Heat pump
GEA RedGenium, Compressor frame size V-HP 300 - 600

Operating instruction (Translation from the original language)
L_151511_2
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• GEA Refrigeration Germany GmbH
herein after referred to as the manufacturer. This restriction also applies to the drawings and diagrams contained in the documentation.

LEGAL NOTICE

These operating instructions are part of the technical documentation for the scope of delivery. They contain 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.
These operating instructions are intended for the users of the product and are 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 these operating instructions prior to transport, installation, start-up, use, maintenance, repair, disassembly and disposal. This obligation to read also applies to personnel involved in activities during the lifetime of the product.
The operating company must supplement these operating instructions with instructions regarding health and safety at work and environmental protection on the basis of existing national regulations for industrial safety.
In addition to these operating instructions 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.
These operating instructions are part of the product. The entire documentation comprises these operating instructions and all additional operating instructions supplied with the unit. It 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.
These operating instructions have been written in good faith. However, GEA Refrigeration Germany GmbH cannot be held responsible for any errors that this document may contain or for their consequences.
The manufacturer reserves the right to make technical modifications during the course of further development of the product covered by these operating instructions.
Illustrations and drawings in these operating instructions are simplified representations. As a result of the improvements and changes, it is possible that the figures 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.
The figure on the front page shows the **heat pump** with subcooler (optional project-related equipment feature).
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 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
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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 downtime, 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
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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? Specialy 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

GEA Refrigeration Germany GmbH has its own practical and rapidly working spare parts department to supply the necessary spare parts worldwide. Necessary spare parts are shipped as quickly as possible.

In most cases, you will receive your spare parts within 24 hours after placing the order.

You can contact us using the following hotlines:

- **Wireless, out of hours**
  +49 (0) 172 30 14 579

- **Landline, weekdays from 8 to 17 hour**
  +49 (30) 43 59 27 50

- **Fax**
  +49 (30) 43 59 27 58

- **Email**
  gea-refrigeration.de.spareparts@gea.com

- **Order spare parts from our G-Pos. online shop**
  (Grasso Parts online shop)
  www.g-pos.gearefrigeration.com

### 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.

- **Email**
  Info@gea.com
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

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<td>One of the following documents, depending on the product, is part of the product documentation for the respective project:</td>
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<td>► Declaration of incorporation</td>
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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.

![CE mark](image)

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.

1.6 Trademark rights

The product contains technical solutions for which GEA Refrigeration Germany GmbH holds the patents or has applied for them.

1.6.1 Evaporator with distributed injection

The design of the evaporator with distributed injection, forced circulation, collection and return flow of refrigerant and oil is protected by law.

Patent DE 10 2010 010 840 B4 "Overrun evaporator with forced circulation"

1.6.2 Evaporator with integrated liquid separation

A patent has been applied for the position and design of the liquid separation integrated in the evaporator.

Patent application 10 2013 010 510 A1
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 must only be operated up to a maximum discharge pressure in accordance with the nameplate.

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 operating pressure (see EN378-2) of the high pressure section of the system, this will lead to bursting of the tank 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 must be monitored and must remain within the specified limits.

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 so that a constant swept volume on the evaporator is always ensured. If the swept volume is reduced, this can lead to freezing of the secondary refrigerant and to triggering the system safety device.

Flow of media must be ensured. If the water flow is reduced or prevented, an end pressure increase with a subsequent switch-off of the compressor will occur.

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 used for any purpose other than the purpose specified here. If the pressure equipment is not used according to the regulations, safe use of the product is not guaranteed. The supplier/install-
ier 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 his operating instructions 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 and must be painted after installation. 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**
- **Hazardous Incident Ordinance** (12. BImSchV) with 1 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 implementation 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 - Directives 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 additional safety instructions as defined in "Appendix E" must be observed for the designated 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\textsubscript{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

**GEA RedGenium** heat pumps work with evaporator systems in forced circulation operation and run with a condenser operating with cooling water as heat carrier. The heat pumps have a modular design and comprise the following main modules:

- Reciprocating compressor package in high pressure design
- Heat exchanger subassembly with integrated liquid separator and de-oiling system
- Low-voltage installation with frequency inverter and control

The modular construction of the **GEA RedGenium** was optimised for a compact design. The arrangement of the components ensures the very small dimensions for large capacities.

**The GEA RedGenium is equipped with:**

- compressor, coupling, motor driveline,
- fully welded plate evaporator with integrated separator,
- fully welded chiller plate condenser,
- air cooled oil cooler
- fully welded chiller plate subcooler
  (optional equipment feature),
- fully welded liquid-cooled plate heater,
  (optional equipment feature),
- expansion device with electronic fuel injection valve,
- 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 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 heat pumps are delivered without refrigerant. They are filled with dry nitrogen (approx. 0.2 bar ... 0.5 bar overpressure).

The heat pump is delivered with the heat pump filled with refrigeration oil after the function test.

**GEA RedGenium** heat pumps are supplied, as a standard, ready for connection, fully piped and wired.
3.1.1 Technical specifications

Notice

The GEA RedGenium is manufactured and delivered according to technical specifications.
▶ Optional equipment variants can be considered on the basis of the standard equipment.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating pressure:</td>
<td>39 bar(a)</td>
</tr>
<tr>
<td>Intended environment:</td>
<td>Closed machine rooms</td>
</tr>
<tr>
<td>Ambient temperatures:</td>
<td>+15 °C to +40 °C</td>
</tr>
<tr>
<td>Installation altitude:</td>
<td>≤ 1000 m above sea level</td>
</tr>
<tr>
<td>Outlet temperature of secondary refrigerant ¹:</td>
<td>RedGenium 500 and RedGenium 1100: 3 °C to 35 °C</td>
</tr>
<tr>
<td></td>
<td>RedGenium 800: 8 °C to 22 °C</td>
</tr>
<tr>
<td>Heat carrier outlet temperature ²:</td>
<td>+50 °C to +70 °C</td>
</tr>
<tr>
<td>Electric motor:</td>
<td>scope of delivery</td>
</tr>
<tr>
<td>Refrigerant:</td>
<td>R717</td>
</tr>
<tr>
<td>Type of oil:</td>
<td>highly refined mineral oils CPI CP-1009-100</td>
</tr>
</tbody>
</table>

Caution!

Please contact the manufacturer in case of other types of oil.
▶ Contact the service or the design department of GEA Refrigeration Germany GmbH.

| Oil cooling:                         | Standard scope of delivery (air cooled)     |
| Oil heater:                          | scope of delivery                           |
| Oil filter:                          | Single stage filter                         |
| Spare oil filter:                    | Oil pressure filter cartridge, delivered separately (included) |
| Oil level switch:                    | none                                        |
| Pressure sensors:                    | on sensor block compressor                  |
| Safety pressure switch:              | electronic                                  |
| Overflow valve:                      | scope of delivery                           |
| Safety valve HP / LP:                | Double safety valve with change-over valve  |
| Flow monitor:                        | mechanical (paddle)                         |
| Control:                             | GEA Omni™                                   |
| Communication:                       | Modbus TCP                                  |
| Power current and frequency inverter:| Default scope of delivery, cable entry from below |
| Colour:                              | RAL 5014 (dove blue), control cabinet RAL 7035 |
| Soundproof housing:                  | none                                        |
| Vibration isolators:                 | without (standard)                          |
| Approval of pressure equipment:      | CE-PED, Module H (piping)                   |
| Documentation:                       | electronic (provided on a server)           |

1 temperature difference secondary refrigerant maximum 10 K
2 Heat carrier temperature difference maximum 40 K, higher outlet temperatures on request
<table>
<thead>
<tr>
<th>Designation</th>
<th>Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spare oil filter:</td>
<td>can be supplied</td>
</tr>
<tr>
<td>Communication:</td>
<td>Profibus DP</td>
</tr>
<tr>
<td></td>
<td>Profinet module</td>
</tr>
<tr>
<td>Electric motor:</td>
<td>customer specific design possible on request</td>
</tr>
<tr>
<td>Subcooler:</td>
<td>can be supplied</td>
</tr>
<tr>
<td>Desuperheater:</td>
<td>can be supplied</td>
</tr>
<tr>
<td>Flow monitor:</td>
<td>electronic</td>
</tr>
<tr>
<td>Vibration isolators:</td>
<td>can be supplied</td>
</tr>
<tr>
<td>Approval of pressure equipment:</td>
<td>CE-PED, module H1 (complete heat pump)</td>
</tr>
</tbody>
</table>
3.1.2 Mounting location of the product identification (nameplate)

The nameplate contains the most important technical data of the product. This data and the contractual agreements define the limits of authorised use. As standard, the nameplate is fixed to the switching cabinet (deviations of the location are possible).

![Fig.2: Mounting location of the product identification (nameplate)](image)

### Data on the nameplate

<table>
<thead>
<tr>
<th>Designation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEA Refrigeration Germany GmbH</td>
<td>Contact data of the manufacturer</td>
</tr>
<tr>
<td>Type:</td>
<td>Type designation of the product</td>
</tr>
<tr>
<td>Serial no.:</td>
<td>Serial number of the product</td>
</tr>
<tr>
<td>Year of manufacture:</td>
<td>Year of manufacture of the product</td>
</tr>
<tr>
<td>Weight without filling:</td>
<td>Weight without filling of the product</td>
</tr>
<tr>
<td>Refrigerant:</td>
<td>Information on the refrigerant used</td>
</tr>
<tr>
<td>Max operating pressure:</td>
<td>Max. permissible operating pressure, high pressure side PS</td>
</tr>
<tr>
<td></td>
<td>Max. permissible operating pressure, low pressure side PS</td>
</tr>
</tbody>
</table>

The standard languages are English and German.
3.1.3 Product designation, heat pumps with reciprocating compressors

GEA RedGenium series

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RedGenium</td>
<td>Heat pump series</td>
</tr>
<tr>
<td>9</td>
<td>Heat pump frame size (output)</td>
</tr>
</tbody>
</table>

RedGenium = Heat pump series
9 = Heat pump frame size (output) at 1500 rpm in kW in relation to the heat output

<table>
<thead>
<tr>
<th>Compressor frame size</th>
<th>Frame size</th>
</tr>
</thead>
<tbody>
<tr>
<td>V-HP 300</td>
<td>RedGenium 500</td>
</tr>
<tr>
<td>V-HP 450</td>
<td>RedGenium 800</td>
</tr>
<tr>
<td>V-HP 600</td>
<td>RedGenium 1100</td>
</tr>
</tbody>
</table>

Sample labelling

<table>
<thead>
<tr>
<th>Example</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RedGenium 1100</td>
<td>Heat pump with reciprocating compressor, evaporator with integrated separator(RedGenium)</td>
</tr>
<tr>
<td></td>
<td>Heat pump frame size, 1100 with V HP 600 compressor</td>
</tr>
<tr>
<td></td>
<td>Evaporator and condenser designed as fully welded plate heat exchanger</td>
</tr>
</tbody>
</table>
3.1.4 Main components

The heat pumps of the GEA RedGenium series consist of the following components:

![Standard GEA RedGenium heat pump](image)

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Common base frame for all components</td>
</tr>
<tr>
<td>10</td>
<td>Reciprocating compressor</td>
</tr>
<tr>
<td>15</td>
<td>Compressor drive motor</td>
</tr>
<tr>
<td>95</td>
<td>Coupling</td>
</tr>
<tr>
<td>180</td>
<td>Switching cabinet, control, and regulator</td>
</tr>
<tr>
<td>200</td>
<td>Oil cooler</td>
</tr>
<tr>
<td>1000</td>
<td>Water cooled subcooler</td>
</tr>
<tr>
<td>2000</td>
<td>Evaporator with integrated liquid separator</td>
</tr>
<tr>
<td>2100</td>
<td>Water cooled condenser</td>
</tr>
<tr>
<td>2900</td>
<td>Water cooled desuperheater</td>
</tr>
</tbody>
</table>
3.1.4.1 Reciprocating compressor

The GEA RedGenium uses open, single-action, multi-cylinder reciprocating compressors for the refrigerant ammonia (R717).

The reciprocating compressors are characterised by compact design, high reliability, high quality components and ease of maintenance.

The compressors are operated with ammonia (NH_{3}) as the refrigerant.

With the compressor the suction of the ammonia vapour and its compression created in the evaporator takes place at condensing pressure.

The pressure and temperature transmitters installed on the compressor are used to monitor the operating values of the compressor. With the compressor the individual cylinders can be switched off either by bypass valves or suction valve relief devices.

The compressors have the following equipment features:

- Start-up load relief
- Capacity control by cylinders switch-off
- Monitoring oil difference pressure
- Oil heater
- Monitoring discharge pressure
- Monitoring suction pressure
- Monitoring crankcase pressure
- Monitoring discharge temperature
- Monitoring oil temperature
- Monitoring suction temperature

Safety equipment on the pressure generators is standard in compliance with EN 378 by current linkage valves combined with DBK safety pressure limiters.
3.1.4.2 Compressor drive motor

**Standard:** The compressor is directly driven by an air-cooled 4-pole electric motor IP23 with an operating voltage of 400 V; 50 Hz using a coupling. The GEA RedGenium series is equipped as standard with a motor which is rpm regulated via a frequency converter (500 to 1500 rpm).

**Optional:** Motor version with protection class IP55.

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

The coupling helps in transmission of torque between compressor and compressor drive motor. The elastic 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
In the evaporator heat is absorbed from the secondary refrigerant (which is thereby cooled) by way of evaporation of the refrigerant.

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

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

![Position of the condenser](image)

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

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

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.
3.1.4.6 Oil cooler

Fig.9: Arrangement of the oil cooler

The GEA RedGenium heat pumps are equipped with an air cooled 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.

The documentation of the oil cooler (acceptance certificate) is part of the product documentation.

3.1.4.7 desuperheater (optional)

Fig.10: Position of the desuperheater
Depending on the specific project conditions, incorporating a desuperheater may have partly significant energy advantages and increase the efficiency of the heat pump, since the desuperheater capacity adds to the heating and cooling capacity without requiring additional drive power.

Before condensing, the refrigerant is heated in the desuperheater by a certain temperature difference (depending on the level of the heat carrier inlet and outlet temperatures), and its heat is transferred to the heat carrier.

The documentation of the desuperheater (operating instructions, acceptance certificate) is an integral part of the product documentation.
3.1.4.8 Subcooler (optional)

Fig. 11: Position of the subcooler

Depending on the specific project conditions, incorporating a subcooler may have partly significant energy advantages and increase the efficiency of the heat pump, since the subcooler capacity adds to the heating and cooling capacity without requiring additional drive power.

After condensing, the refrigerant is supercooled in the subcooler by a certain temperature difference (depending on the level of the heat carrier inlet and outlet temperatures) and its heat is transferred to the heat carrier.

The documentation of the subcooler (operating manual, acceptance certificate) is part of the product documentation.
3.1.4.9 Control cabinet with control

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

The control 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.

The control cabinet with the control is directly mounted on the GEA RedGenium.

**The following functions are implemented as standard** in the control cabinet with the control:

- Display of all important physical and technical parameters, such as pressure, temperature, motor current, capacity, number of hours run, operating mode and status signals.
- Automatic start-up and shutdown of the heat pump as well as capacity regulation depending on the water (brine) outlet temperature However, control is possible only by one variable.
- Monitoring of all operating parameters.
- Compressor capacity limitation, in case the measured discharge pressure, suction pressure, heat carrier outlet temperature (or secondary refrigerant outlet temperature) or motor current indicate overload.
- Alarm memory with date and time.
- Wire failure detection for all analogue input signals.
- Password protection for preventing unauthorised access to parameters.
- Program stored non-volatile on a CFast card
- Possibility of communication with master control via Modbus TCP, Ethernet/IP (optionally via Profibus DP and ProfiNet)
- Remote access (optional via Ethernet)
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.

3.1.4.10 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.

3.1.4.11 Pressure limiting safety devices

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

The overflow valve to protect the compressor is designed according to EN 13136.

The blow-off pressure is set to the maximum permissible operating pressure of the system.

The blow-off pipe has been dimensioned in accordance with EN 13136.

The electro-mechanical safety switching devices for pressure limiting comply with EN12263 and are type-approved. The settings match the specifications of EN 378-2.
If electronic safety switching devices are used for pressure limiting, 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:
- dimensioning of the piping,
- safe discharge of refrigerant when the pressure relief device is triggered.

The safety devices for pressure limiting according to EN 378-2 are the minimum requirements. Before commissioning, the requirements specified in the local operational safety regulations must therefore be compared with those of EN 378-2.

The specified test intervals must be observed to ensure proper functioning of the safety devices for pressure limiting. They are specified in the respective operational safety regulations.

### 3.1.4.12 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 Labels of the pressure and temperature sensors, heater
(safety labels)

![Safety labels of the pressure and temperature sensors, heater](image)

**Importance of the labels:**
Before replacing pressure and temperature sensors without dip tube, it must be ensured that the pipes into which the sensors are mounted are not pressurised. The pressure-free state 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 compressor into which the oil heater is screwed in is not pressurised.

3.1.5.2 Marking the safety valves
(safety labels)

![Marking the safety valves](image)

**Importance of the labels:**
The safety valve must be connected to a blow-off line that leads to the outside.

3.1.5.3 Labels of the screwed connections with cutting ring
(handling instructions)
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 \( \frac{1}{4} \) to \( \frac{1}{3} \) of a turn beyond the point where the increase in force is felt.

→ The leakage is remedied.
3.1.5.4 Labelling of the pipes

(Please refer to the attached figure for visual representation. The figure is not included in this text.

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

• Refrigerant
• Direction of flow
• Physical state

Fig. 16: Labelling of the pipes

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Arrow head (indication of the direction of flow)</td>
</tr>
<tr>
<td>2</td>
<td>Compression stage</td>
</tr>
<tr>
<td>3</td>
<td>Information field (label of the refrigerant)</td>
</tr>
</tbody>
</table>

3.1.5.5 Marking of direction of rotation of the compressor drive motor

(Please refer to the attached figure for visual representation. The figure is not included in this text.

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).
3.1.5.6 Label, Pressurised product

(Safety labels)

Fig.18: Label, Pressurised product

**Importance of the labels:**
Before working on the product, the inert gas filling must be completely emptied.

3.1.5.7 Label for transport

(Handling instructions)

Fig.19: 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.

3.1.5.8 Label of the change-over valve

(Handling instructions)

Fig.20: Label of the change-over valve

**Importance of the labels:**
Representation showing which valve setting is active.
3.1.5.9 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
  - MPI address

- Label on the inside of the switching cabinet:
  - Test verification for the control system

![Test verification for the control system](image)

Fig.21: Test verification for the control system

3.1.5.10 Designation of the earthing connection

Safety labels

![Designation of the earthing connection](image)

Fig.22: 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.
3.1.5.11 Installation and labelling of parts delivered separately

((Handling instructions))

Mounting of the designation: on the evaporator

![Fig.23: Labelling of the parts delivered separately](image)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(2045) Resistance thermometer - secondary refrigerant inlet temperature</td>
</tr>
<tr>
<td>2</td>
<td>(2000) Evaporator</td>
</tr>
<tr>
<td>3</td>
<td>(2050) Flow monitor</td>
</tr>
<tr>
<td>4</td>
<td>(2040) Resistance thermometer - secondary refrigerant - outlet temperature</td>
</tr>
</tbody>
</table>

**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”.

### 3.2 Functional description

GEA RedGenium heat pumps are used for hot water provision by heating of the heat carrier as well as cold water or cold brine cooling for air conditioning or for industrial processes.
The heat pumps are assembled and inspected at the manufacturer's factory and are intended for inside installation in machine rooms.

GEA RedGenium heat pumps are automatic systems with reciprocating compressors and plate evaporators to cool the secondary refrigerant. Water and brines can be used as secondary refrigerants.

A heat carrier is heated in the plate condenser and in the oil desuperheater and subcooler (optional).

Based on the GEA Grasso reciprocating compressor series, the portfolio of GEA RedGenium heat pumps covers a heating capacity range of approx. 350 to approx. 1100 kW with regard to the cold water range.

The heat pumps are specially designed for operation with ammonia (NH₃, R-717) as the refrigerant.

**Notice**

Consultation with regard to corrosion protection for specific individual cases.

► Recommendation: Consultation with GEA Refrigeration Germany GmbH
3.2.1 Process flow chart

**Notice**

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

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

Depending on the project conditions, the heat carrier flows through the desuperheater, condenser and subcooler.

![Process flow chart](image)

Fig.24: Process flow chart

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Reciprocating compressor</td>
</tr>
<tr>
<td>15</td>
<td>Compressor drive motor</td>
</tr>
<tr>
<td>45</td>
<td>Suction filter</td>
</tr>
<tr>
<td>60</td>
<td>Check valve – pressure side</td>
</tr>
<tr>
<td>260</td>
<td>Stop valve</td>
</tr>
<tr>
<td>280</td>
<td>Stop valve</td>
</tr>
<tr>
<td>290</td>
<td>Motor valve – suction side</td>
</tr>
<tr>
<td>1000</td>
<td>Subcooler</td>
</tr>
<tr>
<td>2000</td>
<td>Evaporator with integrated separator</td>
</tr>
<tr>
<td>2100</td>
<td>Condenser</td>
</tr>
<tr>
<td>2245</td>
<td>Injector</td>
</tr>
<tr>
<td>2860</td>
<td>Expansion valve</td>
</tr>
<tr>
<td>2900</td>
<td>Desuperheater</td>
</tr>
</tbody>
</table>
3.2.2 Refrigerant circuit

The reciprocating compressor sucks the refrigerant vapours from the evaporator through the suction filter. The heat is removed from the compressed gas, condensed and chilled in the condenser by emitting the heat absorbed in both the evaporator and compressor. The liquid coolant now being under condensing pressure is relieved to evaporating pressure and is injected into the evaporator. Evaporation and a slight overheating of the refrigerant occur in the evaporator, and also heat absorption from the secondary refrigerant so that the latter is cooled down to setpoint temperature. The small quantities of oil supplied to the coolant circuit by the low oil dip from the reciprocating compressor is collected in the evaporator and returned to the compressor by means of an oil return system.

3.2.3 Oil circuit

During the compressing process, the compressor is supplied with refrigerating machine oil for lubrication and control.

3.2.3.1 Oil heater

The oil heater in the compressor housing is to be started when the plant is shut down in order to ensure a minimum oil temperature and sufficient oil viscosity required for restarting the chiller. The oil heating is not regulated. The maximum oil temperature 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.

3.2.3.3 Oil filter

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. The filter has a relative filter fineness of 25 µm.

3.2.3.4 Oil return from the low pressure side

In spite of the low oil carry over of the Grasso reciprocating compressor, oil will always reach other parts of the plant. For returning the oil from the liquid separator, the product is equipped with a special automatic oil return system. The automatic oil return system works with a draining vessel and five solenoid valves as standard.

1. **Filling the draining vessel (2300)**
   
   A refrigerant/oil mixture is drained from the evaporator and led to the draining tank. To this end, a solenoid valve (2305) is opened.

2. **Evaporation of refrigerant**

   The solenoid valve (2305) is closing. Perhaps existing liquid refrigerant can evaporate in the drainer by heating with pressurized gas. The evaporation time is restricted by the control and the temperature monitored.
3. **Expelling oil from the draining vessel**

After evaporation, hot gas is led via the solenoid valve (2310.1) into the draining vessel for a short while and this pushes the oil into the crankcase of the reciprocating compressor.

The control time parameters for the solenoid valves can be set at the control panel.

### 3.2.4 Capacity control

A capacity setting is also achieved through speed control using a frequency inverter in the speed range of 500 to 1500 rpm.

The capacity setting in the reciprocating compressors is achieved by raising and lowering the suction valves on the refrigerant compressor using the control oil pressure.

**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 Level control of the evaporator

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

Control is effected by calculating the mass flow of refrigerant in relation to the pressure loss across the expansion valve and its characteristics.

In addition, the fluid level of ammonia is evaluated in an oblique pipe after the condenser. If the level decreases, the lower sensor sends a signal to the valve to reduce the opening position. If, on the other end, the maximum level sensor indicates a level that is too high, the expansion valve opens further.

Notice

The following points must be checked before commissioning to ensure correct functioning of the injection control.

- Checking the settings: have compressor frame size and type of expansion valve been properly selected; are pressure transmitters correctly scaled?
- Checking the fill level indicators: are the sensors installed and wired?
- Checking the information for filling: is the system filled according to the specifications for refrigerant and oil? (No condensable gases, e.g. air, may be in the piping to ensure proper functioning of the injection control.)
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.
4.3 Storage conditions

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

The storage area of product must be a safe and sheltered environment secured against access of unauthorized personnel. The product should be placed on a flat, load bearing surface on suitable timber supports.

Notice

The product must be adequately protected from external influences (humidity, frost, extreme heat) during storage. This may occur where some period of storage may occur outdoors or after installation in unheated plant rooms prior to start-up of the installation of the product.

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

► The venting slits of the electric motors must always be covered!

Storage temperature: 5 °C ... 40 °C

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

Notice

When delivered, the product is filled with protective gas that will prevent a change of the properties of an operating media (e.g. refrigerator oil).

► Check the protective gas filling once a week and recharge to the specified overpressure of 0.3 - 0.5 bar if required. Dry nitrogen with a residual moisture of ≤ 30 ppm is used for this purpose.

Turn the shaft of the compressor at least once every four weeks (approx. 10 revolutions).

The transport packing (foil), that needs to be opened for turning the compressor shaft and for checking the protective gas filling, must be closed again after carrying out the activities in order to ensure protection against external influences. The packing (foil) must be replaced as needed and for lengthy storage times.

Notice

The build-up of condensation on the product surface must be avoided.

► Regular ventilation of the product must be guaranteed!

Long-term storage

With a standstill of the compressor for more than 16 weeks prior to start-up, there is a danger that the shaft seal may stick on the shaft and therefore be damaged on start-up.

For this reason the removal and cleaning of the shaft seal is prescribed to guarantee its subsequent functionality.
4.4 Transport (crane transport)

Transport with a forklift 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 have the same position (frame downwards) as in operation. Do not use any other lifting points than those specially provided for this purpose. The lifting points are marked!

![Designation of the lifting points](image)

Caution!

Avoid damaging the product during transport!

- It is forbidden to fasten the product to fittings or pipes or to the eyebolts/lifting rings of the compressor, the electric motor, the vessels or the control 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.

Make suitable arrangements (timber or insulating material) to avoid damage to the surface.

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.

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**

Essentially, all regulations and directives, such as described in the transport instructions for the respective product series from GEA Refrigeration Germany GmbH must be complied with.

The current version always applies. The transport instructions are valid for in-house transport and transport to the customer, including the necessary loading and unloading operations for the transport.

When introduced on the customer side, additional and other regulations can apply that are not within the area of responsibility of GEA Refrigeration Germany GmbH.

In the event of damages caused by deviations from the described transport instructions and the use of impermissible slinging equipment, GEA Refrigeration Germany GmbH shall not be liable.

► **The transport instructions can be accessed as a separate document at GEA Refrigeration Germany GmbH.**

### 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.
5 Technical data

5.1 Key data

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

- order specification,
- parameter list,
- general assembly drawing,
- P+I diagram,
- Panel data report.

5.2 Basic terms

**Refrigerant**

Materials circulating in a plant (liquid or gas), which by means of their change of state of the package withdraw heat from another medium (cooling or heating agent) 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).

**Heating agents**

Media (liquid or gas) that, e.g. transport and dissipate the absorbed heat. If water is used as the heat carrier, the terms warm water or cooling water are also used.

**Performance test**

Factory acceptance test (FAT), test run of the heat pump under defined conditions (depending on the secondary refrigerant or heating agent, ambient temperature) at the plant's test bench.

The maximum heat carrier outlet temperature is limited, however, to 47 °C, allowing a performance test for the GEA RedAstrum product currently only under reduced project conditions.

**Function test**

Function test (EOL = end-of-line test), start-up of the heat pump and passing through the entire speed band for which the motor is designed.

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 Refrigerator oils

**Caution!**

In order to ensure an adequate load-bearing capacity of the sleeve bearings and to ensure the service life of the roller bearings, a minimum viscosity of 7cSt upstream of the compressor is required. 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 "GEO Grasso VHP". This technical information forms part of the product documentation.
- GEA Refrigeration Germany GmbH can provide assistance in the selection of a suitable refrigerator oil on request.

Recommended oil type: **CPI CP-1009-100**

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
  - Temper
  - NH₃ solution
  - Alcohols (e.g. Ethanol)

**Notice**

Compatibility with the materials used must be ensured for all secondary refrigerants.

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

5.3.4 Heating agents

- Water, non corrosive, maximum 150 ppm Cl
- Approved brines:
  - Ethylene glycol based
  - Propylene glycol based
  - Temper

**Notice**

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

- Recommendation: Consult with GEA Refrigeration Germany GmbH in specific use cases.
If brines are used as the heating agent in the condenser, it must also be checked whether the 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 heating agent in the condenser!
  - The operating pressure of the heating agent must always be above the respective boiling pressure of the heating agent which corresponds to the medium temperature. The inlet temperature on the ammonia side of the condenser and the outlet temperature on the liquid side are significant for this temperature and pressure.

### Example

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating agent water:</td>
<td>Inlet temperature 50 °C</td>
</tr>
<tr>
<td></td>
<td>Outlet temperature 70 °C</td>
</tr>
<tr>
<td>Reciprocating compressor:</td>
<td>$T_{\text{Pressure side}} \leq \text{up to } 150 , ^\circ \text{C}$</td>
</tr>
<tr>
<td>Inlet temperature of refrigerant gas in the condenser:</td>
<td>up to 150 °C</td>
</tr>
<tr>
<td>Operating pressure to be maintained on the water side:</td>
<td>500 kPa (1500kPa(a))</td>
</tr>
</tbody>
</table>

#### 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 heat carrier, 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 Operation limits

The heat pumps from the GEA RedGenium series can be operated within the specified operation limits according to the respective specifications under diverse work conditions. The operation limits listed below are based on the operational principle of the reciprocating compressor, thermodynamic relationships, the vessels and safety devices in use, and the practical operating conditions.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>GEA RedGenium value</th>
<th>500...1100</th>
<th>800</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>( n ) rpm</td>
<td>min 500</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>max 1500</td>
<td></td>
</tr>
<tr>
<td>Design pressure - high pressure side</td>
<td>( PS ) bar (a)</td>
<td>max 39</td>
<td></td>
</tr>
<tr>
<td>Design pressure - low pressure side</td>
<td>( p ) bar (a)</td>
<td>max 26</td>
<td></td>
</tr>
<tr>
<td>Suction pressure</td>
<td>( p_{suc} ) bar g.</td>
<td>min 2.0</td>
<td>5.17</td>
</tr>
<tr>
<td>Discharge pressure</td>
<td>( p ) bar (a)</td>
<td>max 13.0</td>
<td>10.0</td>
</tr>
<tr>
<td>Pressure ratio ( p / p_{suc} )</td>
<td>( \pi )</td>
<td>min 1.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>max 6.0</td>
<td></td>
</tr>
<tr>
<td>Pressure difference ( p - p_{suc} )</td>
<td>( \Delta p ) bar</td>
<td>max 25.0</td>
<td></td>
</tr>
<tr>
<td>Outlet temperature of water as secondary</td>
<td>( t_{K2} ) °C</td>
<td>min +3.0</td>
<td>+8.0</td>
</tr>
<tr>
<td>refrigerant</td>
<td></td>
<td>max +35.0</td>
<td>+22.0</td>
</tr>
<tr>
<td>Heating agent outlet temperature in the</td>
<td>( t_{W2} ) °C</td>
<td>min +50.0</td>
<td></td>
</tr>
<tr>
<td>heat pump</td>
<td></td>
<td>max +70.0</td>
<td></td>
</tr>
<tr>
<td>Oil temperature</td>
<td>( t_{oil} ) °C</td>
<td>min +45</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>max +70</td>
<td></td>
</tr>
<tr>
<td>Discharge temperature at compressor outlet</td>
<td>( t_{dis} ) °C</td>
<td>min +80</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>max +150</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>( t_{U} ) °C</td>
<td>min +15</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>max +40</td>
<td></td>
</tr>
<tr>
<td>Ambient humidity</td>
<td>( f ) %</td>
<td>max 95</td>
<td></td>
</tr>
</tbody>
</table>

Notes

1. When considering a specific application, all the conditions specified in the table must be taken into account and adhered to.
2. If the specified limits are exceeded for a specific application, GEA Refrigeration Germany GmbH must be consulted.

\[3\] The given pressure ratio and pressure difference ensure reliable compressor operation. Furthermore, allowance must be made for the pressure difference necessary for the control valves fitted in the refrigerating plant. Generalised maximum values for pressure ratio and difference cannot be specified due to their dependence on different parameters. Depending on the suction pressure level, the maximum possible discharge pressure may be below the value specified. The respective compressor usage diagrams apply. To comply with the minimum pressure difference, we recommend customer to provide a water-side 3-way valve.

\[4\] Depending on the secondary refrigerant temperature level and the corresponding suction pressure, the maximum possible outlet temperatures of the heat carrier may be below the value specified due to the maximum pressure ratios and the pressure differences. The respective temperature operation limit diagrams of the compressor apply. Higher outlet temperatures on request.
3. In addition to the operating limits stated in the tables, the applicable operating conditions of the compressor must also be considered (e.g. start-up regime, oil pressure, oil quantity, oil type etc.).

4. The oil temperature at the compressor inlet must be at least 18 °C and below 70 °C.

5. The specified data refer to the operating conditions of a heat pump. During downtime or start-up, the limiting values may be exceeded or fallen short of for a short (never long-term) period of time.

6. The operating parameters of the order confirmation apply for an agreed field test.
5.6 Monitoring and display of process values

The following operating parameters are continuously monitored and displayed by the control:

<table>
<thead>
<tr>
<th>Designation</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suction pressure</td>
<td>Suction pressure in bar (a) and the corresponding evaporating temperature in °C</td>
</tr>
<tr>
<td>Discharge pressure</td>
<td>Discharge pressure in bar (a) and the corresponding condensation temperature in °C</td>
</tr>
<tr>
<td>Oil pressure</td>
<td>Oil pressure in bar(a)</td>
</tr>
<tr>
<td>Crankcase pressure</td>
<td>Crankcase pressure in bar (a)</td>
</tr>
<tr>
<td>Suction temperature</td>
<td>Suction temperature in °C</td>
</tr>
<tr>
<td>Discharge temperature</td>
<td>Discharge temperature in °C</td>
</tr>
<tr>
<td>Oil temperature</td>
<td>Oil temperature in °C</td>
</tr>
<tr>
<td>External temperature</td>
<td>Secondary refrigerant - outlet temperature in °C</td>
</tr>
<tr>
<td>SR inlet temperature</td>
<td>Secondary refrigerant - inlet temperature in °C</td>
</tr>
<tr>
<td>Motor current</td>
<td>Motor current in A</td>
</tr>
<tr>
<td>Motor speed</td>
<td>Motor speed in rpm</td>
</tr>
<tr>
<td>Heating agent inlet temperature</td>
<td>Heat carrier inlet temperature into the heating circuit in °C</td>
</tr>
<tr>
<td>Heat carrier outlet temperature</td>
<td>Heat carrier outlet temperature from the heating circuit in °C</td>
</tr>
<tr>
<td>Heat carrier inlet temperature</td>
<td>Intermediate temperature from the heat carrier circuit between condenser and desuperheater in °C</td>
</tr>
<tr>
<td>Heat carrier outlet temperature</td>
<td>Intermediate temperature from the heat carrier circuit after subcooler exit in °C</td>
</tr>
<tr>
<td>Operating hours</td>
<td>Running hours</td>
</tr>
<tr>
<td>Auto start delay</td>
<td>Remaining time for auto start delay in sec.</td>
</tr>
<tr>
<td>GEA VTrac™</td>
<td>Continuous monitoring of the compressor and motor bearings by means of two sensors in m/s for early detection of sudden bearing damage (no normal long-term wear)</td>
</tr>
<tr>
<td>Oil return temperature</td>
<td>Temperature in oil collection tank in °C</td>
</tr>
<tr>
<td>Switch-on blocking time</td>
<td>Start to start, remaining time between two starts of the compressor in sec.</td>
</tr>
<tr>
<td>Compulsory break</td>
<td>Compulsory break timer, remaining time in sec.</td>
</tr>
<tr>
<td>Ambient air temperature</td>
<td>External temperature in °C</td>
</tr>
</tbody>
</table>

5.7 Sound pressure level

**Measuring-surface sound pressure level**

Distance to the machine surface: 1 m (A-sound level at free field conditions on reflecting surface) for heat pumps (1 compressor and 1 drive motor).

**Determining the measurement values without secondary sound insulation.**

**Notice**

Measuring-surface sound-pressure level strongly depends on the type of the heat pump and especially on the type of the drive motor (manufacturer, type, protection type).

► We can provide you with the values on request. Contact the Design or Sales department at GEA Refrigeration Germany GmbH.
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 Requirements 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 product on a level surface. The difference from the horizontal must not be more than 0.3 %. Provide enough space for maintenance work.

Under normal conditions, the product stands solidly on the installation surface due to its dead weight. It is advisable to provide ribbed rubber plates in between the installation surface and base or product base frame.
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 products have to be installed in closed machine rooms 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 +15 °C to +40 °C.

Notice

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

► See EN 378-1 and EN 378-3.

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 Installation of the Screw Compressor for Insulation against Structure-borne Sound

For installation on intermediate ceilings, matched vibration decoupling must be carried out on the ceiling construction.

The vibration isolators supplied have to be fixed to the foundation bolts during assembly. Please consult the drawing of the product for further information about the layout and position of the holes for attaching the vibration isolators (order documentation). Lines for the secondary refrigerant and the cooling medium must be decoupled from any vibrations with flexible connections.

Be sure to check the alignment of the coupling prior to or during the start-up, and correct any deviations.

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 heat pump must be purged by opening the vent valves on the suction side before the connection of the pipes.

**Caution!**

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

► There are always small residual amounts of NH$_3$ in this heat pump.

► Heat pumps posing a corresponding hazard are identified with a yellow sign indicating: Warning inert gas filling on refrigerant side: N$_2$ 0.5 bar g. with remnants of ammonia (factory test run).

► These heat pumps are filled after the functional run with the operating amount of oil (labelling on the oil filter with appropriate oil type).

Establish all pipe connections so that the transmission of thermal expansion and vibration to the heat pump 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.

All pipe connections are to be fitted with fixed points directly on the heat pump.

• Connection of:
  – Secondary refrigerant
- Heating agents
  - For heat pumps with TÜV approval: shut off safety valve on the blow-off line

⚠️ Caution!

The heat pump requires a constant flow of secondary refrigerant 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 heat pump 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 heat pump 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.

► The manufacturer recommends enlisting the services of a reputable water conditioning company.

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

- Secondary refrigerant system

After the heat pump has been aligned, its secondary refrigerant side can be connected up. The piping system for the secondary refrigerant 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 secondary refrigerant 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 secondary refrigerant should be kept at a constant level. Temperature sensor item 2040 for measurement of the outlet temperature and item 2045 for measurement of the inlet temperature of the secondary refrigerant are delivered with a separate welded sleeve and are, like the flow switch item 2050, to be installed into the pipeline system by the installer.
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.

Between the secondary refrigerant outlet from the evaporator and the temperature sensor item 2040 there should be at least 2 m of pipeline and two 90° changes of direction installed via pipe elbows or fittings. If the temperature sensor item 2040 is installed immediately downstream of the flow switch item 2050, then a clearance of 5 to 10 times the pipe diameter must be allowed for. 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.26: Secondary refrigerant system**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>Evaporator/liquid separator</td>
</tr>
<tr>
<td>2040</td>
<td>Resistance thermometer - secondary refrigerant outlet temperature</td>
</tr>
<tr>
<td>2045</td>
<td>Resistance thermometer - secondary refrigerant inlet temperature</td>
</tr>
<tr>
<td>2050</td>
<td>Flow monitor</td>
</tr>
</tbody>
</table>

---

**Heating agent system**

The size and position of the water connections for the condenser, oil cooler and subcooler (optional) are indicated in the drawing contained in the order documentation.

Install the heat exchangers on the pressure side of the pump.

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

Temperature controllers to measure the cooling medium inlet temperature (item 2145) or outlet temperature (item 2140) as well as the flow switch (item 2050) must be installed with the loosely supplied welded sleeves, as well as the secondary refrigerant sensors on the evaporator side.

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 increasing maintenance costs as a consequence of additional applications for removing dirt layers or exchanging corroded components, a water treatment specialist should be consulted.

### 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 earthing connection".

The heat pump has been designed for plug-in and reliable automatic operation. All connections must be carried out according to the current installation regulations.

All connections to the heat pump 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 heating agent and for heat carriers).

► 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.

Standard colour of product: RAL 5014 pigeon blue (other colours can be selected as required.)

Colour of control cabinet / switching cabinet: RAL 7035 light grey

**Insulation**

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!**

Danger of ammonia!

► For systems with FAT, you must refer to chapter "Measures during shut-downs"!

**See nameplate for permissible operating pressure.**

The necessary safety precautions must be taken before performing the leak test.

Prior to the pressure test, the valve positions must be checked.

For testing, perform a pressure loss test for approx. 3 hours with dry nitrogen.

For compressor packages, perform the pressure loss test with a test pressure of 7 bar, for chillers and heat pumps separate by low pressure side or high pressure side 1 bar below maximum operating pressure.

A pressure drop of 2% is permissible during the 3 hours, while fluctuations of the ambient temperature must be taken into account.
A record should be kept of the leak test, noting the pressure in the pipes tested, the ambient temperature and the outside temperature in the shade at hourly intervals.

The removed measuring and control instruments should be reinstalled after completion of the leak test and if there are no leaks in the product.

**Test strategy**

Dry nitrogen is used as the test medium. After reaching the test pressure, the pressure drop is measured via the differential pressure measurement. This may only change by 0.02 bar within an hour. If the display device does not indicate a leakage through foam formation, the system is sealed.

**Testing devices**

A pressure gauge with an accuracy of 0.5 % over the entire measuring range, with a digital resolution of 0.01 bar must be used for the measurement.

The test procedure described here refers to pressure gauges with gauge and LEAK modes from Keller.

**Display devices**

A foaming agent must be used as the means to indicate leakages. A solution of 50 parts water and 1 part detergent can be used as the foaming agent. Leakage is detected by formation of foam. A leak detection spray can be used in problem areas.

**Carrying out the test**

1. Wet all connecting joints (welded seams, flange connections, screw fastenings, etc.) with foaming agent.
2. Remedy any leakages detectable from the noticeable formation of foam.

**Caution!**

- Do not damage the gasket in the valve insert!
  - To prevent damage to the valve insert, vent the low pressure side after pressure-testing the system, or the valve must be fully open during the pressure test and during venting.
  - If the control (GEA Omni™) is operational, the valve can also 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.
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.

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**Fig.28: Stop valve open**

Stop valve *open* during normal operation

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**Fig.29: Stop valve closed**

Stop valve *closed* during normal operation

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**Fig.30: Check valve**

Check valve during normal operation

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**Fig.31: Shuttable check valve open**

Shuttable check valve *open* during normal operation
Control valve *adjusted*:
- Start-up
- when operating conditions change

Shuttable check valve with integrated control function *open* during normal operation

Controlled by (e.g. GEA Omni™)

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

Operating position: *shut*
\[ \Delta p \, x, x \pm x \, \text{bar} \] control pressure to be set vis-à-vis reference pressure (see P+I diagram)

**Caution!**

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!

▶ See chapter "Adjustment of oil pressure"
Start-up
First start - Start-up procedure

Fig. 37: Overflow valve, safety valve
Overflow valve, safety valve

Fig. 38: Pressure controlled check valve
controlled self-sufficient

Fig. 39: Quick acting valve, spring-loaded
manually operated if necessary

Fig. 40: Charging valve, drain valve
• ½” connections
• with cap

Fig. 41: Service valve
• Connection Rp ¼”
• For pressure gauge and pressure transmitter

Fig. 42: Thermostatic 3-way valve
controlled autonomously using control element
7.5.5 Oil filling

⚠️ Caution!

Check the oil grade to be filled!
► See contract/project or recommendation of GEA Refrigeration Germany GmbH.

Only charge with fresh, unused oil.

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

The stop valve oil drain connection or oil filling (90) must be connected with the oil charging tank.

Before filling with oil, switch the valves to the operating position.

Open the stop valve (90) until the oil level has reached the top third of the sight glass assembly in the compressor crankcase.

When charging with oil for the first time, oil must also be charged via the oil prelubrication valve on the reciprocating compressor.

The installation and maintenance instruction for the reciprocating compressor which is part of the product documentation is to be observed for this.

Notice

Due to the use of selected components, the refrigerator oils tend to absorb more moisture.
► Therefore, when charging a product, 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.
7.5.6 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 Setting the oil differential pressure

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

**Setting value = see parameter list**

⚠️ **Warning!**

Maintaining the correct oil differential pressure!

► The oil differential 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.
7.5.8 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.

• When checking the direction of rotation of the compressor driving motor pay attention to the conditions for switching the compressor on.

![Diagram of motor direction of rotation](image)

Fig.45: Motor direction of rotation (schematic representation)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Compressor</td>
</tr>
<tr>
<td>B</td>
<td>Motor</td>
</tr>
</tbody>
</table>

• The compressor drive motor is started directly and then switched off again by forcing the digital outputs. Before starting, check that the coupling hub (motor side) is seated tightly. 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.
7.5.9 Mounting the coupling

1. The electric switchgear is secured to prevent it from being switched on accidentally.

2. Mount the coupling while observing the instructions of the separate documentation.

3. 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.

**Danger**

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

▶ Solid mounting of the coupling protection must be checked.

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 or heat carrier controller is installed, this must be set under project conditions so that the condensing and oil temperature lies within the allowable range.
7.5.11 First refrigerant fill

⚠️ Warning!
Exposure to leakage of refrigerant is possible.
► Whenever work is carried out on the parts of the refrigeration circuit carrying refrigerant or oil, extreme caution is required.

Notice
In order to charge the refrigerant, the compressor must be ready for operation.
► Check that 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)

Only use ammonia acc. to ISO no. D15 11014 that contains less than 30 ppm of water!
For the amount of ammonia fill, refer to the Technical Specifications.

Filling connections:
After the lubricant has been filled, the refrigerant circuit can be charged with refrigerant through the refrigerant draw-in valve(s). The refrigerant draw-in valve is shown on the supplied P+I diagram of the product (see order-dependent documentation).

Notice
Comply with occupational safety and health regulations!
► Wear safety glasses and protective gloves.

Filling procedure for refrigerant:
1. Required equipment: NH₃ filling cylinder, scales, special NH₃ filling hose line with cylinder connection at one end and stop valve at the other end.
2. Connect hose to the cylinder and vent when evacuating the product, for example.
3. Connect the stop valve hose to the product refrigerant draw-in valve by means of an adapter
4. Determine the cylinder weight
5. Open the product refrigerant draw-in valve.
6. Open the cylinder valves and admit refrigerant circuit. Monitor the change in weight of the cylinder. Leave the refrigerant draw-in valve open until the required amount is in the refrigerant circuit or pressure compensation has been produced. If more refrigerant is needed, it can only be topped up after the initial operation
7. Close refrigerant draw-in valve and stop valve hose, separate the hose from the product and lift up the hose to make liquid refrigerant flow back into the cylinder, then close cylinder valve.

8. Prior to disconnecting the filling hose from the cylinder, and respecting all relevant safety rules, carefully drain the gas contents of the hose into the water tank.

→ The refrigerant filling procedure is complete.

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.

7.6 Handing over to the operator

Shipment is made in the type of packing stipulated in the order. The product is generally supplied without packaging.

The product has a protective gas filling in the refrigerant circuit.

The media connections are closed.

⚠️ Warning!

The compressors of the product are not filled with oil, therefore the product cannot be started immediately after delivery!

► It may only be started after proper assembly, installation and commissioning!

7.7 Restarting

7.7.1 Start-up after long standstill periods

1. Inserting the main fuse
2. Switching on the control unit according to the operating manual.
3. Checking all parameters on the control unit display. See parameter list.
4. Checking the settings of all control and safety devices.

7.7.2 Restart after about 1 year shut-down

1. Change the oil filter elements (see maintenance instructions).
2. Switch on the oil heater at least 1 hour before starting the product.
3. Close the stop valve on the suction side and the pressure side (or shuttable check valves).
4. If available: open stop valves (or (or shuttable check valves) in the suction line of the economiser (not included as standard for heat pump applications).

5. If present: open the refrigerant supply to the thermosyphon - oil cooler (not included as standard for heat pump applications).


7. Remove all non-condensible gases by venting. To this end, check the condensing pressure and temperature (see parameter list).

8. Check the oil collection sump and empty if necessary.

9. 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 15 °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 regulation

Possibilities of the compressor regulation:

• Manual regulation
• Automatic regulation
• Remote regulation via contacts
• Remote regulation via a network connection

**Notice**

Regulation parameters with a description of their function are represented in the operating manual of GEA Omni™.

► The operating manual of GEA Omni™ is part of the documentation for 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.**

### 8.3.4 Operation of the system

**Caution!**

Familiarise yourself with the control system documentation.

► Contact the technical customer service department of GEA Refrigeration Germany GmbH if you need assistance.

The product is operated via the controller. (Standard: GEA Omni™)

1. The control is mounted directly on the product as standard, but alternatively may also be set up in a control centre.

2. The control system consists of the control unit with operator keypad and display unit (TouchPanel), indicator lights for "Running", "Warning" and "Fault", the emergency STOP button, the output relays and the housing.

3. All switching, operating and control actions are carried out via this TouchPanel. The TouchPanel is the interface between the human user and the product.

**The control system performs the following functions as standard:**

- Display of all important physical and technical parameters, e.g. pressure, temperature, motor current, capacity, number of running hours, operating 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 discharge pressure or a media outlet temperature),

- monitoring of all operating parameters,

- performance limits of the compressor in case the controlled variable measured (e.g. suction pressure or discharge pressure or a media outlet temperature parameter) or the motor current indicates 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,

- program stored non-volatile on a CFast card,

- communication via Modbus TCP, Ethernet/IP (optionally via Profibus-DP, Profinet or Modbus RTU).
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 65 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 refrigerant 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 Opening the compressor

**Notice**

Carry out the work on the compressor in accordance with the compressor maintenance manual.

▶ The Installation and Maintenance Manual is part of the product documentation.

If the compressor has to be opened to clean the crankcase or replace components, the pressure must be relieved first.

**Procedure:**

1. Shifting the refrigerant to the evaporator in manual operating mode by closing the suction stop valve and the oil return stop valve.
2. After the crankcase pressure has dropped to \( p = 0 \) bar (overpressure), switch off the compressor and close both manual stop valves on the compressor.
3. Attach hose to pressure chamber service valve and use an extraction device to remove remaining refrigerant.

▶ The compressor may now be opened.

After opening the compressor and prior to a restart, remove any air that may have entered during evacuation.

**Comply with the occupational safety regulations.**

10.4.2 Replacing the oil filter

Change the oil in accordance with the compressor maintenance manual.

10.4.3 Dismantling the compressor suction filter

The suction filter is a dirt trap on the suction side of the compressor.
To clean it, proceed in the same way as for dismantling the compressor.
Remove the suction filter after the ambient pressure is reached.

After cleaning or filter change and reassembly, you should evacuate.

**Notice**

See also Installation and Maintenance Manual for compressor.

▶ The Installation and Maintenance Manual is part of the product documentation.
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, implementation

(See also installation and maintenance instructions for compressor)
1. The chiller must be run for at least half an hour to reach its operating temperature before the oil can be changed.

2. First shut down the chiller as described in the operating instructions.

3. Close the stop valves of the compressor side and the compressor pressure side and evacuate the compressor.

4. Subsequently, drain the used oil through the oil draining / oil charging valves and dispose of it (Attention! Hazardous waste!). Once this has taken place close the valve again.

5. Clean the interior of the compressor crankcase with a lint-free cloth.

   Subsequently, mount the covers on the crankcase again using new gaskets.

6. The filter insert of the oil pressure filter must be replaced.

7. Charge the compressor crankcase above the oil charging valve with fresh oil of the indicated amount.

   Check the fill levels at the sight glass during this.

8. Evacuate the compressor using a vacuum pump.

9. Open the suction side and pressure side stop valves again.

10. Then check all components for leakages. The oil charge oil and start-up of the chiller 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
   • if there is too much oil in the circuit.

   The oil must be drained in accordance with points 1 to 4 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.

10.4.6 Checking the oil level

   The oil level is checked visually in the sight glass of the oil separator.

   The filling level should be 1/2 to 3/4 of the height of the sight glass.

   If the filling level is too low, replenish the oil. The filling amount must be documented in an appropriate log.

10.4.4.7 Filling with oil, topping up with oil

   See chapter "Start-up, charging with oil".
10.4.5  
**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.

10.4.6  
**Coupling maintenance**

1. Decommissioning the plant  
2. Secure the electric motor against accidentally being switched on.  
3. Visually inspect the disk packs.  
4. Check the tightening torques of the fit screws.  
5. Check the alignment condition of the electric motor and, if necessary, correct in accordance with the steel disc coupling documentation  
6. Re-grease the coupling (if provided for in the maintenance instructions for the coupling).

10.4.7  
**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.

10.4.8  
**Searching for leaks on the refrigerant side / leak test**

The absence of leaks is a precondition for perfect functioning of the product. 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 filling (delivery state),  
- Loss of the entire refrigerant filling  
  or  
- resulting under-filling.
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 after assembly or commissioning.

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 air is about 5 ppm and thereby far below the permitted MAK values.

Methods of leak detection:

- Regular visual inspections.
- Smudges/dirt stains indicate leaking refrigerant/oil mixture.
- Leak test with nitrogen with max. 0.5% ammonia by volume and a dwell time > 3 h and brushing all connection areas with foaming agent. Oil-filled compressors or circuit sections must only be filled with nitrogen, not with air, to generate pressure.
- Use of an NH₃ leak 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!**

Risk of explosion

► Never use oxygen to build up the pressure!

For the leak test for determining the leakage on the refrigerant side, e.g. with escaping inert gas or refrigerant filling, a test pressure must be generated in the refrigerant circuit which corresponds to the specified operating pressure. When system parts are individually tested, the maximum operating 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. Relieve the test pressure before starting repairs! Evacuate the system after repairs are perform another leak test.

The supplier is not liable for losses of refrigerant caused by a lack of or improper maintenance!

**10.4.9 Venting the refrigerant circuit**

When air penetrates into the refrigerant circuit, this makes itself felt in a fall-off in performance, and the manometer on the discharge side of the compressor indicates a higher pressure. Any leaking must be properly rectified. 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 gap between condensing temperature (from condensing pressure) and heating agent outlet is widening. Contamination of the circuit with air or other gases is caused by carelessness during evacuation, filling oil or contaminated refrigerant.

**If this gas obstructs further operation:**

- Shut down the product
- Close the pressure valve
- Lower the refrigerant level in the liquid line down to the stop valve (item 2010) level by manually opening the injection valve
- Close stop valve
- Drain air/ NH$_3$ mixture into water-filled tank (dispose of properly)
- Evacuate condenser
- Open valves

There are several ways of venting the system. The air or the NH$_3$ air mixture is drained into tanks filled with water at the vent valves of the suction filter during standstill of the heat pump.

If air is contained in the mixture, the venting NH$_3$ is absorbed by water.

### 10.4.10 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.

### 10.4.11 Draining refrigerant circuit

Open the stop valve (2330) **carefully** to drain any existing oil out of the evaporator.

**Danger**

You must observe the safety rules of working with the refrigerant ammonia!

- Keep the safety equipment handy (protective breathing mask)!
- Working only together with a 2nd person!
10.4.12 Charging refrigerant
See Section 7.5.11, Page 85

10.4.13 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 threaded together with the drain valve and the other end fixed firmly 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 permissible limits.

### Checking the operating parameters

<table>
<thead>
<tr>
<th>Parameter to be checked</th>
<th>Every 24 to 72 h</th>
<th>Weekly</th>
<th>Monthly</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discharge temperature</td>
<td>X</td>
<td></td>
<td></td>
<td>Maximum discharge temperature 150 °C, in individual cases (e.g. heat pump applications) this may be exceeded in agreement with the manufacturer.</td>
</tr>
<tr>
<td>Oil temperature</td>
<td>X</td>
<td></td>
<td></td>
<td>See parameter list!</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The viscosity must not be less than 10 cSt.</td>
</tr>
<tr>
<td>Oil pressure</td>
<td>X</td>
<td></td>
<td></td>
<td>The oil difference pressure to the discharge pressure must not be lower than 1.7 bar. In the event of an oil difference pressure fault, a contaminated oil filter may be the cause.</td>
</tr>
<tr>
<td>Compression discharge pressure</td>
<td>X</td>
<td></td>
<td></td>
<td>See project value (parameter list). Determine the superheat temperature on the pressure side by comparison with the final discharge temperature.</td>
</tr>
<tr>
<td>Oil level in compressor</td>
<td>X</td>
<td></td>
<td></td>
<td>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, refill oil.</td>
</tr>
<tr>
<td>Oil heater</td>
<td></td>
<td></td>
<td>X</td>
<td>When compressor is shut down, the heater must automatically start.</td>
</tr>
<tr>
<td>Setting the safety devices</td>
<td></td>
<td>X</td>
<td></td>
<td>See the setting values in the parameter list.</td>
</tr>
<tr>
<td>Number of operating hours</td>
<td></td>
<td></td>
<td>X</td>
<td>See maintenance instructions for maintenance work to be carried out according to the number of operating hours.</td>
</tr>
</tbody>
</table>
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 65 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>
<thead>
<tr>
<th>Fault table</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fault</strong></td>
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<tr>
<td>The compressor(s) do not start after switching on or switch off again immediately after the start.</td>
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<tr>
<td>External safety.</td>
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<tr>
<td>The compressors do not adapt to the required capacity.</td>
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<tr>
<td>Product output does not increase although the refrigerant temperature is way above the set point.</td>
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<tr>
<td>Suction pressure too low, output drops.</td>
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<tr>
<td>Fault</td>
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<td>-------------------------------------------</td>
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<tr>
<td>Malfunction of compressor suction valve,</td>
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<tr>
<td>pressure valve or overflow safety valve.</td>
</tr>
<tr>
<td>Compressor output controller does not work.</td>
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<tr>
<td>Discharge pressure and/or discharge</td>
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<tr>
<td>temperature too high.</td>
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<tr>
<td>Oil pressure too low.</td>
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<tr>
<td>Excessive oil temperature.</td>
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<tr>
<td>Oil temperature too low.</td>
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<tr>
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<tr>
<td>Maximum motor current.</td>
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<td></td>
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<tr>
<td>Refrigerant temperature too low.</td>
</tr>
</tbody>
</table>
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 65 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. If necessary, shut down all ancillary drives.
3. Switch off the main switch of the three-phase electric system.
4. If necessary, shut off the secondary refrigerant, heat carrier and cooling water supply.
5. Ensure that the vent slits of the electric motors are covered under all circumstances!

➔ System has been decommissioned
Notice

Short-term shut-down

► If the product is shut down temporarily, the valves do not need to be op-
erated; 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 com-
pressor 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 ob-
served!

If the product is shut down for a longer period of (>48 hours), the following activi-
ties 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 on the suction side and the pressure side (or lockable
check valves).
5. Shut off secondary refrigerant, heating agent or cooling water supply.
6. Block the manual stop valve of the refrigerant injection (if present)
7. Ensure that the vent slits of the electric motors are covered under all circum-
stances!

→ 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.
• Run the oil pump (if present) for about 5 minutes.
• 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 at the latest. (See maintenance instructions.)

- Check the insulation resistance of the drive motors (see the operating manual for the electric motor).

- Run the oil pump (if present) for about 5 minutes.

- Check the system for leak tightness.
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)

<table>
<thead>
<tr>
<th>Operating parameters of refrigerant circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>User</strong></td>
</tr>
<tr>
<td><strong>Refrigerant</strong></td>
</tr>
<tr>
<td><strong>Type of oil</strong></td>
</tr>
<tr>
<td><strong>Heat pump - Type / Manufacturer</strong></td>
</tr>
<tr>
<td><strong>Construction no. / year of manufacture</strong></td>
</tr>
<tr>
<td><strong>Compressor - Type / Manufacturer</strong></td>
</tr>
<tr>
<td><strong>Construction no. / year of manufacture</strong></td>
</tr>
<tr>
<td><strong>Date / Time</strong></td>
</tr>
<tr>
<td><strong>Operating hours</strong></td>
</tr>
<tr>
<td><strong>Power steps</strong></td>
</tr>
<tr>
<td><strong>Speed</strong></td>
</tr>
<tr>
<td><strong>P_suc</strong> suction pressure</td>
</tr>
<tr>
<td><strong>t₀ evaporating temperature</strong></td>
</tr>
<tr>
<td><strong>P_dis</strong> discharge pressure</td>
</tr>
<tr>
<td><strong>tₐ₀ discharge temperature</strong></td>
</tr>
<tr>
<td><strong>t_c condensation temperature</strong></td>
</tr>
<tr>
<td><strong>t_suc-t₀ overheating</strong></td>
</tr>
<tr>
<td><strong>P_Oil oil difference pressure</strong></td>
</tr>
<tr>
<td><strong>t_oil oil temperature</strong></td>
</tr>
<tr>
<td><strong>I_motor compressor motor current</strong></td>
</tr>
<tr>
<td><strong>t_W₁ heat carrier inlet temperature</strong></td>
</tr>
<tr>
<td><strong>t_W₂ heat carrier outlet temperature</strong></td>
</tr>
<tr>
<td><strong>t_W3,4 heat carrier intermediate temperatures</strong></td>
</tr>
<tr>
<td><strong>t_K₁ secondary refrigerant - inlet temperature</strong></td>
</tr>
<tr>
<td><strong>t_K₂ secondary refrigerant - outlet temperature</strong></td>
</tr>
<tr>
<td><strong>Oil level in compressor</strong></td>
</tr>
<tr>
<td><strong>Refrigerant level in the sight glass</strong></td>
</tr>
<tr>
<td><strong>Remarks</strong></td>
</tr>
<tr>
<td><strong>Service technician</strong></td>
</tr>
</tbody>
</table>

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5 Measure suction gas temperature with a suitable sensor at the compressor suction tube
6 Oil level needs to be visible
7 Normal status: clear and bubble free
### 13.1.2 Data sheet of oil filling (template)

<table>
<thead>
<tr>
<th>Oil charging</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>User</td>
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<tr>
<td>Refrigerant</td>
<td></td>
<td></td>
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<tr>
<td>Type of oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat pump - Type / Manufacturer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction no. / year of manufacture</td>
<td></td>
<td></td>
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<tr>
<td>Compressor - Type / Manufacturer</td>
<td></td>
<td></td>
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<tr>
<td>Construction no. / year of manufacture</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Operating hours</th>
<th>Filled recovered oil quantity (in l)</th>
<th>Absorbed oil quantity (in l)</th>
<th>Remarks (for example: quantity balance, result of oil analysis)</th>
<th>Service technician</th>
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</tbody>
</table>
### 13.1.3 Data sheet of refrigerant filling (template)

<table>
<thead>
<tr>
<th>Refrigerant filling</th>
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</thead>
<tbody>
<tr>
<td>User</td>
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</tr>
<tr>
<td>Refrigerant</td>
<td></td>
</tr>
<tr>
<td>Type of oil</td>
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</tr>
</tbody>
</table>

#### Heat pump - Type
Manufacturer
Construction no. / year of manufacture

#### Compressor - Type / Manufacturer
Construction no. / year of manufacture

<table>
<thead>
<tr>
<th>Date</th>
<th>Operating hours</th>
<th>Removed refrigerant quantity (kg)</th>
<th>Refrigerant quantity intake (kg)</th>
<th>Remarks (for example: quantitative balance)</th>
<th>Service technician</th>
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</thead>
<tbody>
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**Plans**

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19.12.2019

**115**
# Appendix

## 14.1 Abbreviations and terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>Figures in percent</td>
</tr>
</tbody>
</table>
| °            | Symbol for the divider of a scale [degrees]  
  All degrees stand for the angle [angular degree] unless explicitly specified otherwise. |
| °F           | Temperature measurement unit [degrees Fahrenheit] |
| °C           | Temperature measurement unit [degrees Celsius] |
| Δp           | Pressure difference |
| π            | Pressure ratio |
| AISI         | American Iron and Steel Institute; material designation for the North American professional association for the steel industry |
| ATEX         | Atmosphères Explosibles  
  Directive of the European Union governing explosion protection |
<p>| bar          | Pressure measurement unit [Bar] |
| CFR          | Code of Federal Regulations; collection of federal regulations of the USA |
| CO₂          | Carbon dioxide; chemical molecular formula |
| dB           | Unit for logarithmic variables such as sound pressure level, voltage level, etc. [Decibel] |
| DIN          | German Standard by the Deutsches Institut für Normung e.V. (DIN) |
| dm³          | Volume measurement unit [cubic decimetre] |
| DN           | DN nominal diameter |
| EC           | European Community |
| EN           | European Standard |
| EX           | Explosion protection |
| h            | Time measurement unit [hour] |
| H₂O₂         | Hydrogen peroxide; chemical molecular formula |
| HP           | High pressure |
| Hz           | Frequency measurement unit [Hertz] |
| IP           | Protection type for electric operating material |
| ISO          | International standard of the International Organization for Standardization |
| KM HFC       | Refrigerant - Fluorinated hydrocarbons |
| KM NH₃       | Refrigerant - Ammonia |
| KM R22       | Refrigerant - Chlorodifluormethane |
| KM R290      | Refrigerant - Propane |
| KM R600a     | Refrigerant - Isobutane |
| Lp           | Sound pressure |
| Lw           | Sound power |
| m/s          | Speed measurement unit [metre per second] |
| m³/h         | Volume flow measurement unit [cubic metre per second] |
| min.         | Time measurement unit [minute] |
| rpm          | Revolutions per minute |
| mm           | Length measurement unit [millimetre] |
| MPI          | Interface for Simatic-S7 devices from Siemens [multi-point interface] |
| µm           | Length measurement unit [micrometre] |</p>
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>LP</td>
<td>Low pressure</td>
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<tr>
<td>Nm</td>
<td>Energy measurement unit [Newton metre]</td>
</tr>
<tr>
<td></td>
<td>Details for the torque: 1 Nm = 0.737 lbft</td>
</tr>
<tr>
<td></td>
<td>Pound-Force (lb) + Feet (ft)</td>
</tr>
<tr>
<td>p</td>
<td>Maximum permitted pressure</td>
</tr>
<tr>
<td>p₀</td>
<td>Suction pressure</td>
</tr>
<tr>
<td>Item</td>
<td>Position</td>
</tr>
<tr>
<td>P+I</td>
<td>Piping and instrumentation flow diagram</td>
</tr>
<tr>
<td>tₒᵢ</td>
<td>Suction temperature (compressor inlet)</td>
</tr>
<tr>
<td>tₒ</td>
<td>Condensing temperature</td>
</tr>
<tr>
<td>tᵣ</td>
<td>Discharge temperature (compressor outlet)</td>
</tr>
<tr>
<td>tₒᵢ</td>
<td>oil inlet temperature into the compressor</td>
</tr>
<tr>
<td>TÜV</td>
<td>German technical monitoring association</td>
</tr>
<tr>
<td>V</td>
<td>Electric voltage measurement unit [Volt]</td>
</tr>
<tr>
<td>VDI</td>
<td>Verein Deutscher Ingenieure - Association of German Engineers</td>
</tr>
<tr>
<td>VDMA</td>
<td>Verband Deutscher Maschinen- und Anlagenbau e.V. - Association of German Mechanical and Plant Engineers</td>
</tr>
</tbody>
</table>
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