the rules set out in the maintenance manual for the components concerned.

The following maintenance notes must be observed:

Only use original manufacturer replacement or spare parts for repairs and to replace parts subject to wear and tear. They must be requested from the spare parts service.

11.5.1 Repair information

Important features of the technology and production process must be taken into account when repairing the system:

- Complete sealing of all devices and pipes.
- Dryness and cleanliness of the entire system.
- Use of welding methods causing only a minimum amount of dirt to collect in the system.
- Pipes bent on a pipe-bending machine only using refrigerator oil.
- If repairing the piping system from your own stocks, we recommend that you use a pipe with NBK surface quality (annealed and descaled, mechanically or chemically descaled after annealing).
- When carrying out repairs to piping systems, care should be taken to maintain the original piping routes.
- Only pipes of sufficient material quality, which are certified according to DIN 10216-2 should be used.

11.5.2 Repairs of pressure vessels subject to approval inspection

Notice

The responsible appointed body must be informed in advance.

► For example TÜV

Re-inspection and approval are required after pressure vessels that are subject to approval have been repaired or changed. Welding may only be carried out by approved welders with a valid welder’s card.

12 Decommissioning

12.1 Special personnel qualification

The personnel for decommissioning must have the respective qualification for this work. See also Section 6.1, Page 94 for this purpose.

12.2 Safety Instructions

The following safety instructions must be observed during decommissioning:

- Decommissioning must only be carried out by authorised and qualified technical personnel.
- Decommissioning must only be carried out when the system is switched off and at a standstill.
- Always de-energise the system before decommissioning.
- Secure the system against being switched back on unintentionally.
- Always depressurise the system before decommissioning.
- Always allow the system to cool down before decommissioning.

12.3 Temporary decommissioning

12.3.1 Shut-down for a period of <48 hours

Notice

Labelling obligation

► The obligation to label the plant as "Plant not in operation" must be observed!

If the product is shut down for a period of <48 hours, the following activities must be performed:

1. Switch off the compressor in accordance with the operating instructions for the electrical switchgear.
2. Switch off all ancillary drives.
3. Switch off the main switch of the three-phase electric system. Removing the main fuse.
4. Close the stop valve (or closable check valves) on the suction side and the pressure side.
5. If necessary, and if present, shut off the secondary refrigerant, heat carrier and cooling medium supply.
6. Block the manual stop valve of the refrigerant injection (if present)
7. The vent slits of the electric motors **must be covered without fail**!

→ System has been shut down

Notice

Short-term shut-down

► If the product is shut down temporarily, the valves do not need to be operated; they remain in their operating positions. If there is a possibility of the temperature in the evaporator rising above the cooling water temperature, the cooling water supply must be interrupted or the stop valve on the compressor suction side must be closed.
► The stop valve on the suction side of the compressor must also be closed if it is possible that the temperature in the evaporator could rise above the ambient temperature of the system.

12.3.2 Shut-down for a period of >48 hours

Notice

Labelling obligation

► The obligation to label the plant as "Plant not in operation" must be observed!

If the product is shut down for a longer period of (>48 hours), the following activities must be performed:

1. Switch off the compressor in accordance with the operating instructions for the electrical switchgear.
2. Switch off all ancillary drives.
3. Switch off the main switch of the three-phase electric system. Removing the main fuse.
4. Close the stop valve (or closable check valves) on the suction side and the pressure side.
5. Shut off the secondary refrigerant, cooling medium or cooling water supply.
6. Shut off the cooling medium supply to the oil cooler. (if present)
7. Close the manual stop valve of the refrigerant injection.
8. Shut off the remote condenser (Version (R) of the condenser) to prevent refrigerant displacements.
9. Preparation for winter operations (Version (R) of the condenser). See chapter "Winter Operation".
10. Always uncover the ventilation slot of the**electric** motors.

→ The system has been taken out of service.

12.3.3 Measures during downtimes

Even though the product is under overpressure, check the moisture content of the refrigerant and refrigerator oil in case it is shut down for more than half a year. The moisture content must not differ substantially from the initial values.

12.3.4 Monthly measures during downtime

- Check that the product is constantly under overpressure. Check the product for leak tightness using a leak detector.
- Manually rotate the compressor shaft (min. 10 rotations).

12.3.5 Four weeks before restarting

- Check the moisture content and ageing condition of the refrigerating machine oil. Analyse the oil for this purpose. Compare the results of the analysis with the values for fresh oil. We recommend an oil change after 1 year (ammonia as refrigerant) (see Maintenance Instructions).
- Check the insulation resistance of the drive motors (see the operating manual for the electric motor).
- Check the chiller for leak tightness.

12.3.6 Winter operation

(for version (R) of the condenser)

"Winter operating conditions" means that the outside temperature is lower than the temperature on the site of the chiller installation.

In order to protect the system, unusual measures for longer stop periods during the cold season are necessary.

⚠ Warning

Avoid moving the refrigerants!

► Close stop valves condenser outlet to receiver; pressure compensation line between receiver and condenser inlet must be closed to prevent refrigerant displacements!

Otherwise suction pressure faults would occur when restarting the chiller.

The valves should be motor valves, closing automatically when the chiller is switched off.

12.4 Dismantling, disposal

Preparatory measures

Notice

Components removed must be disposed of correctly and according to legal requirements.

► Components may be under excess pressure and must be depressurised before opening.
► During decommissioning and disposal, it must be ensured that the various materials are separated and passed on to the recycling system for further processing.
► Disposal of component residues and components as domestic waste is prohibited.
► In general, the legal regulations for the disposal of electrical equipment applicable at the installation location must be considered.
► The information in Chapter "Decommissioning" must be observed.

- Removal and disposal of the product must be carried out in such a way that:
  - the system is free of voltage and is protected against unintentional reactivation,
  - accidents to persons are prevented,
  - material damage is prevented,
  - uncontrolled escape of refrigerant or oil is prevented.
- Disposal and decommissioning work must only be carried out by personnel which is qualified according to EN 13313.
- In case of contact with refrigerant or operating media, their hazardous properties (e. g. toxicity, inflammability) must be taken into account (see also the safety data sheet for the refrigerant). Personal protective equipment according to EN 378-3 must be worn.
- National regulations (e. g. EN 378-4, Section 6) must be observed for the recovery and disposal of refrigerants.
- National regulations (e. g. EN 378-4, Annex A) must be observed for the recovery and disposal of operating media (oil).
- No unauthorised persons must be within the installation area of the plant during decommissioning, as they could come into contact with refrigerant.
- All components of the plant which are not to be re-used, as well as refrigerant and operating media, must be stored in suitable separate containers. They must be treated as waste and disposed of safely.

Notice

Re-use of operating media is not possible!

► Operating media must be treated as waste and disposed of safely.

13 Plans

13.1 Equipment log

Notice

Owners or operators of refrigeration equipment or a heat pump with filling levels of more than 3 kg of refrigerant are required to keep an equipment log under EN378 Part 2.

► The technical customer service at GEA Refrigeration Germany GmbH offers support in maintaining the equipment log.
► The equipment log needs to be stored for at least five years after manufacture and presented to the relevant authorities upon request.

The equipment log needs to include the following information:

- Service and maintenance work,
- Proof of a regular leak test,
- Quantity and type of the filled or recovered refrigerant including quantitative balance,

  If recovered refrigerant is used, then the

  – analytical findings

    and

  – the source of the recovered refrigerant

  need to be specified.
- Quantity and type of the filled or recovered oil including quantitative balance,
- Changes to and replacement of components,
- Regular and routine inspections with results and dates,
- Longer shut-down periods,
- Identification of the company or of the technical staff that carried out the servicing/maintenance.

The following documents that are part of the product documentation or this operating manual can be used for keeping a system log:

- Maintenance manual
- Measurement log of operating parameter (template)
- Data sheet of oil filling (template)
- Data sheet of refrigerant filling (template)

13.1.1 Data sheet (sample)

Operating parameters of refrigerant circuit						
User						
Refrigerant						
Type of oil						
Chiller - Type / Manufacturer **Construction no. / year of manufacture**						
Compressor - Type / Manufacturer **Construction no. / year of manufacture**						
Date / Time						
Operating hours	OH					
Slide position	%					
Speed	min^{-1}					
P_{suc} suction pressure	bar					
t_0 evaporating temperature	°C					
P_{dis} discharge pressure	bar					
T_{dis} discharge temperature	°C					
t_C condensation temperature	°C					
T_{suc}-t_0 superheat [11]	K					
P_{oil} oil difference pressure	bar					
T_{oil} oil temperature	°C					
I_{mot} compression motor current	A					
t_{W1} Inlet temperature cooling medium	°C					
t_{W2} Outlet temperature cooling medium	°C					
t_{K1} secondary refrigerant - inlet temperature	°C					
t_{K2} secondary refrigerant - outlet temperature	°C					
Oil level in oil separator [12]						
Refrigerant level in the sight glass [13]						
Remarks						
Service technician						

11 Measure suction gas temperature with a suitable sensor at the compressor suction tube
12 Oil level needs to be visible
13 Normal status: clear and bubble free

13.1.2 Data sheet oil filling (template)

Oil charging					
User					
Refrigerant					
Type of oil					
Chiller - Type / Manufacturer **Construction no. / year of manufacture**					
Compressor - Type / Manufacturer **Construction no. / year of manufacture**					
Date	**Operating hours**	**Filled recovered oil quantity (in l)**	**Absorbed oil quantity (in l)**	**Remarks (for example: quantity balance, result of oil analysis)**	**Service technician**

13.1.3 Data sheet refrigerant filling (template)

Refrigerant filling					
User					
Refrigerant					
Type of oil					
Chiller - Type / Manufacturer Construction no. / year of manufacture					
Compressor - Type / Manufacturer Construction no. / year of manufacture					
Date	**Operating hours**	**Removed refrigerant quantity (kg)**	**Refrigerant quantity intake (kg)**	**Remarks (for example: quantitative balance)**	**Service technician**

14 Appendix

14.1 Abbreviations and terms

Abbreviation	Remark
%	Numerical values in percentages
°	Symbol for the division of a scale [degree] All degree values represent angles [angular degree], unless explicitly stated otherwise.
°F	Unit of measurement for temperature [degree Fahrenheit]
°C	Unit of measurement for temperature [degree Celsius]
Δp	Pressure difference
π	Pressure ratio
AISI	American Iron and Steel Institute; material designation of the North American steel industry association
ATEX	Atmosphères Explosibles Directive of the European Union on explosion protection
bar	Unit of measurement for pressure [Bar]
CFR	Code of Federal Regulations
CO_2	Carbon dioxide; chemical formula
dB	Unit of measurement for logarithmic quantities such as sound pressure level, voltage level, etc. [Decibel]
DIN	German standard of the DIN (German Institute for Standardization e.V.)
dm^3	Unit of measurement for volume [cubic decimeter]
DN	DIN nominal size
EC	European Community
EN	European Norm
EX	Explosion protection
h	Unit of measurement for time [hour]
H_2O_2	Hydrogen peroxide; chemical formula
HP	High pressure
Hz	Unit of measurement for frequency [Hertz]
IP	Protection class of electronic equipment
ISO	International standard of the International Organization for Standardization
KM HFKW	Refrigerant - fluorinated hydrocarbons
KM NH_3	Refrigerant - ammonia
KM R22	Refrigerant - chlorodifluoromethane
KM R290	Refrigerant - propane
KM R600a	Refrigerant - isobutane
Lp	Sound pressure
Lw	Acoustic level
m/s	Unit of measurement for speed [meters per second]
m^3/h	Unit of measurement for volume flow [cubic meters per hour]
min.	Unit of measurement for time [minute]
min^{-1}	Revolutions per minute
mm	Unit of measurement for length [millimetre]
MPI	Interface of Simatic-S7 devices from Siemens [Multi Point Interface]
µm	Unit of measurement for length [micrometer]

Abbreviation	Remark
LP	Low Pressure
Nm	The unit of measurement for work [Newtonmeter] The unit of measurement for torque: 1 Nm = 0.737 lb·ft Pound-Force (lb) + Feet (ft)
PS	Maximum permitted pressure
p_0	suction pressure
Item	Position
P+I	Piping and Instrumentation Diagram
t_{0h}	Suction temperature (compressor inlet)
t_c	Condensing temperature
t_e	Discharge temperature (compressor outlet)
t_{Oil}	oil inlet temperature into the compressor
TÜV	Technical Inspection Association
V	The unit of measurement for electronic voltage [Volt]
VDI	Verein Deutscher Ingenieure (Association of German Engineers)
VDMA	Verband Deutscher Maschinen- und Anlagenbau e.V. (The German Engineering Federation)

GEA Refrigeration Germany GmbH
Holzhauser Str. 165
13509 Berlin , Germany

Phone +49 30 43592-600