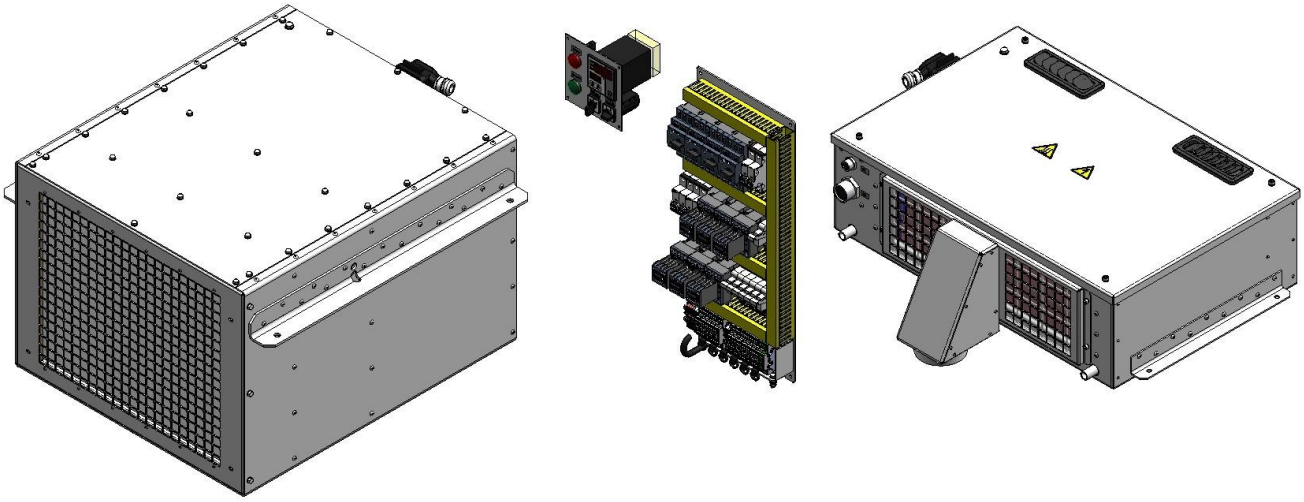
OPERATING MANUAL

VEHICLE AIR-CONDITIONING SYSTEM

RVE 14,5-U / K 14,5-I

Item number 1000187067



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1 GENERAL

1.1 Purpose

This system description explains the features, safety measures and the maintenance and service instructions for the RVE 14,5-U / K 14,5-I air conditioning system of the "INTAMIN Monorail" project.

1.2 Basic Information

Products from NOSKE-KAESER RAIL&VEHICLE GERMANY GmbH are developed and manufactured according to the current state of technology and are based on experience in operating comparable systems. Certain hazards can still occur when handling these systems, however. In order to avert hazards to life, limb, and health, and to prevent damage and use the system in an optimal way, the operating manual contains various instructions.

As a rule, unless otherwise specified, the technical data specified in this user and maintenance manual has a tolerance of ± 5 % of the declared value.

This user and maintenance manual contains all specifications and information required to operate the cooling and heating unit.

NOSKE-KAESER RAIL&VEHICLE GERMANY GmbH has made every effort to ensure that all the information contained in this manual is correct and complete.

Details on threshold values, tests and maintenance intervals have been chosen based on the current state of knowledge and in a manner that enables safe and reliable operation.

NOSKE-KAESER RAIL&VEHICLE GERMANY GmbH does not assume any liability, however, for faults or damage that are directly or indirectly attributed to the use of this documentation.

We reserve the right to make changes to this manual without previous notice.

For inquiries on the system, please indicate the type of unit and unit number (see rating plate).

1.3 Copyright

1.4 General safety instructions

It is essential to follow the instructions in this user and maintenance manual in order to:

- prevent risk to life and limb for the user and third parties,
- to ensure operating safety of the system and
- to prevent downtime due to improper handling.

The safety instructions in this manual do not replace the safety instructions of the operator or any statutory regulations and guideline
The applicable accident prevention regulations must be followed, along with legal provisions for the operating safety of vehicles carrying passengers.
The aim of this manual is to be able to operate the system with a maximum of safety. The manual contains all specifications and information required for doing so.
The manual is a component of the system and must be available at all times to the operating and maintenance personnel. The instructions in the manual must be observed when performing maintenance and repairs.
Liability of NOSKE-KAESER RAIL&VEHICLE GERMANY GmbH is excluded for
damage resulting from improper use.
It is assumed that only qualified employees will be assigned to carry out the duties described in this manual, and that the appropriate tools and testing devices will be available to them. Qualified employees are persons who, due to their training, experience, and instruction, as well as their knowledge of relevant standards, laws, provisions, accident prevention regulations and operating conditions, have been authorized by the person responsible for the safety of the system/component to carry out any required tasks and, in doing so, can recognize and prevent possible risks (see also DIN EN 50110 (VDE 0105), DIN EN 50153 and IEC 364).

Risks can occur, especially if:
- inadequately trained personnel is operating the system,
- the product is being transported, installed or maintained improperly,
- the units are not being operated as intended.

2 DATA SHEET

2.1 RVE 14,5 -U

Refrigerating capacity	: 5900 W at tc 50°C and +35°C ambient temperature
Compressor	: 2.3 kW / 4.3 A / 400 V / 3 phases / 50 Hz
Condenser fan	: 2x 0.45 kW / 2x 0.7 A / 400V / 3 phase / 50 Hz
Refrigerant	: R 407c
Refrigerant quantity	: approx. 3.5 kg
Thermostat weight, mounted	: 0.5 kg / each
Current	: three-phase current
Voltage	: 400V / 50Hz / 3 phases, 24V / DC
High pressure switch (max. service pressure)	: ON non-adjustable differential gap OFF 25 bar
Suction pressure switch	ON 4.0 bar OFF 3.6 bar
P77 condensor fan regulation 1	ON 21.5 bar OFF 14.5 bar
P77 condensor fan regulation 2	ON 11.5 bar OFF 7.0 bar
Oil	: P.O.E
Oil quantity	: 1330cm³
Dimensions	: 730 x 620 x 480 (WxDxH)
Weight	: 90 kg
Degree of protection	: IP 42

The above-mentioned data are subject to a tolerance of ± 5%.

2.2 K 14,5 -I

Refrigerating capacity	: max. 4500 W at +26°C/50% relative humidity upstream of the evaporator and +32°C ambient temperature
Supply air fan	: max. 394W / 15,2 A / 24V DC
Supply air capacity	: Step 1 - 60% 400 m^3/h Step 2 - 80% 520 m^3/h Step 3 - 100% 860 m^3/h
Heater Steps coupled to fan speed	: Step 1 - 1.5 kW / 2.2 A / 400 V / 3 phases / 50 Hz Step 2 - 3.0 kW / 4.4 A / 400 V / 3 phases / 50 Hz Step 3 - 4.5 kW / 6.5 A / 400 V / 3 phases / 50 Hz
External pressure	: at 860 m^3/h 50 Pa
Refrigerant	: R 407c
Refrigerant quantity	: 0.1 kg
Dimensions	: 820 x 500 (660) x 220 (WxDxH)
Weight	: 25 kg
Degree of protection	: IP 42

The above-mentioned data are subject to a tolerance of ± 5%.

3 UNIT DESCRIPTION

3.1 General

The air-conditioning unit has been especially designed for portable applications.

The refrigerating and heating capacities of the air-conditioning unit have been designed to meet the specified conditions in the contract.

The conditioned air is blown over adjustable nozzles into the driver's cab.

The air to be conditioned (circulating air from the service room) is directly supplied to the air-conditioning unit. It will be mixed with fresh air (which is supplied via a duct system) and cleaned by a filter.

After having selected the desired room temperature, is heating and cooling automatically controlled by the room thermostat.

3.2 Air-conditioning unit

All components are mounted inside a thermally and acoustically insulated housing.

The unit consists of a condenser section (RVE 14,5-U) and an air-conditioning section (K14,5-I) which are arranged separate from each other.

The compressor is mounted on vibration dampers.

The pressure and suction lines connected to the compressor are either provided with compensators or laid in such a way that vibration resistance is ensured.

The air-conditioning and condenser fans are driven directly by electric motors.

Both the circulating air and the fresh air are cooled by the evaporator or warmed by the heater and supplied as conditioned air to the room.

An air-cooled condenser is used to liquefy the refrigerant.

The fresh air required for the operation of the condenser is drawn in by the condenser fan via condenser fins and blown out via an outlet. The integrated high and suction pressure switch shuts down the compressor when the maximum refrigerant pressure in the high pressure line is exceeded or the refrigerant pressure in the suction line has fallen below minimum. The air ventilation remains unaffected.

The condenser fan is activated by an integrated speed regulator producing an optimum refrigerant pressure.

All other fittings comprising the collector, filter drier, sight glass, suction and pressure side compensators, service valves and the pressure switches are arranged at the condenser section.

All parts are accessible after removing the service covers.

The unit is connected to electric power either by a power cable or plug connections.

3.3 Control units

The control unit for the air-conditioning unit is integrated in the unit or arranged on a separate switch panel

The control panel, indicating lights and warning lights, switches and the thermostat. The air-conditioning unit and thermostats are connected by multi-core control lines to the main switch cabinet. The main switch cabinet is connected to the power line, the condenser section (RVE 14,5-U) and an air-conditioning section (K14,5-I).

3.4 Thermostat

The microprocessor-controlled thermostat ST 72-30.02 PTC controls the temperature with a high accuracy.
The temperature and other parameters are set by means of three membrane keys.

- When no key has been operated the actual value is indicated.
- When pressing the SET key the set value is indicated.

Setting:
- Press and hold the SET key.
- Set temperature using the UP and DOWN keys.
- Release UP/DOWN keys.
- Release SET key.

Note!
The temperature can only be set within the preset limits. These limits must only be changed by trained personnel.
The gap between the individual switching steps cannot be changed.

Installation dimensions: 72 x 72 mm front
66.5 x 66.5 mm panel cutout
approx. 120 mm installation depth

Recommended set point:
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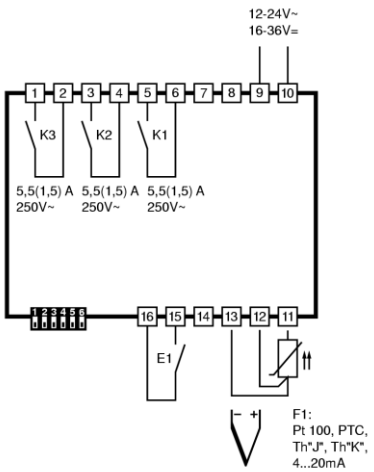
Normal:	Summer	= + 26°C
	Winter	= + 20°C



4 OPERATION

4.1 Switching the air-conditioning unit on and off

Preconditions to switch on the unit:

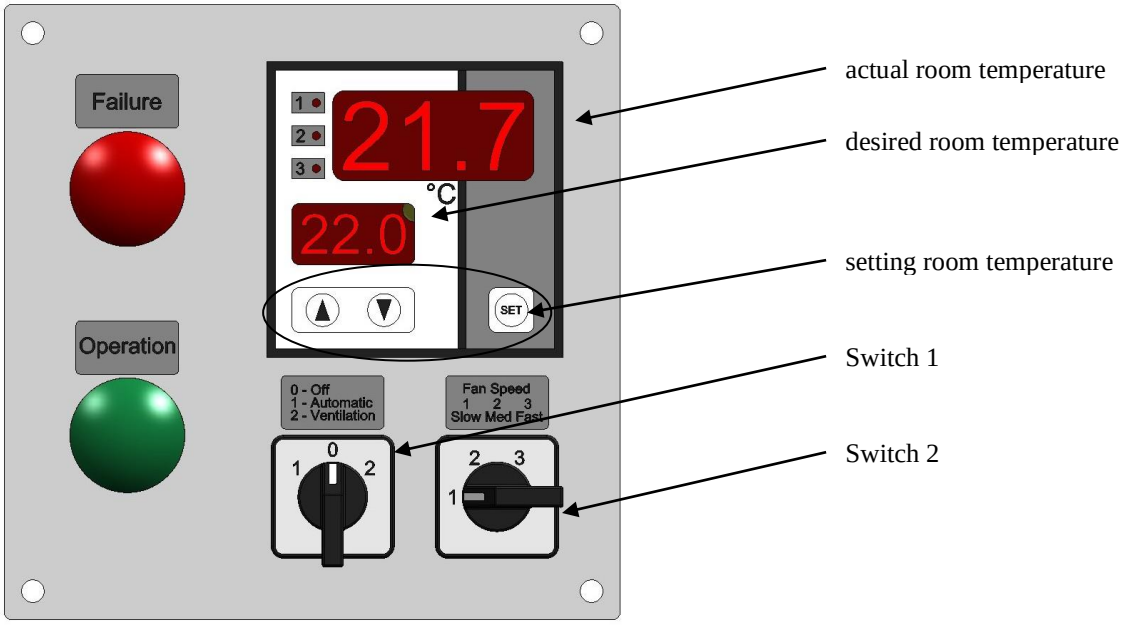
1. All air intake and outlet openings of the unit must be free.
2. Power must be present.
   Turn switch 1 in position 1 or 2. The operation lamp lights green.
3. Setting the desired room temperature.
4. Switch 1 in position 1: The system is automatically heating or cooling to reach the desired room temperature
   Switch 1 in position 2: Only ventilation mode, no temperature regulation.
5. The evaporator fan is operating in 3 Steps (switch 2).
   The heat output depends on the fan speed, see data sheet K14,5I.

Failure indication:

A failure of the unit is indicated by the failure lamp. After elimination of the fault, the lamp is shut down automatically.

Switching off the unit:

To turn off the system, the switch 1 must be set to 0.
When the system is in heating mode, it is recommended that before turning off the system, to run this for a few minutes in ventilation mode.



5 MAINTENANCE

5.1 General

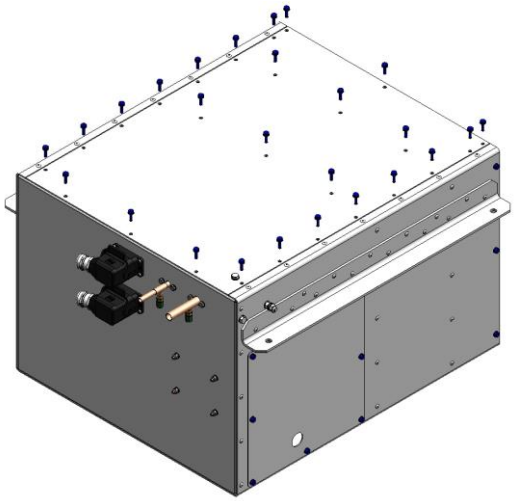
A perfect operation of the air-conditioning unit can only be ensured when all maintenance activities are correctly carried out by qualified personnel.

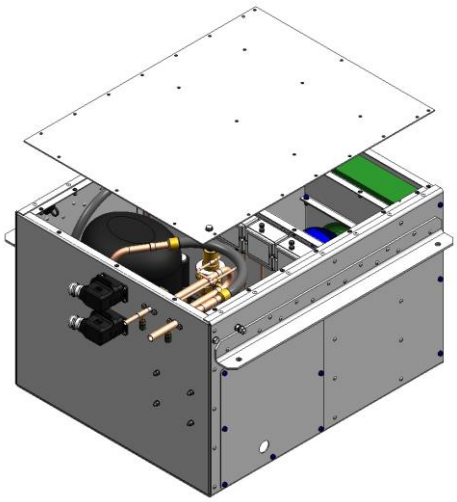
In principle, tampering of unauthorised persons has to be avoided and repairs should only be carried out by qualified refrigeration mechanics.

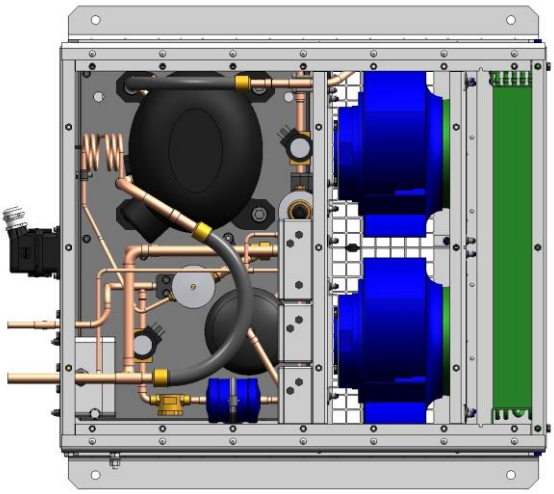
When filling or refilling the refrigerating plant with refrigerant or refrigerator oil it has to be observed that only prescribed refrigerants or refrigerator oils are used (see data sheet and manufacturer's plate). Other refrigerants or refrigerator oils must not be used. The **consumption of refrigerant and refrigerator oil** has to be documented (see annex).

After repair, all components concerned have to be checked for tight seat and proper function. The **leakage test** has to be documented (see annex).

5.2 Open RVE 14,5-U



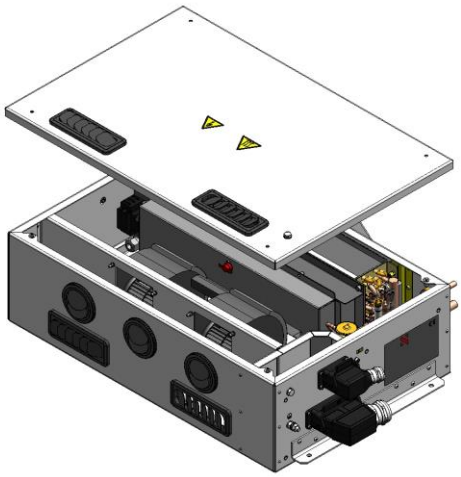




In order to carry out the maintenance work on the RVE-14,5-U, the cover must be removed first.

To do this, remove the twenty-six screws on the top and then lift the top cover.

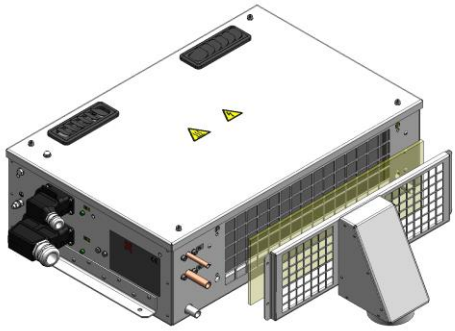
5.3 Open K 14,5-I



In order to carry out maintenance work on the K-14.5-I, the top cover must be removed first.

To perform this, remove the four screws on the top and then lift the top cover off.

5.4 Change Filter K-14,5-I



To change the filter on the K-14,5-I, first loosen the four screws on the hood.

The hood can then be removed and the filter can be replaced.

5.5 Intervals

Shortly after initial start-up

Shortly after the initial start-up (after 10-20 operating hours) all fastening screws and all refrigerant connections have to be checked for tight seat.

Monthly

Clean and control air filter mats.

When the air drawn in is highly contaminated the filter mats have to be checked, cleaned and replaced (if necessary) more frequently.

Check condenser fins for contamination. Clean with compressed air, if necessary. Check plant for unusual ball bearing and other noise.

Quarterly

Check all refrigerant lines for damage and leaks using the leakage tester/leakage test spray. Check compressor mounting for tight seat.

Check condenser fan and evaporator fan for proper function.

Check refrigerant charge. For this, observe sight glass for approx. 10 minutes after having switched on the compressor. The refrigerant must flow without producing bubbles. The formation of bubbles can indicate the lack of refrigerant (see section "Refilling of Refrigerant").

Half-Yearly

The following work has to be carried out by the after-sales service. Check the oil charge of the compressor and refill, if necessary.

Inspection of the complete plant by a refrigeration/air-conditioning specialist.

Inspection of the complete control system.

5.6 Air filter

The air filter mat consists of a tangled-fibre fleece hardened by binder materials. The filter ensures a high air penetration, dust separation and dust catching. In addition, the fleece is insensitive to moisture.

The higher the dust quantity, the more often the filter mat has to be cleaned.

Cleaning is done by rinsing in water with a max. temperature of approx. 40°C. Intensive cleaning by adding commercial mild-action detergents.

Avoid beat-out, sucking off or blowing out with compressed air to get a longer time of life.

Do never wring filter material and avoid sharp water jets!

Replace filter material after repeated cleaning.

6 TROUBLESHOOTING CHART

6.1 General

In case of any malfunction of the air-conditioning unit, the necessary repairs must only be carried out by expert personnel.

This especially applies to work on the refrigerating circuit and the control system.

The following troubleshooting lists have been prepared to be used by the maintenance personnel. Basic knowledge in electrical and refrigeration engineering will be necessary.

6.2 No conditioned air

	Fault	Probable cause		Remedial action
1.	**No conditioned air**	1.1	Contaminated air filter	Clean or replace filter mat
		1.2	Contaminated evaporator fins	Clean fins
		1.3	Circuit breaker for control voltage tripped	Reset circuit breaker. Check control circuit when circuit breaker trips once again
		1.4	Air-break contactor for evaporator fan defective	Replace air-break contactor
		1.5	On/off switch defective	Replace switch
		1.6	Phase failure	Check lines and back-up fuses
		1.7	Evaporator fan motor defective	Replace Evaporator fan
		1.8	Thermostat defective	Replace thermostat

6.3 No cooling

	Fault	Probable cause		Remedial action
2.	**No cooling**	2.1	Set-point of thermostat too high	Set thermostat to a lower value
		2.2	Suction pressure switch tripped: - Refrigerant leak - Contaminated air filter (insufficient dissipation of heat)	 Have the refrigerant refilled by an expert Clean or replace filter mat
		2.3	High pressure switch tripped: - Obstructed condenser feed air opening - Excessive outside temperature - Motor protector for condenser fan tripped - Air-break contactor for condenser fan defective - Condenser fan motor defective	 Eliminate obstruction, eliminate air short circuit, clean fins Protect condenser air intake against the effects of heat (eliminate air short circuit, if applicable) Reset protector. Check motor when protector trips again Replace air-break contactor Replace motor
		2.4	Motor protector for compressor defective	Replace protector
		2.5	Air-break contactor for compressor defective	Replace contactor
		2.6	Time relay defective	Replace time relay
		2.7	Compressor defective	Replace compressor
		2.8	High and suction pressure switch defective	Replace high and suction pressure switch
		2.9	Thermostat defective	Replace thermostat

6.4 No heating

	Fault	Probable cause		Remedial action
3.	**No heating**	3.1	Set-point of thermostat too low	Set thermostat to a higher value
		3.2	Dirty air filter	Change Filter
		3.3	supply fan defective	Check supply fan and if necessary exchange
		3.4	Thermal switch defective	Exchange Thermal switch
		3.5	Over-temperature switch has triggered	First, fix the cause, then refresh glass cartridge
		3.6	heater defective	Exchange heater
		3.7	Miniature circuit breakers Q75 or Q76 defective	Exchange Miniature circuit breakers
		3.8	Heating contactor K107 or K108 defective	Exchange Heating contactor K107 or K108
		3.9	Release contactor K106 defective	Exchange Release contactor K106
		3.10	Temperature monitoring protective K78 defective	Exchange Temperature monitoring protective K78

7 REFRIGERATING CIRCUIT

7.1 Safety Regulations

When carrying out work on the refrigerating circuit the Safety Regulations (Germany: BGR 500 Kap.2.35, Handling of refrigerant systems) have to be observed.

The necessary maintenance and repair work must only be carried out by trained refrigerant mechanics.

7.1.1 Refrigerant Properties, Health Hazards and First Aid Measures

The refrigerant is a liquid or liquefied partially halogenated (HFC). Due to the low boiling point it is highly volatile and cools down considerably during evaporation. It is inflammable and the vapours can only be smelled in concentrations above 20% volume.

Inhalation: In low concentrations may cause narcotic effects. Symptoms may include dizziness, headache, nausea and loss of co-ordination.
In high concentrations may cause asphyxiation. Symptoms may include loss of mobility/consciousness. Victim may not be aware of asphyxiation.
Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped.

Skin/eye contact: In case of frostbite spray with water for at least 15 minutes. Apply a sterile dressing. Immediately flush eyes thoroughly with water for at least 15 minutes. Obtain medical assistance

Ingestion: Ingestion is not considered a potential route of exposure. Concentrations of more than approx. 30% reduce the oxygen content in the breathing air to less than 15% volume and my cause suffocation. The thermal decomposition products are poisonous and have a highly irritating and thus warning effect. Due to the degreasing effect continuous or frequent contact with the skin may cause skin diseases.

7.1.2 Handling of Refrigerants

- Wear safety goggles and protective gloves.
- Do not eat, drink or smoke when handling refrigerants.
- Avoid contact of liquid refrigerants with the skin as they cause local frostbite.
- Only use in well ventilated rooms.
- Do not breath in higher concentrations as they may cause suffocation and have an intoxicating effect.

Note:

Even small refrigerant quantities which might escape during assembly or maintenance of refrigerant lines or hoses are dangerous and have to be strictly avoided.

7.1.3 Inside Rooms

- Eliminate and record leakages on refrigerating plants immediately.
- Carry out and record leakage checks regularly.
- Do **not** let refrigerants escape in closed rooms during refilling or repair work.
- Ensure proper ventilation and extraction.
- Leave the room immediately when large quantities of refrigerant escape and enter the room only after proper ventilation.
- Welding and brazing work only in well ventilated rooms.
- Welding and brazing work only with nitrogen.
- Evacuate refrigerant completely when a plant has to be welded or brazed. Remove remaining refrigerant by blasting with nitrogen.
- When working with unavoidable high refrigerant concentrations use respiratory equipment independent of the ambient air. Do not use filter masks. Decomposition of refrigerant due to overheating can be noticed by a pungent smell. In such a case leave the room immediately or use filter masks with B-type filters (acid gases).
- Do not carry out emergency work alone.

7.2 Operation of the Refrigerating Circuit

This air-conditioning unit is cooled by air for direct evaporation and is hermetically sealed. All controls have been set at the factory and are matched precisely to the refrigerating circuit. Copper tubing or refrigerant-resistant hoses are used for interconnection of the respective components.

The air-conditioner has four different functions:

1. Absorption of heat by gasification of the liquid refrigerant in the evaporator (inner heat exchanger).

2. Increasing the temperature of the resulting vapour by compression in the compressor.

3. Transfer of heat of the vaporised refrigerant in the condenser (outer heat exchanger);

4. Pressure reduction of the liquid refrigerant through flow restriction in the expansion valve.

The refrigerant passes through the distributor and enters the evaporator the flow is regulated by the thermostatic expansion valve. The refrigerant is expanded from high pressure to the lower evaporator pressure. This point in the refrigerating circuit is the borderline between the high pressure and the low pressure sides of the system. The thermostatic expansion valve is influenced on the one hand by the evaporator pressure via the compensator line, and on the other hand by the superheating temperature at the evaporator outlet as indicated by a temperature sensor.

The refrigerant absorbs latent heat in the evaporator until it is fully vaporised. This vapour is drawn by the compressor through the suction line into the compressor where the vapour is compressed, thus increasing its temperature and pressure.

The suction line is connected via compensators to the compressor. The outlet valve prevents the compressed refrigerant vapour from entering the cylinder during the next piston suction stroke. The resulting pressure forces the hot vapour to flow through the pressure line into the condenser.

The pressure line is also connected with the compressor via compensators. In the condenser (, the heat of the compressed vapour is transferred to the cooling medium (air). The air cools the vapour and liquefies it. The liquid flows under high pressure into the liquid container and into the filter drier. The filter drier protects against the formation of acid and sludge and filters out moisture and dirt from the refrigerating circuit.
In the sight glass, through which the refrigerant passes next, it can be seen whether the flow of refrigerant is interrupted or if gas bubbles have formed because of a lack of refrigerant. This occurs if the pressure drop is too great as a result of overheating of the liquid line.

If no gas bubbles are visible in the sight glass, the refrigerating circuit has been filled with the correct amount of refrigerant and is operable.

The pressure switch on the compressor switches the compressor off in case of refrigerant loss and if the suction pressure drops too much as a result of an ice-coated evaporator due to inadequate airflow.

The condenser fan is controlled by an on/off speed regulator. The speed regulator arranged on the pressure side of the refrigerating circuit prevents unacceptably high refrigerant pressure caused by inadequate air flow through the condenser or an excessive outside air temperature.

The power regulator matches the compressor output with the evaporator output.

The regulator is arranged in a bypass between the high and the low pressure side of the air-conditioning plant. When the evaporator load and thus the compressor load drops the suction pressure of the compressor drops as well. Thereupon, the regulator opens and hot vapour streams from the high pressure side to the low pressure side (artificial load).

7.3 Compressor

The built-in compressor is a semi- (air cooled) or fully hermetic (suction vapour cooled) unit. The compressor is driven via a V-belt or an electric motor. The compressor is equipped with a suction and discharge connection. The larger line is always the suction line.

The compressor is filled at the factory with the correct oil charge.

If the compressor is defective, it is recommended to replace the complete compressor.

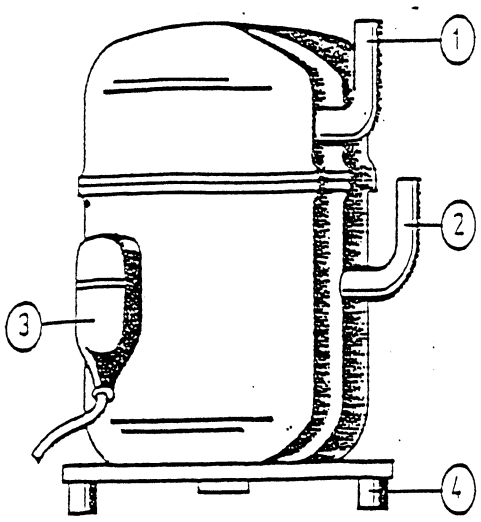
Compressor Replacement

If the compressor has to be replaced, it is necessary to drain the remaining refrigerant via the service valves. Remove the suction and pressure lines from the compressor, disconnect the electric lines, loosen the mounting bolts and remove the compressor.

The new compressor is already filled at the factory with the correct oil charge.

After installing the compressor and connecting all pressure and suction lines, the system has to be properly evacuated. Thereupon, the system has to be refilled with the correct quantity of refrigerant.

COMPRESSOR



1. Suction line connection
2. Pressure line connection
3. Power cable connection
4. Vibration damper

7.4 HP/LP Switch (adjustable)

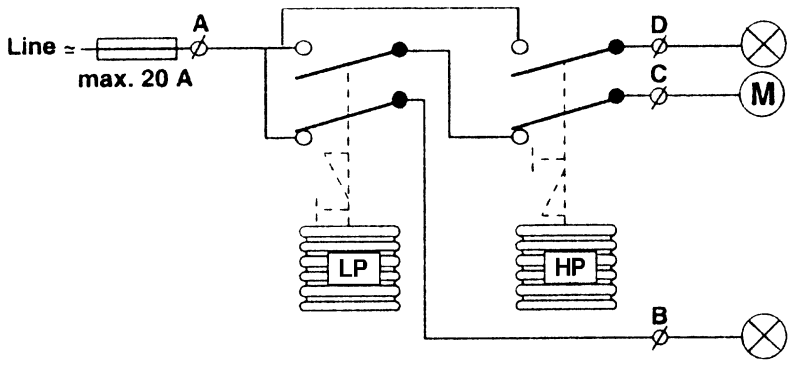
The pulse and switch mechanism for pressure monitoring is arranged in a compact housing. Controls for setting the required high and suction pressures as well as the differential gap are arranged on the front side.

Connections for pick-up and control lines are arranged at the lower housing side.

The combined high and suction pressure (HP/LP) switch de-energises the compressor when the suction pressure in the low pressure line is too low or the pressure in the high pressure line is excessively high.

Settings:

HP	:	OFF	:	24 bar
		ON	:	fixed differential gap
LP	:	OFF	:	0.5 bar
		ON	:	3.4 bar

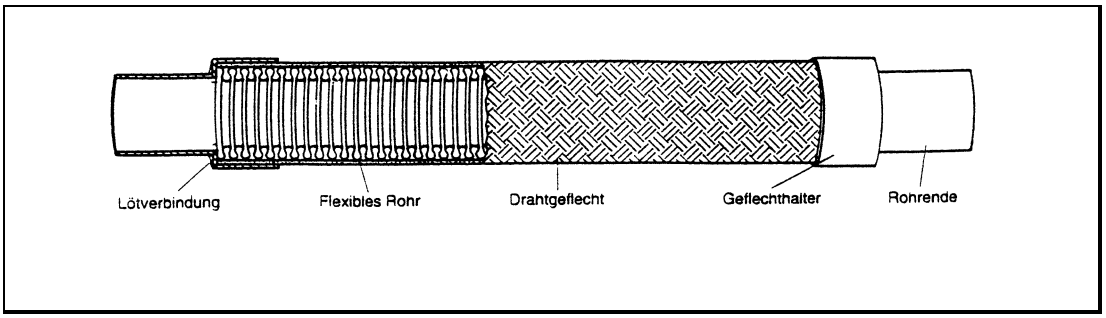


ND (LP)	:	A - C open when the pressure drops A - B close at the same time (signalling contacts)
HD (HP)	:	A - C open when the pressure rises A - D close at the same time (signalling contacts)

7.5 Compensator

The compensators are vibration dampers in the refrigerating circuit, form part of the suction and pressure lines and are arranged in the direct vicinity of the compressor connections. The inside of the compensators is made of a refrigerant-resistant material. The jacket is made of braided metal. The compensator ends are provided with encapsulated brazing sleeves.

The compensators serve to absorb horizontal and vertical vibrations of the compressor to the refrigerating lines to avoid that the lines break.



7.6 Power regulator (mechanical)

The power regulator matches the compressor output to the evaporator load.

The control valve is arranged in a bypass between the compressor and the evaporator. When the evaporator load and, thus, the compressor load drops the suction pressure of the compressor drops. The regulator opens and a "simulated" load (replacement load) in the form of hot vapour is fed from the high pressure side to the low pressure side.

The power regulator injects hot vapour at the evaporator inlet between the thermostatic expansion valve and the distributor.

The regulator is connected to the suction line via a control line. As a result, the degree of opening of the regulator is a direct function of the suction pressure of the compressor and is independent of the pressure drop on the evaporator side.

Hot-vapour bypass regulators control the suction pressure within narrow limits and avoid that the pressure drops below the minimum. It needs to be observed that the minimum pressure drops by approx. 0.5 bar from the point the regulator opens (at that moment the output is almost zero) up to the point the regulator is fully open (at that moment reaching the rated output).

Caution:

Regulators are factory set. Any change of the setting may influence the overall regulating behaviour of the system.

Setting and adjusting:

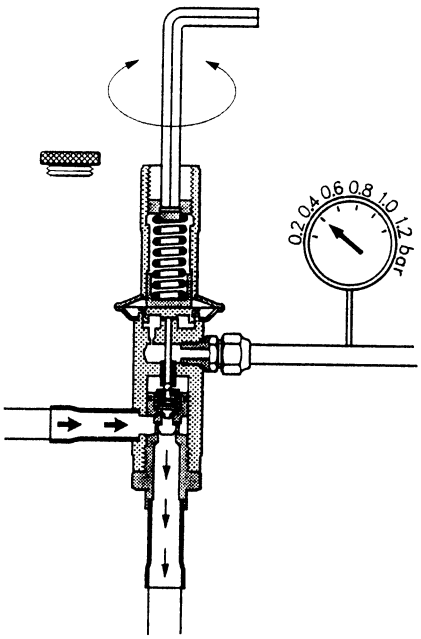
1. Install a gauge in the suction line.

2. Unscrew upper cap nut at the valve top so that the upper adjusting spindle is accessible. A full turn of the adjusting spindle changes the opening pressure by approx. 0.3 bar.

Turning right	: Increasing of suction pressure
Turning left	: Decreasing of suction pressure

3. Before setting the plant to work close the regulator by turning the upper adjusting spindle to the left. As soon as the plant has reached the suction pressure at which the regulator has to open slowly, turn the upper adjusting spindle slowly to the right until the regulator starts to let through hot vapour. The start of opening can be noticed by the heating up of the regulator outlet area and a slowly increasing suction pressure.

4. Screw on the cap nut upon completion of adjustment.



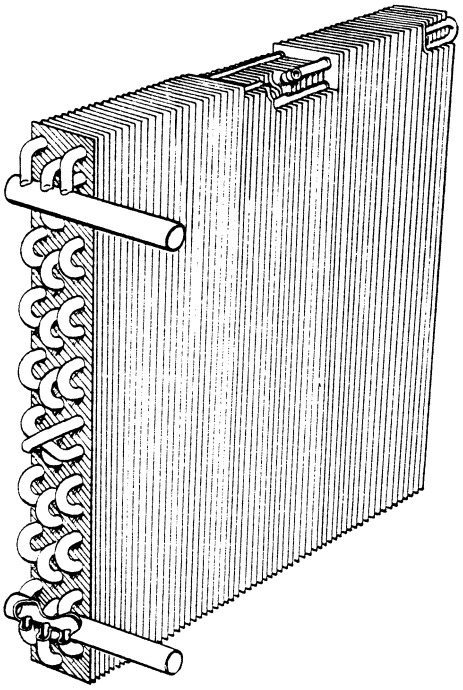
7.7 Condenser (Outer Heat Exchanger)

The condenser consists of a pack of aluminium fins onto which a bundle of copper tubes has been pressed. Face fins at each end secure the tube bundle.

The fin spacing provides optimum heat transfer. The collector lines with their inlet (hot vapour) and outlet (condensate) are arranged at one face of the condenser.

The compressed hot vapour refrigerant coming from the compressor is led through the copper tube system.

By the cooling effect of the condenser air the refrigerant is liquefied and collected in the liquid collector.

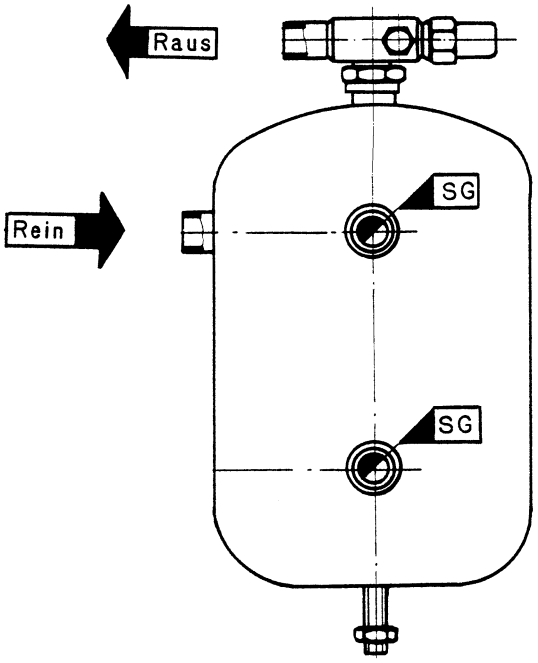


7.8 Liquid Collector

The liquid collector consists of a cylindrical steel housing resistant to pressure and is provided with one each inlet and outlet connection (either threaded or for brazing) to connect the copper tubes.

Most of the refrigerant coming from the condenser is liquid. The liquid part of the refrigerant is separated and collected in the lower part of the collector.

The liquid refrigerant is transferred to the circuit via a tube reaching to the bottom of the collector.



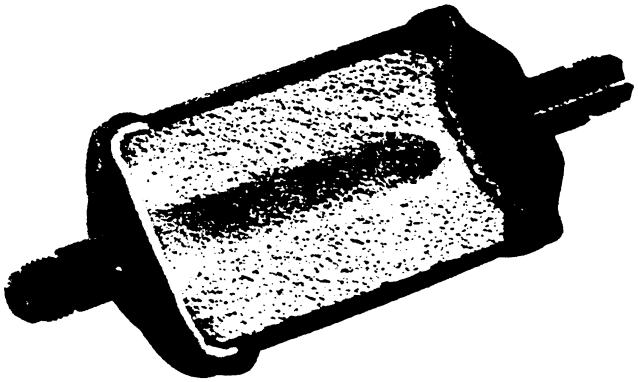
7.9 Filter Drier

The filter drier consists of a cylindrical steel housing resistant to pressure and is provided with one each inlet and outlet connection (either threaded or for brazing) to connect the copper tubes.

The built-in filter block removes and catches dirt particles and moisture from the refrigerating circuit.

By the filtration in the block the unit is protected against the formation of acid, mud, moisture and dirt to a very high degree.

The filter drier has to be replaced with each maintenance/repair.



7.10 Sight Glass

The refrigerant flow can be checked at the sight glass. The integrated humidity indicator shows the content of moisture in the refrigerant.

A bubble-free flow shows that only liquid refrigerant emerges from the liquid collector and that the refrigerator circuit works properly.

In case of refrigerant lack or refrigerant loss gaseous refrigerant emerges from the liquid collector and passes the sight glass.

A continuous bubble flow in the sight glass indicates that refrigerant needs to be refilled.

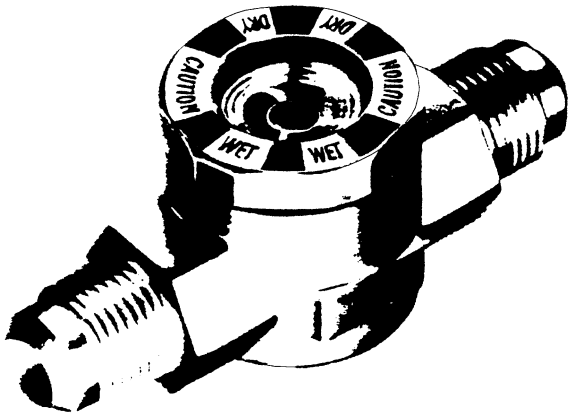
Another cause for the formation of bubbles is a clogged filter drier. In such a case the filter drier has to be replaced.

A humidity indicator (if installed) at the sight glass shows the content of moisture in the refrigerant.

Indicator colours:

- between black blue and violet = dry
- between violet and purple = caution
- between purple and bright red = wet

When "purple to bright red" is indicated the filter drier has to be replaced.



7.11 Thermostatic Expansion Valve

The thermostatic expansion valve is a hermetically sealed regulating component in the refrigerating circuit.

The purpose is always to feed the evaporator that amount of refrigerant which it is to vaporise under the respective conditions.

During this process the refrigerant is reduced from the high liquefaction pressure to the lower vaporisation pressure.

The interaction of three forces determines the operation of the expansion valve:

Pressure A: Sensor pressure – which depends on the temperature of the vaporised refrigerant and the sensor opening – acts as opening pressure on the diaphragm.
Result: The valve opens, the refrigerant flow increases

Pressure B: Spring force – which depends on the spring pressure – acts as closing pressure on the diaphragm.
Result: The valve cone reduces the cross section of the refrigerant flow.

Pressure C: Evaporator pressure – which depends on the temperature of the vaporised refrigerant – acts as supplementary control pressure against the sensor pressure.
Result: The valve cone reduces or interrupts the refrigerant flow.

As long as these three forces are in equilibrium, the opening position of the valve does not change. If, however, the temperature of the medium in the sensor increases because the evaporator contains too little liquid refrigerant, the pressure in the sensor rises.

This rising pressure acts on the diaphragm opening the valve and – thus – increasing the cross section for refrigerant flow.

Contrarily, if the evaporator pressure in the compensation line drops, the cross section for refrigerant flow is reduced.

If the sensor temperature drops or the evaporator pressure in the pressure compensation line rises, the valve cone moves in the direction of closure.

When the compressor is switched off at the end of a cooling cycle the pressure in the evaporator rises because vapour is no longer drawn into the suction line; the valve closes as
long as the pressure in the sensor is greater than the evaporator pressure plus the force of the regulator spring.

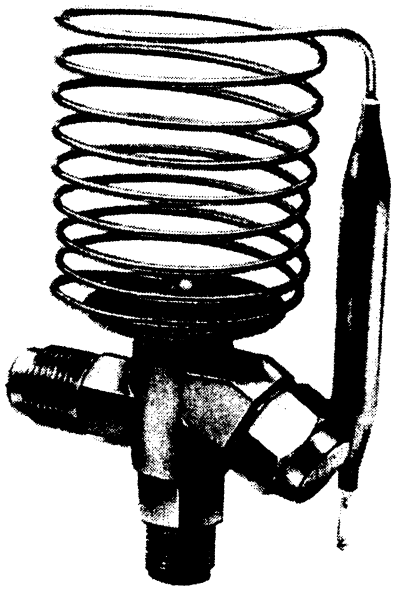
The sensor pressure and the evaporator pressure affect one another directly and are directly dependent on one another.

The combination of both forces determines the amount the valve opens as a function of the respective filling of the evaporator, assuring the best-possible utilisation for any operating condition.

The sum of the forces of the evaporator pressure plus the regulator spring on the other side of the diaphragm act against the sensor pressure on the other side.

The sensor pressure is determined by the temperature of the superheated vapour at the evaporator outlet and is compared continuously in the valve with the evaporator pressure which acts through a pressure-compensation line against the sensor pressure.

The evaporator pressure acting on the diaphragm must, therefore, correspond as closely as possible with the sensor pressure.



7.12 Evaporator (Inner Heat Exchanger)

The evaporator consists of a pack of aluminium fins onto which a bundle of copper tubes has been pressed. Face fins at each end secure the tube bundle.

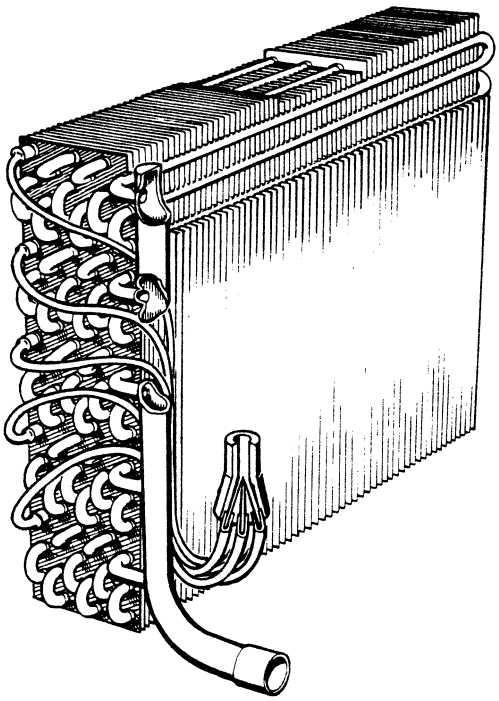
The fin spacing provides optimum heat transfer.

The inlet via distributor with distributor tubes and the outlet manifold are located at the two faces of the evaporator.

The refrigerant – in the form of wet vapour – which comes from the thermostatic expansion valve is injected through the distributor into the evaporator.

The tubing coils and fins serve as heat exchanger surfaces taking heat from the air flowing by and transferring it to the refrigerant.

At the end of the tube coils, the dry and slightly superheated refrigerant from the manifold is fed to the compressor as suction vapour.



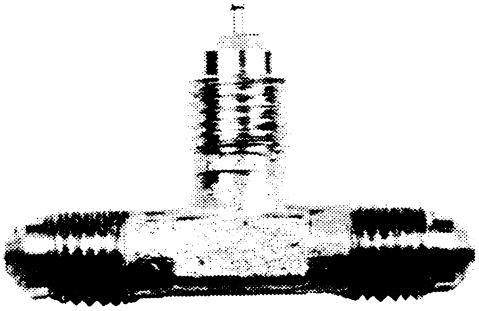
7.13 Service Valve (Schrader Valve)

The service valve consists of a brazed socket, a threaded valve insert, a refrigerant-resistant rubber seal and a protective cap.

The valve insert closes the valve towards inside.

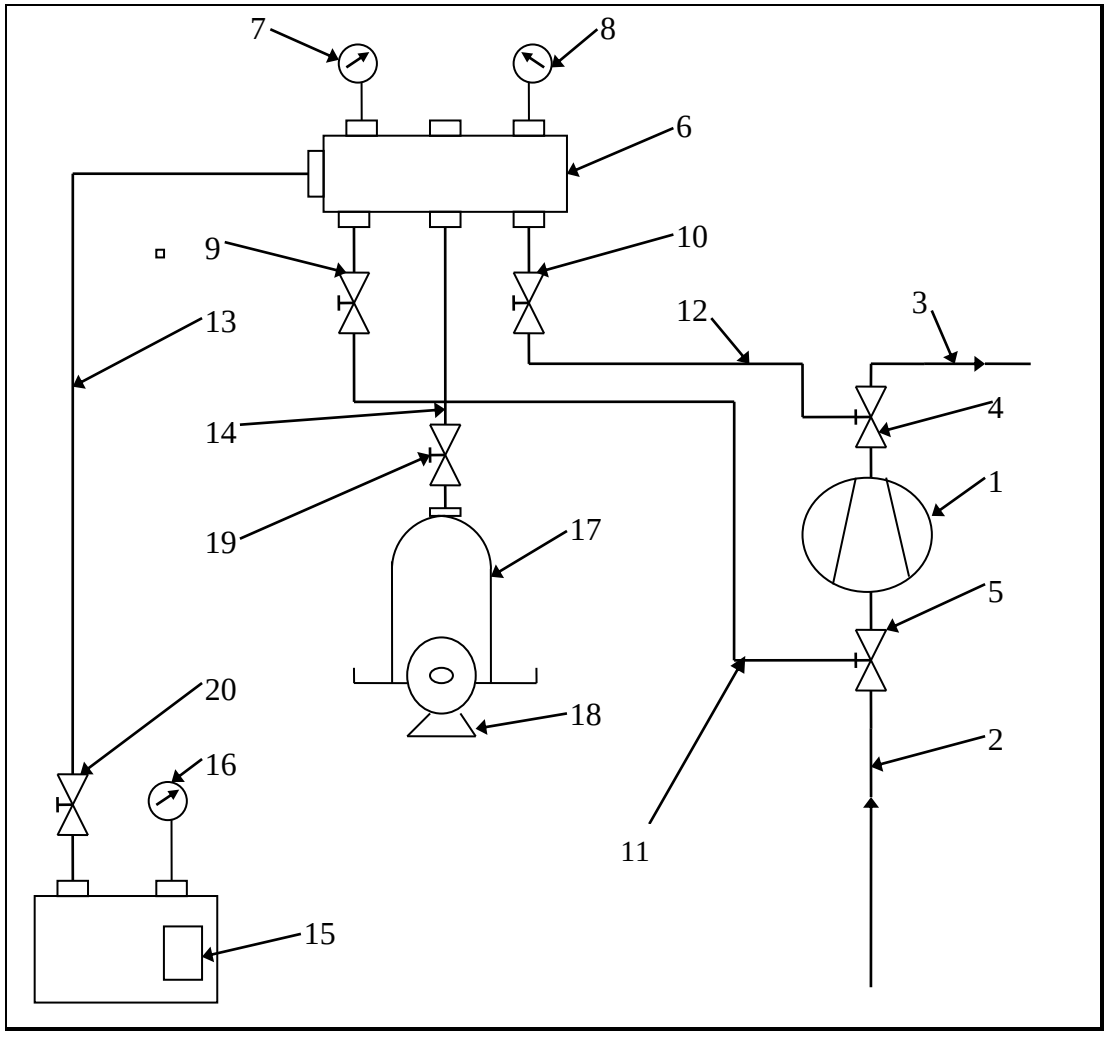
By means of a pressure clamp mounted inside the connecting adapter, the valve needle is pressed down when the connecting hose is closed and opens the valve for suction, evacuating and refilling.

The valve insert can be unscrewed with a valve key.



7.14 Leak Test

7.14.1 Diagram



1 Compressor
2 Suction line (low pressure)
3 Pressure line (high pressure)
4 Service valve (pressure)
5 Service valve (suction)
6 Gauge battery
7 Suction pressure gauge
8 High pressure gauge
9 Suction pressure gauge valve
10 High pressure gauge valve
11-14 Service hoses
15 Vacuum pump
16 Gauge
17 Refrigerant bottle
18 Balance
19 Refrigerant bottle valve
20 Vacuum pump valve

7.14.2 Sequence of work

1. Connect hoses (11), (12) to the connections of pressure (4) and suction valves (5) of the compressor (1) and the gauge battery (6).

2. Connect hose (14) to refrigerant bottle valve (19) and gauge battery (6).

3. Connect hose (13) to vacuum pump valve (20).

4. Evacuate hoses via vacuum pump.

5. Fully open spindles of pressure (4) and suction valves (5) and screw in by about two turns.

6. Open refrigerant bottle valve (19).

7. Let the refrigerant stream into the plant until the suction pressure gauge (7) and the high pressure gauge (8) on gauge battery (6) indicate the ambient temperature.

8. Check refrigerating circuit for leaks using the leakage tester/leakage test spray.

9. Upon completion of the leak test close refrigerant bottle valve (19) and service valves (4, 5).

10. Evacuate hoses (11,12 and 14) from residual refrigerant via the vacuum pump.

11. Close suction pressure gauge valve (9) and high pressure gauge valve (10) at the gauge battery (6).

7.14.3 Leakage tester

The electronic leakage tester works on the halogen molecule decomposition principle.

The measuring result is indicated either by a buzzer signal or on a scale.

The advantage of electronic leakage testers is the high sensitiveness indicating even the smallest leak.

7.14.4 Leakage test spray

The easiest method to find refrigerant leaks is the use of soapsuds. For this, the area a leakage is expected is coated with soapsuds (leakage test spray). Escaping vapour will produce bubbles.

This leak test method is mainly used when looking for larger leaks.

7.15 Evacuating and Filling of Refrigerant

7.15.1 Evacuating the Refrigerating Plant

1. Put refrigerant bottle (17) on balance (18).
2. Connect hose (14) to refrigerant bottle valve (19) and gauge battery (6).
3. Open suction pressure gauge valve (9) and high pressure gauge valve (10) of gauge battery (6).
4. Open vacuum pump valve (20).
5. Start vacuum pump (15) and evacuate plant for approx. 2 -6 hours (depending on the degree of moisture evacuate until the vacuum meter (16) indicates 0.67 – 1.33 mbar).
6. Close suction pressure gauge valve (9) and high pressure gauge valve (10) of gauge battery (6) and vacuum pump valve (20).
7. Switch off vacuum pump (15).

7.15.2 Refilling the Refrigerating Plant

1 Open refrigerant bottle valve (19) and vent filler line of gauge battery (6) via the vacuum pump.

2 Slowly open suction pressure gauge valve (9) of gauge battery (6).

3 Let refrigerant stream into the refrigerant plant.

4 Start compressor after a short time.

When filling the plant with refrigerant the pressure monitor (suction side) can interrupt the filling process frequently. The larger the temperature difference between the air-conditioning unit (= higher ambient temperature) and the refrigerant (=low ambient temperature) the more often the pressure monitor switches off the compressor. For resetting, press the reset pushbutton at the control panel.

The number of interruptions can be reduced by putting the refrigerant bottle into warm water (max. 40°C).

NEVER HEAT UP BOTTLE BY AN OPEN FLAME!

Fill up until balance (18) indicates the correct quantity.

5 Close refrigerant bottle valve (19) and shut down compressor (1). Completely unscrew spindles of suction (5) and pressure valves (4) (operating position).

6 Evacuate hoses (11,12 and 14) from refrigerant via the vacuum pump.

7 Remove hoses (11) and (12) of gauge battery from the compressor.

8 The refrigerant flow in the sight glass must be bubble free.

When there is enough refrigerant in the system there will be a uniform flow of refrigerant in the sight glass behind the filter drier. As refrigerants are colourless, an air-free refrigerant flow will be invisible. If there are bubbles in the refrigerant flow, the refrigerating circuit may not be filled with the necessary quantity. Before refilling the plant, the reason for the leak must be found and has to be eliminated and recorded by skilled or service personnel.

Refilling of Refrigerant

1 Shut down the compressor.

2 Remove cap from the suction valve.

3 Open valve spindle completely to ensure that there is no connection to the compressor and the suction line.

4 Connect filler line to the refrigerant bottle valve.

5 Connect filler line to the suction valve and vent via the vacuum pump.

8 Fully open refrigerant bottle valve.

9 Close valve spindle completely to cut off the suction line.

10 Bridge terminals of suction pressure switch.

11 Put compressor into operation. After a short time of operation open the valve spindle half way (= evacuation and refilling position).

12 Fill system until the refrigerant flows free from bubbles through the sight glass.

13 Close the refrigerant bottle valve.

14 Open valve spindle completely (= operating condition).

15 Pump out filler line and install cap on suction valve.

16 Shut down compressor.

17 Remove bridge from the suction switch.

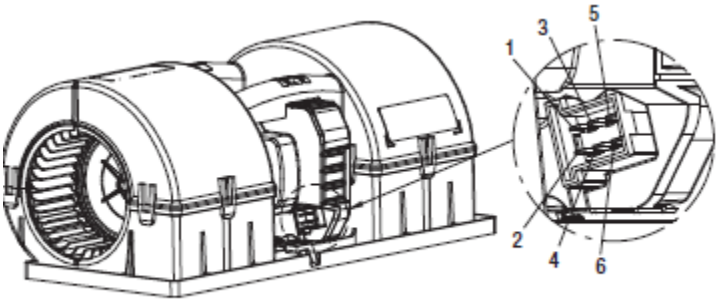
8 VENTILATION

8.1 Air-conditioning Fan (radial, two-way suction)

The evaporator fan is a double- radial fan with four-way suction and consists of a synthetic material housing with the necessary intake and outlet openings, a synthetic material fan wheel with swept guide blades for the supply of air and a hub laid out as stator and the fan shaft with the internal rotor motor. The type of construction is matched to the plant.

The fan sucks the circulating air from the mixing chamber via the filter and forces the conditioned air via the air cooler and the electric heater to the duct system or the room respectively.

The volume flow and the static and dynamic pressures of the fan are designed in such a way that optimal room conditions are reached.



8.2 Condenser Fan (axial)

The impeller and drive motor of Ziehl- Abegg centrifugal fans form an integral, optimized unit in terms of both airflow and design. The drive motor is a variable-speed, external rotor motor, which simultaneously constitutes the fan's hub and is therefore cooled highly effectively by the airflow.

The volume flow passes the fan motor and, thus, cools the motor. The motor heat is dissipated towards outside by the airflow.

During cooling operation the fan draws in the required condenser air from outside through the inlet opening and forces the air heated up by the condenser towards outside via the waste air opening.

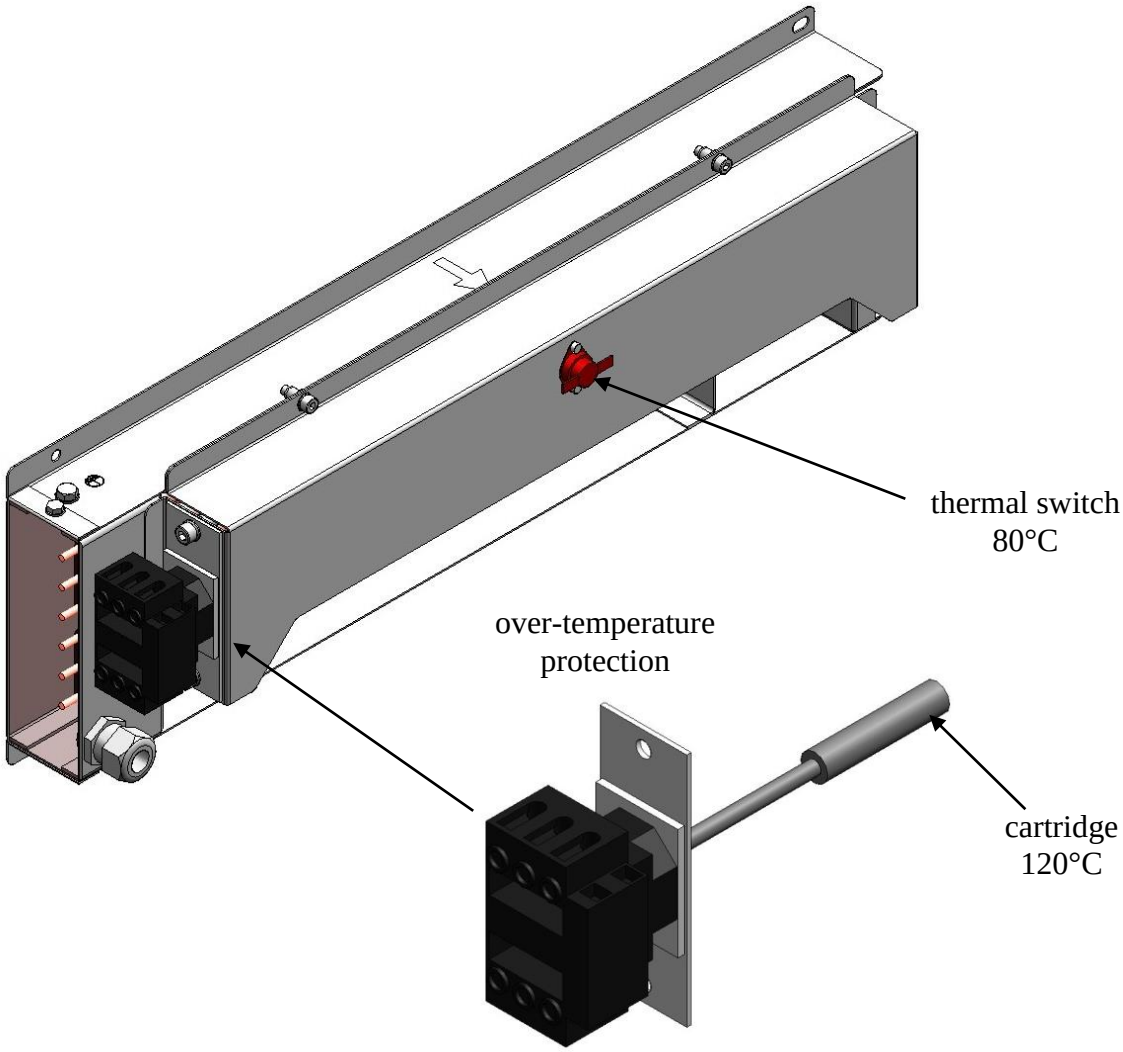
The volume flow and the static and dynamic pressures of the fan are designed in such a way that optimal conditions are reached.

9 HEATER

The heater consists of 6 heating elements, which are mounted and wired in a stainless steel housing. To avoid overheating a thermal switch and an over-temperature protection is installed.

The heating power is adjusted by the fan speed.
Fan speed 1 = 1.5 kW heating power
Fan speed 2 = 3.0 kW heating power
Fan speed 3 = 4.5 kW heating power

The overheat protection takes place in 2 steps.
Step 1: thermal switch 80 ° C automatic reset
Step 2: over-temperature protection 120 ° C manual reset (replacing the cartridge)



10 SPARE PARTS LISTS

10.1 General

To ensure a fast delivery of spare parts without any problems it is necessary to indicate, in addition to the required quantity, the relevant part or identification number and the order number.

Our service department is then able to arrange dispatch immediately or to hand over the correct parts to the service expert carrying out the repair.

10.2 Compressor-Condenser Unit Type RVE 14,5-U

Item.	Part No.	Quantity	Denomination
1	1000187085	1	Compressor (TFH5527)
2	1000086444	1	Compensator (suction side)
3	1000086445	1	Compensator (pressure side)
4	418333611	1	Pressure switch (suction and pressure side adjustable)
5	1000027573	1	Power regulator, mechanical
6	1000037604	2	Condenser fan motor
7	1000053710	1	Filter drier
8	1000187083	1	Liquid tank
9	1000002474	1	Sight glass
10	418369047	2	Speed regulator (Pressure switch)
11	1000187090	1	Condenser
12	1000098049	1	quick fitting coupling size 08 male
13	1000098048	1	quick fitting coupling size 12 male

10.3 Evaporator Unit Type K14,5-I

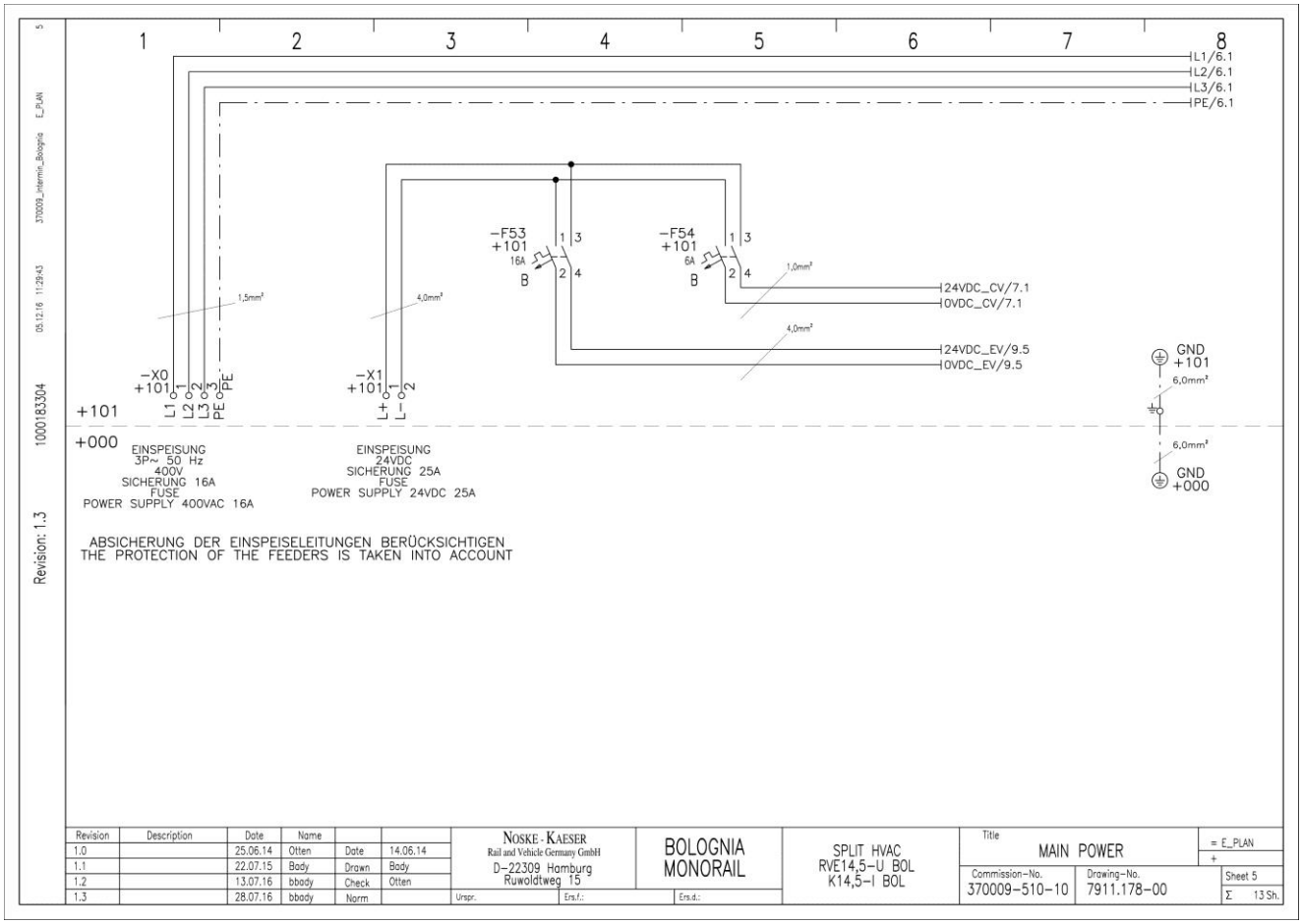
Item.	Part No.	Quantity	Denomination
1	1000119034	1	Evaporator fan
2	290465055	1	Expansion valve body
3	290459538	1	Expansion valve insert
4	1000183311	1	Evaporator
5	105008503	1	Filter K15/150
6	1000183399	1	Heater 4,5 kW
7	350561648	1	glass cartridge for over-temperature protection
8	1000098049	1	quick fitting coupling size 08 male
9	1000098048	1	quick fitting coupling size 12 male

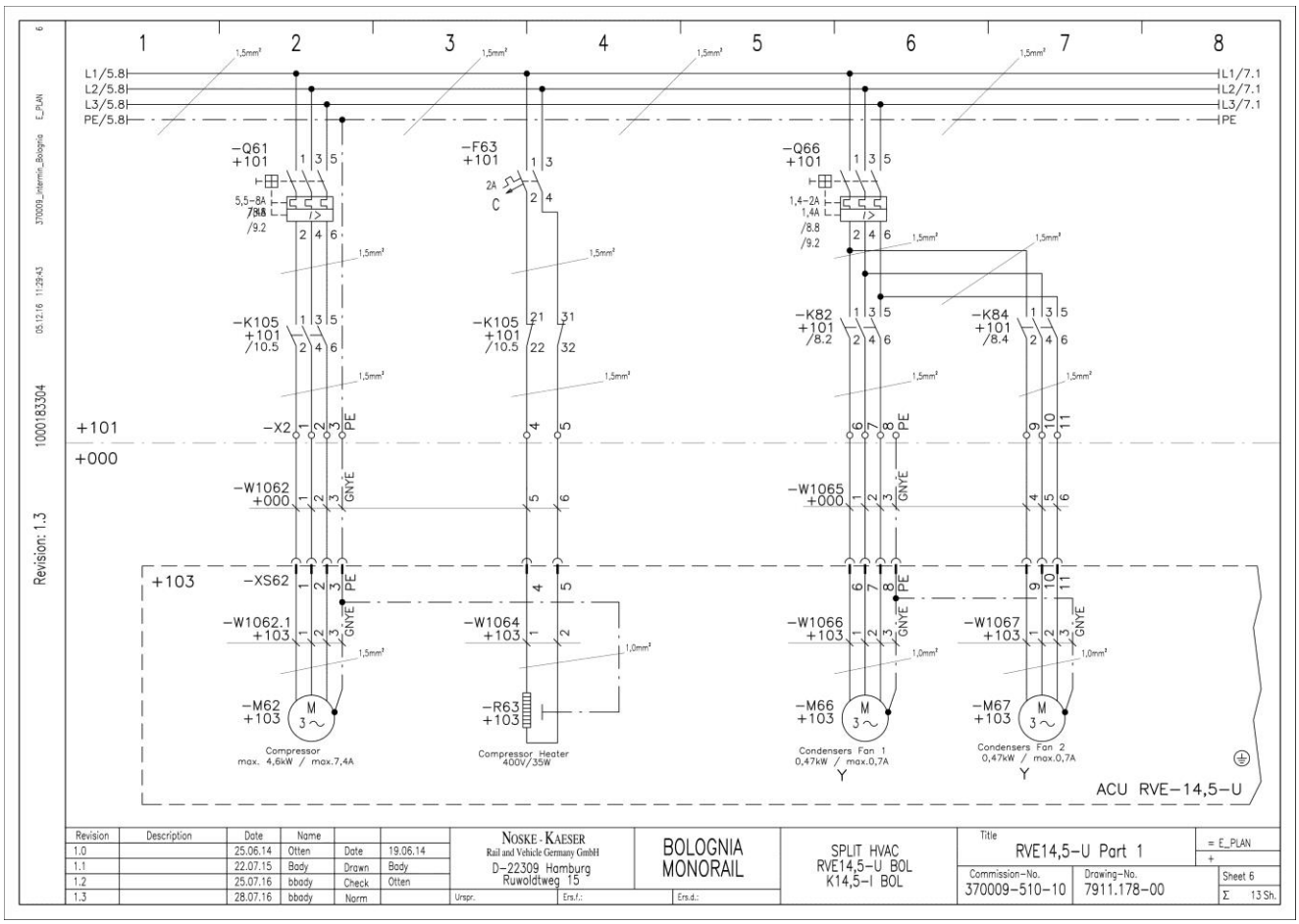
10.4 Electrical components

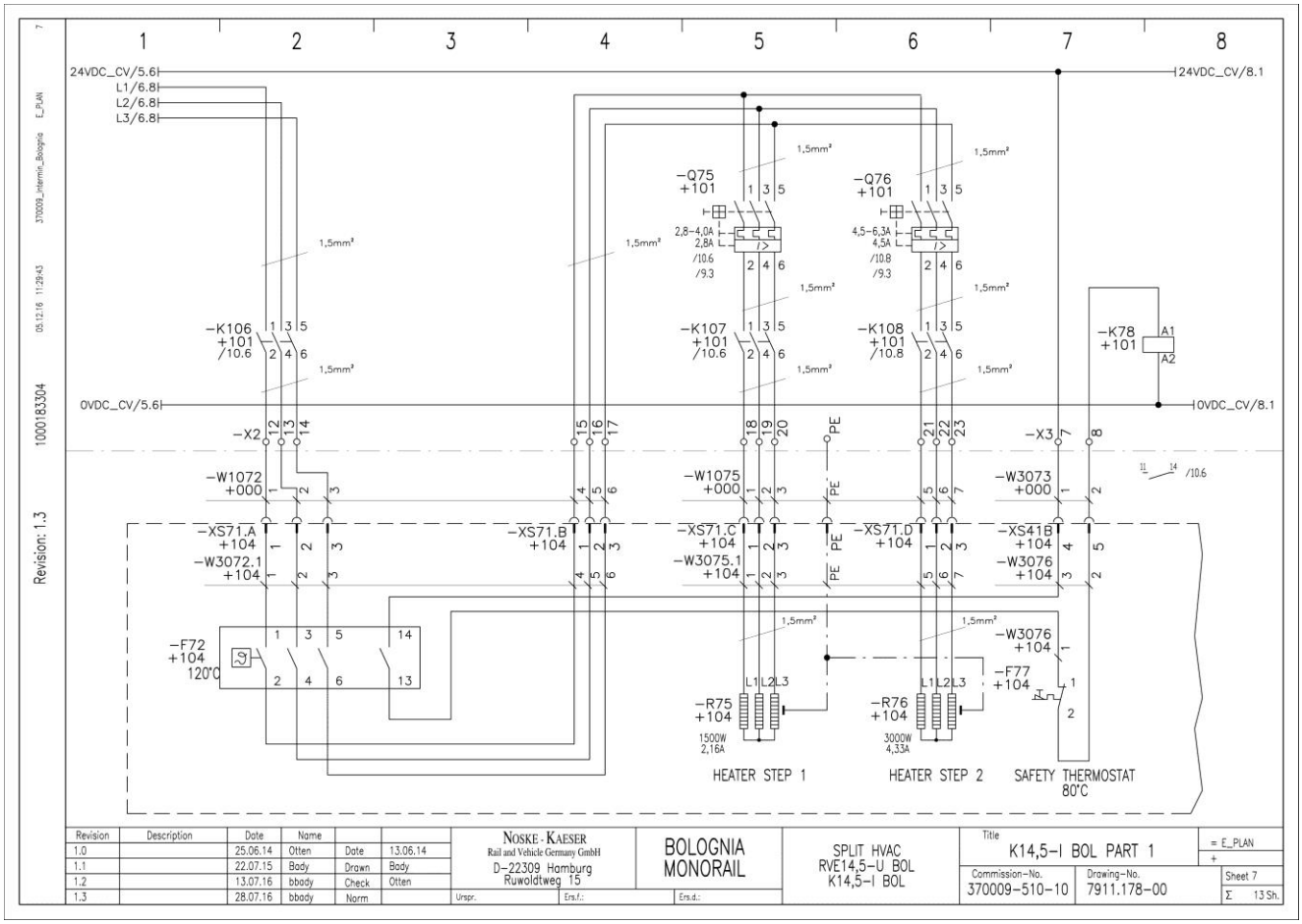
Item	Part No.	Denomination
1	1000121734	Protective motor switch 16A
2	1000121735	Protective motor switch 2A
3	1000121736	Protective motor switch 16A
4	1000121762	Contactor 4,0 kW 400V
5	1000125478	Contactor 5,5 kW 400V
6	1000080850	Relais miniature
7	1000121766	3 steps hand switch with 0
8	1000121765	3 steps hand switch without 0
9	1000121420	Thermostat (ST72 Störck)
10	422272306	Sensor PTC
11	1000121761	Lamp, red
12	1000121760	Lamp, green
13	1000121833	Powerswitch 1,4-2,0 A
14	1000121834	Powerswitch 2,8-4,0 A
15	1000146137	Powerswitch 4,5-6,3 A

11 Diagrams

11.1 Electrical circuit diagram




L1/5.8
L2/5.8
L3/5.8
PE/5.8
L1/7.1
L2/7.1
L3/7.1
PE
-Q61 +101
-F63 +101
-Q66 +101
-K105 +101 /10.5
-K82 +101 /8.2
-K84 +101 /8.4
+101
+000
+103
-X2
-XS62
-W1062 +000
-W1065 +000
-W1062.1 +103
-W1064 +103
-W1066 +103
-W1067 +103
-M62 +103
-R63 +103
-M66 +103
-M67 +103
Compressor max. 4,6kW / max.7,4A
Compressor Heater 400V/35W
Condensers Fan 1 0,47kW / max.0,7A
Condensers Fan 2 0,47kW / max.0,7A
ACU RVE-14,5-U
Revision: 1.3
1000183304
NOSKE-KAESER Rail and Vehicle Germany GmbH
D-22309 Hamburg
Ruwoldtweg 15
BOLOGNIA MONORAIL
SPLIT HVAC
RVE14,5-U BOL
K14,5-I BOL
RVE14,5-U Part 1
Commission-No. 370009-510-10
Drawing-No. 7911.178-00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L1/6.8
L2/6.8
L3/6.8
24VDC_CV/8.1
0VDC_CV/5.6
0VDC_CV/8.1
-Q75 +101
-Q76 +101
-K106 +101 /10.6
-K107 +101 /10.6
-K108 +101 /10.8
-K78 +101
-X2
-X3
-W1072 +000
-W1075 +000
-W3073 +000
-XS71.A +104
-XS71.B +104
-XS71.C +104
-XS71.D +104
-XS41B +104
-W3072.1 +104
-W3075.1 +104
-W3076 +104
-F72 +104 120°C
-R75 +104 1500W 2,16A
-R76 +104 3000W 4,33A
-F77 +104
HEATER STEP 1
HEATER STEP 2
SAFETY THERMOSTAT 80°C
Revision: 1.3
1000183304
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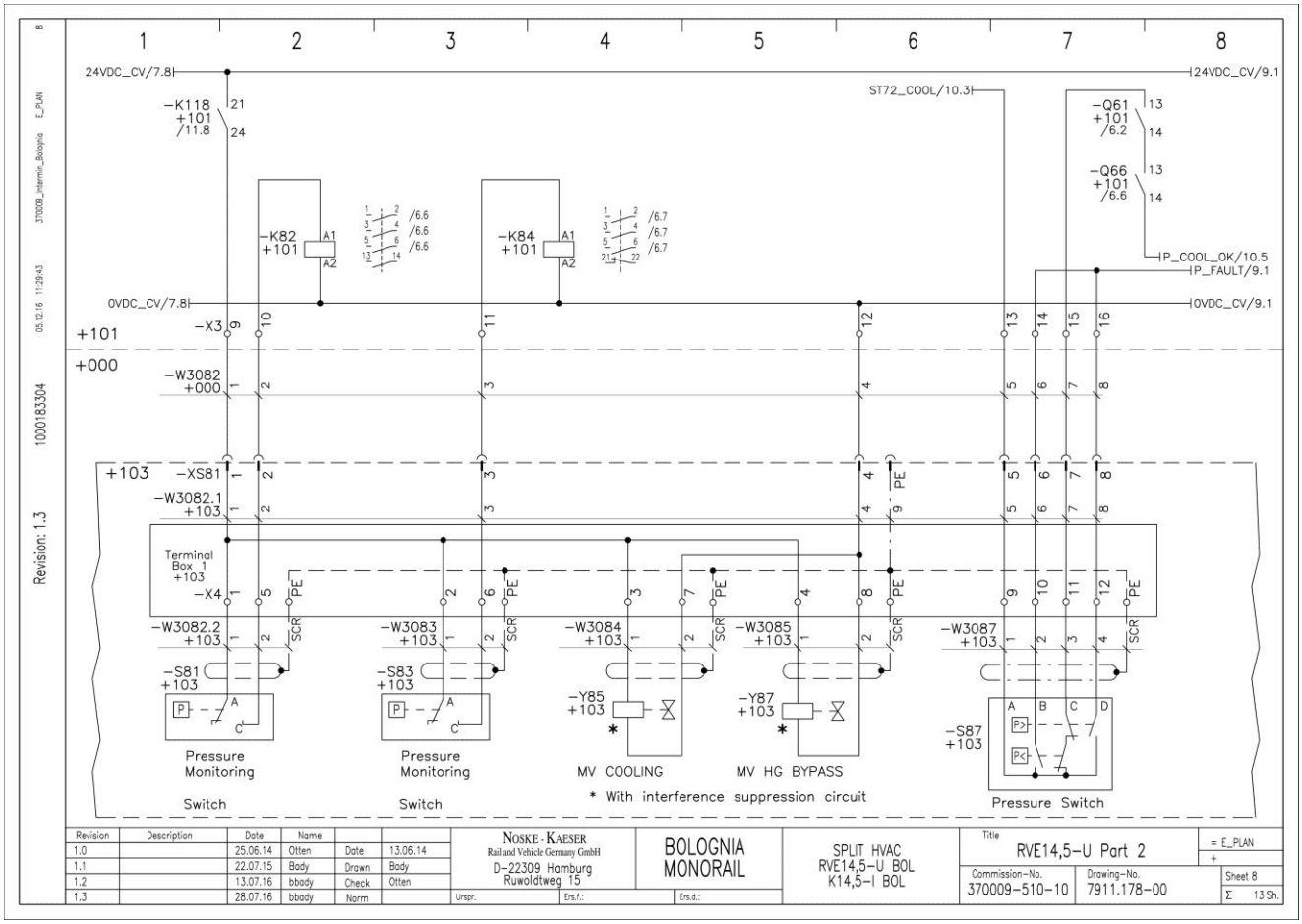
NOSKE-KAESER Rail and Vehicle Germany GmbH
D-22309 Hamburg Ruwoldtweg 15
BOLOGNIA MONORAIL
SPLIT HVAC RVE14,5-U BOL K14,5-I BOL
K14,5-I BOL PART 1
Commission-No. 370009-510-10
Drawing-No. 7911.178-00
Sheet 7


24VDC_CV/7.8
24VDC_CV/9.1
ST72_COOL/10.3
-K118 +101 /11.8
-Q61 +101 /6.2
-Q66 +101 /6.6
-K82 +101
-K84 +101
P_COOL_OK/10.5
P_FAULT/9.1
0VDC_CV/7.8
0VDC_CV/9.1
+101
+000
-X3
-W3082 +000
+103
-XS81
-W3082.1 +103
Terminal Box 1 +103
-X4
-W3082.2 +103
-W3083 +103
-W3084 +103
-W3085 +103
-W3087 +103
-S81 +103
-S83 +103
-Y85 +103
-Y87 +103
-S87 +103
Pressure Monitoring Switch
Pressure Monitoring Switch
MV COOLING
MV HG BYPASS
* With interference suppression circuit
Pressure Switch
Revision: 1.3
1000183304
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D-22309 Hamburg
Ruwoldtweg 15
BOLOGNIA MONORAIL
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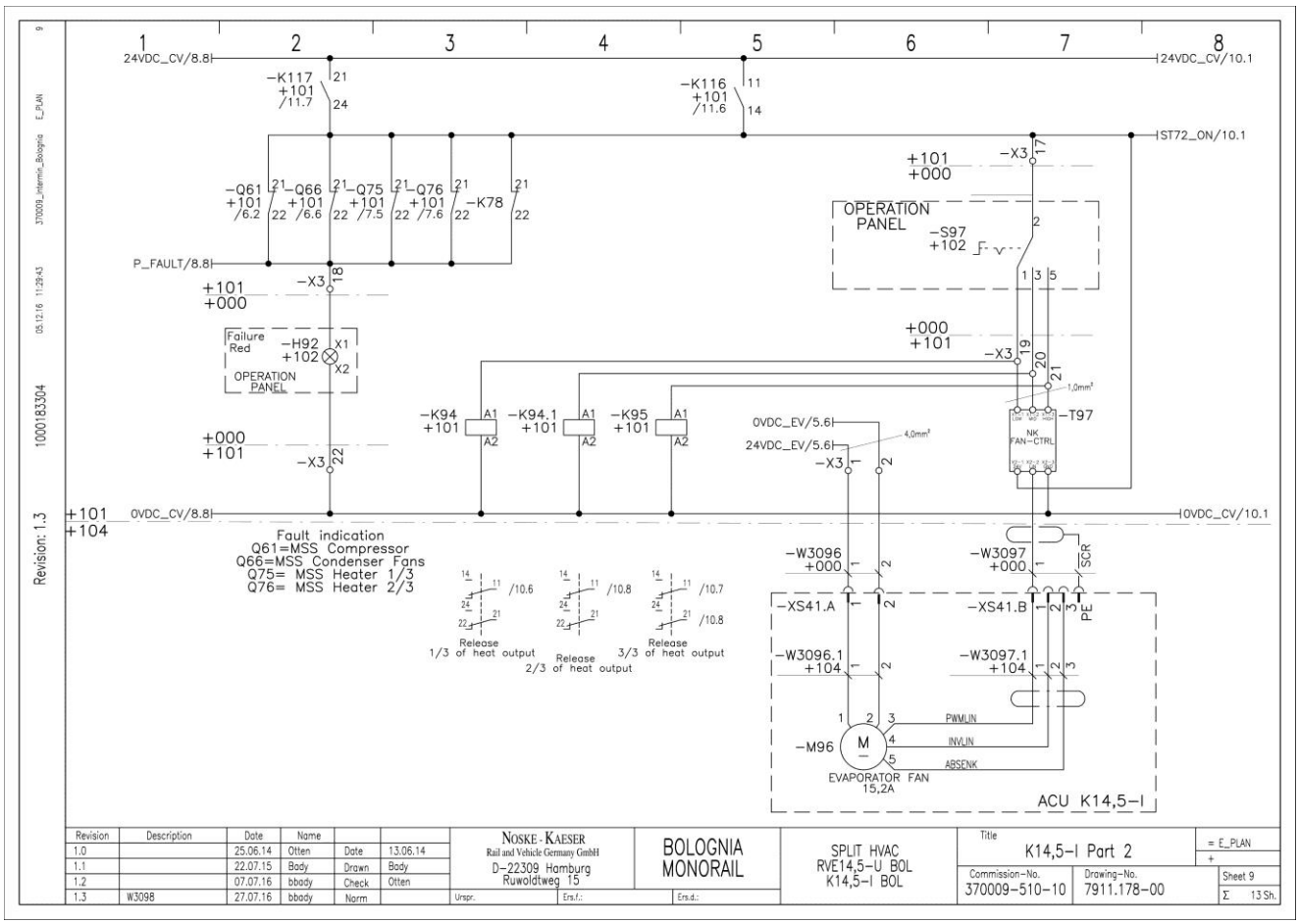
RVE14,5-U BOL
K14,5-I BOL
RVE14,5-U Part 2
Commission-No. 370009-510-10
Drawing-No. 7911.178-00
Sheet 8
Σ 13 Sh.


24VDC_CV/8.8
24VDC_CV/10.1
-K117 +101 /11.7
-K116 +101 /11.6
IST72_ON/10.1
-Q61 +101 /6.2
-Q66 +101 /6.6
-Q75 +101 /7.5
-Q76 +101 /7.6
-K78
OPERATION PANEL
-S97 +102
P_FAULT/8.8
-X3
Failure Red
-H92 +102
-K94 +101
-K94.1 +101
-K95 +101
-T97
NK FAN-CTRL
0VDC_EV/5.6
24VDC_EV/5.6
0VDC_CV/8.8
0VDC_CV/10.1
Fault indication
Q61=MSS Compressor
Q66=MSS Condenser Fans
Q75= MSS Heater 1/3
Q76= MSS Heater 2/3
Release 1/3 of heat output
Release 2/3 of heat output
Release 3/3 of heat output
-W3096 +000
-W3097 +000
SCR
-XS41.A
-XS41.B
PE
-W3096.1 +104
-W3097.1 +104
-M96
EVAPORATOR FAN 15,2A
PWMLIN
INVLIN
ABSENK
ACU K14,5-I
Revision: 1.3
1000183304
NOSKE-KAESER Rail and Vehicle Germany GmbH
D-22309 Hamburg
Ruwoldtweg 15
BOLOGNIA MONORAIL
SPLIT HVAC RVE14,5-U BOL K14,5-I BOL
K14,5-I Part 2
Commission-No. 370009-510-10
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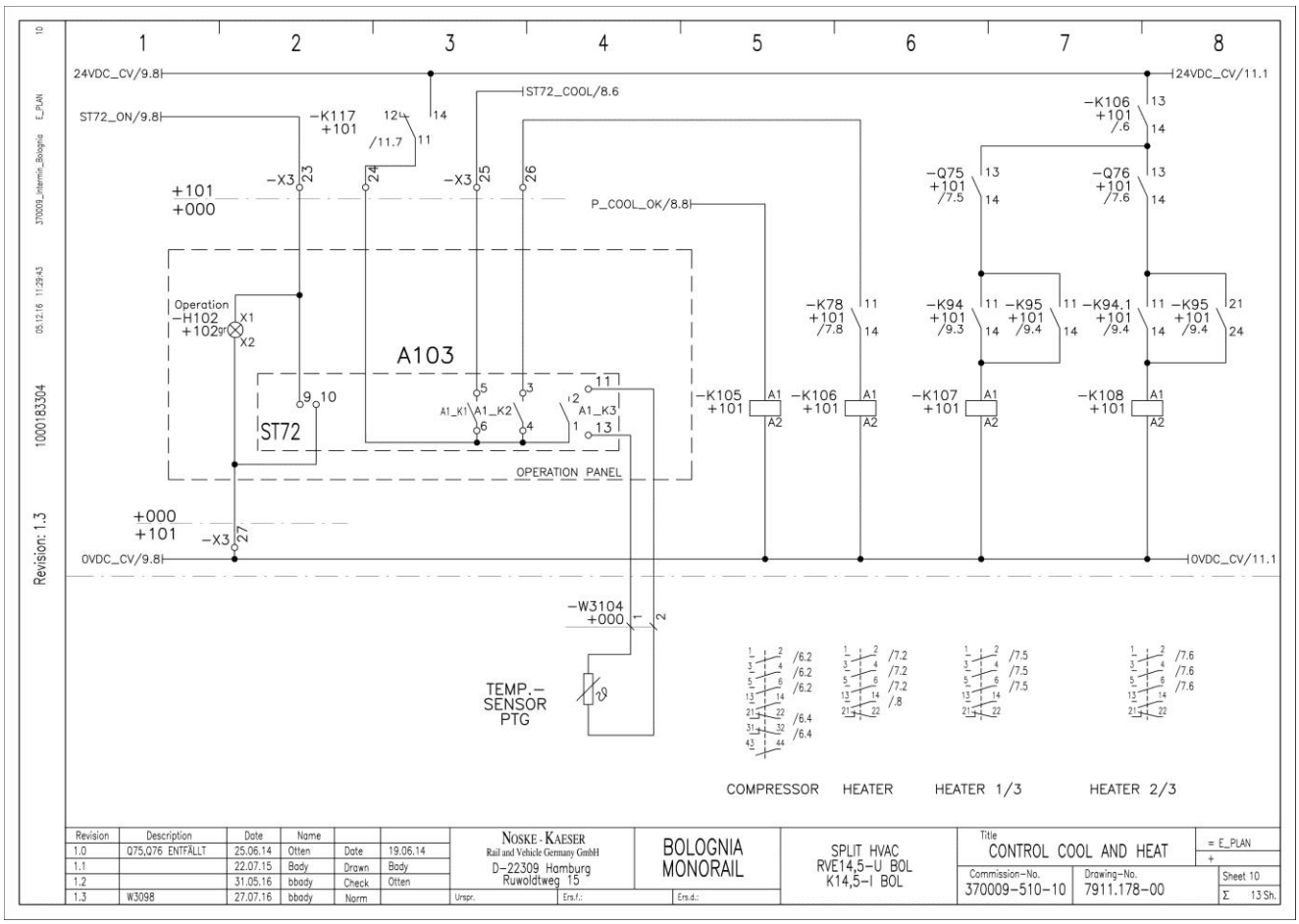
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24VDC_CV/11.1
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ST72_COOL/8.6
P_COOL_OK/8.8
-K117 +101 /11.7
-K106 +101 /.6
-Q75 +101 /7.5
-Q76 +101 /7.6
+101 +000
+000 +101
Operation -H102 +102gr
A103
ST72
OPERATION PANEL
A1_K1
A1_K2
A1_K3
-K78 +101 /7.8
-K94 +101 /9.3
-K95 +101 /9.4
-K94.1 +101 /9.4
-K105 +101
-K106 +101
-K107 +101
-K108 +101
0VDC_CV/9.8
0VDC_CV/11.1
-W3104 +000
TEMP.-SENSOR PTG
COMPRESSOR
HEATER
HEATER 1/3
HEATER 2/3
Revision: 1.3
1000183304
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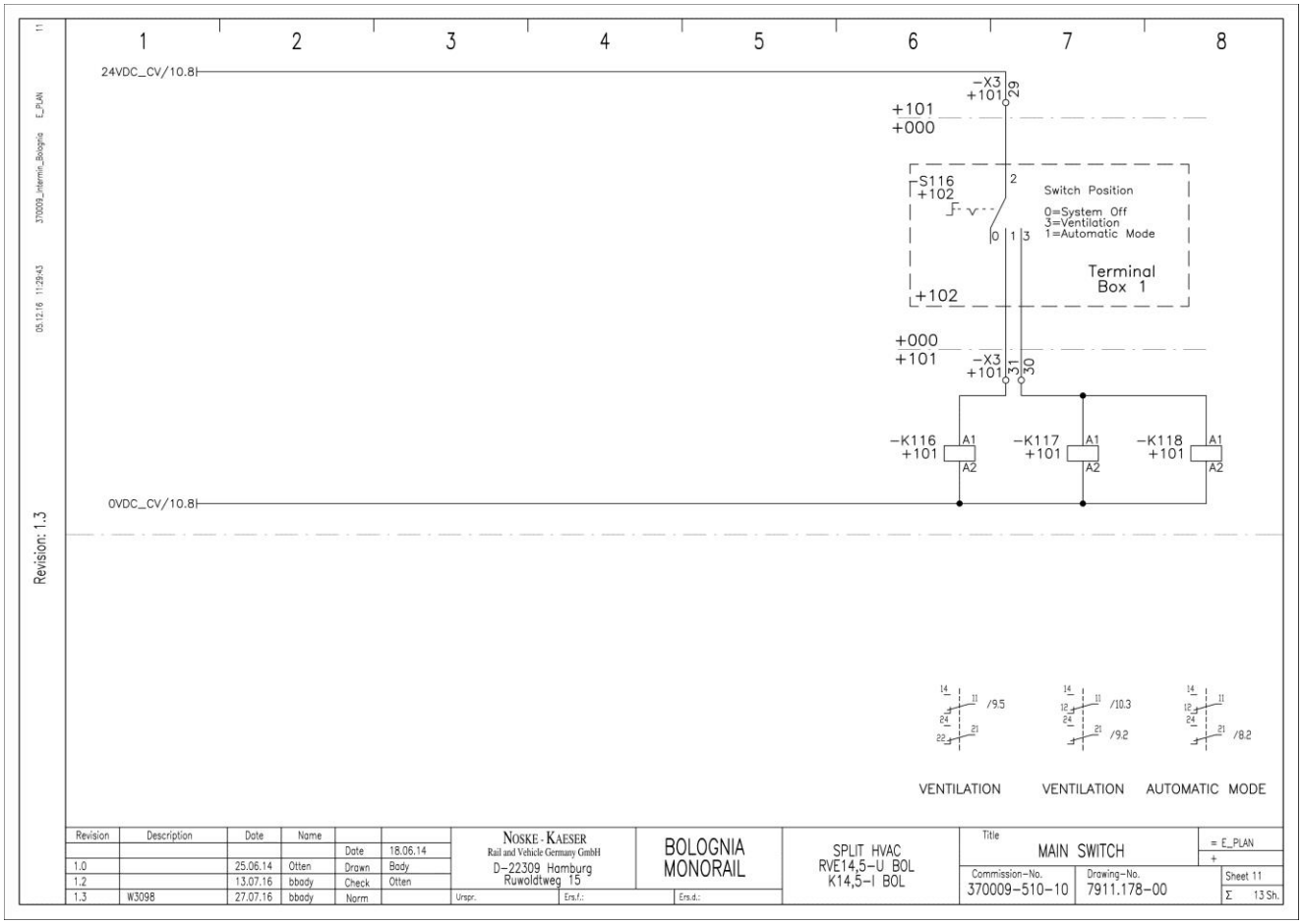
05.12.16 11:29:43
10
NOSKE-KAESER Rail and Vehicle Germany GmbH
D-22309 Hamburg Ruwoldtweg 15
BOLOGNIA MONORAIL
SPLIT HVAC RVE14,5-U BOL K14,5-I BOL
CONTROL COOL AND HEAT
Commission-No. 370009-510-10
Drawing-No. 7911.178-00
Sheet 10
Σ 13 Sh.
1.0 Q75,Q76 ENTFÄLLT 25.06.14 Otten 19.06.14
1.1 22.07.15 Body Body
1.2 31.05.16 bbody Otten
1.3 W3098 27.07.16 bbody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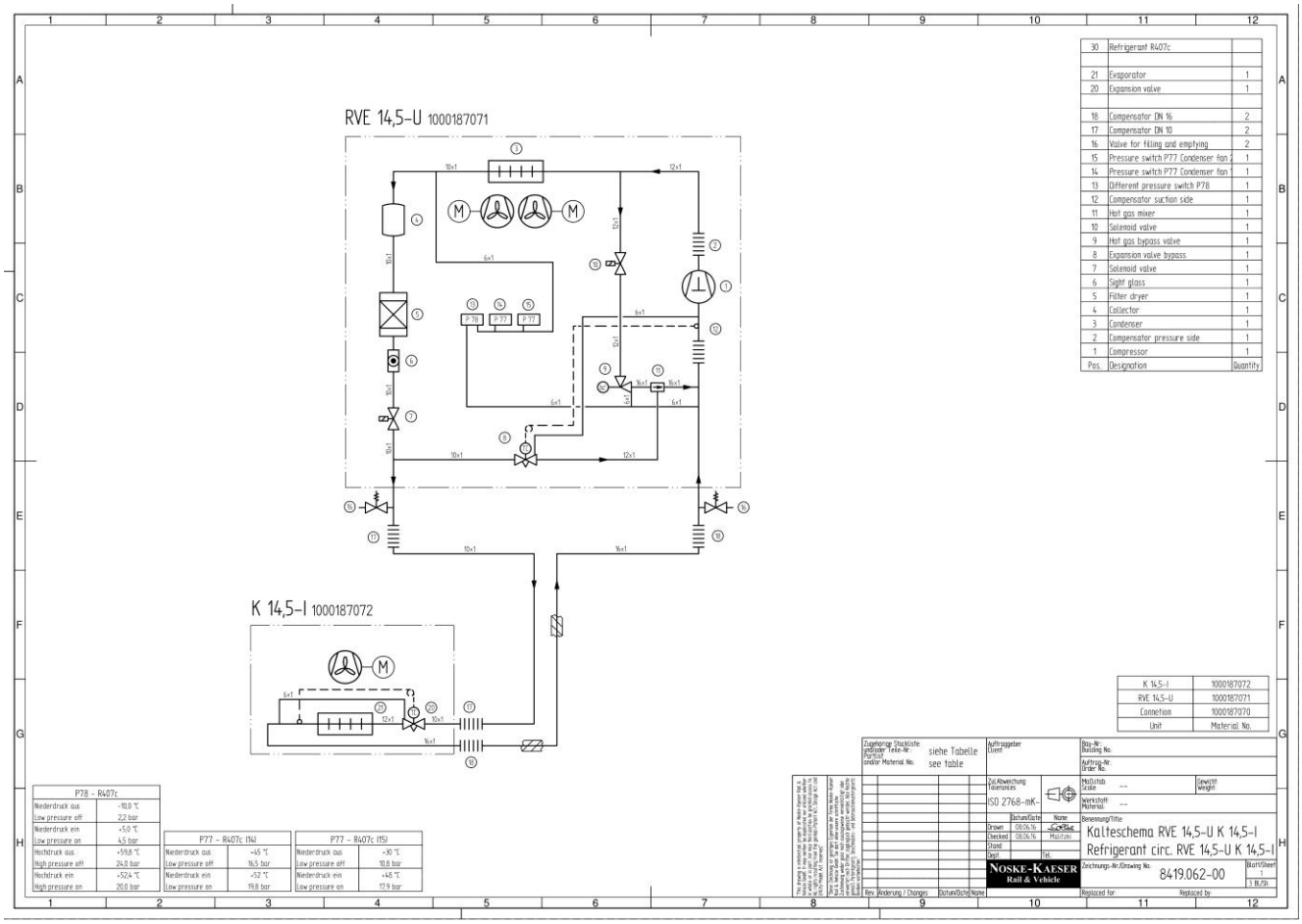
3=Ventilation
1=Automatic Mode
Terminal Box 1
+102
+000 +101
-X3 +101 31 30
-K116 +101
-K117 +101
-K118 +101
A1
A2
/9.5
/10.3
/9.2
/8.2
VENTILATION
VENTILATION
AUTOMATIC MODE
Revision: 1.3
NOSKE-KAESER
Rail and Vehicle Germany GmbH
D-22309 Hamburg
Ruwoldtweg 15
BOLOGNIA MONORAIL
SPLIT HVAC
RVE14,5-U BOL
K14,5-I BOL
MAIN SWITCH
Commission-No. 370009-510-10
Drawing-No. 7911.178-00
= E_PLAN
Sheet 11
Σ 13 Sh.

11.2 Flow diagram refrigerant circuit



12 Consumption Record for Refrigerants and Refrigerator Oil

Air-conditioning plant

Type: _____

Serial No., year of manufacture _____

12.1 Refrigerant

CONS .NO.	TOPPING-UP QUANTITY (KG)	Quantity drained (kg)	Remark (e.g. reason)	Date	Name of Fitter
1					
2					
3					
4					
5					

12.2 Refrigerator oil

CONS . NO.	TOPPING-UP QUANTITY (KG)	Quantity drained (kg)	Remark (e.g. reason)	Date	Name of Fitter
1					
2					
3					
4					
5					

Please copy!

13 Leakage Test Report

Air-conditioning plant

Type: _____

Serial No., year of manufacture _____

13.1 Air-conditioning plant

CONS. NO.	No leaks:	Remark (e.g. leakage reason)	Date	Name of Fitter
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

Please copy!

14 Safety Datasheet R407C

Conforms to 91/155/EEC - 2001/58/EC - United Kingdom (UK)

SAFETY DATA SHEET

Honeywell

R-407C

1. Identification of the substance/preparation and of the company/undertaking

Identification of the substance or preparation

Product name : **R-407C**

Use of the substance/preparation : Refrigerant.

Company/undertaking identification

Supplier : Honeywell Fluorine
Products Europe B.V.
Kempenweg 90
6002 SX Weert, The Netherlands
Tel: +31-495-514200
Fax: +31-495-518259

BIG number : 23231

Emergency telephone number : (32) 16 391 391

2. Composition/information on ingredients

Substance/Preparation : Preparation

Ingredient Name	CAS number	%	EC Number	Classification
United Kingdom (UK)				
1,1,1,2-tetrafluoroethane. (HFC-134a)	811-97-2	52	212-377-0	
Ethane, pentafluoro- (HFC-125)	354-33-6	25	206-557-8	
Difluoromethane. (HFC-32)	75-10-5	23	200-839-4	R10
See Section 16 for the full text of the R Phrases declared above				

*** Occupational Exposure Limit(s), if available, are listed in Section 8**

3. Hazards identification

The preparation is not classified as dangerous according to Directive 1999/45/EC and its amendments.

Additional Hazards : Dermal contact with rapidly evaporating liquid could result in freezing of the tissues or frostbite. High vapour concentrations can cause headaches, dizziness, drowsiness, and nausea, and may lead to unconsciousness. Heartbeat irregularity (arrhythmia).

See Section 11 for more detailed information on health effects and symptoms.

4. First aid measures

First aid measures

Inhalation : If inhaled, remove to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Get medical attention.

Ingestion : As this product is a gas, refer to the inhalation section. Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention.

Skin Contact : Dermal contact with rapidly evaporating liquid could result in freezing of the tissues or frostbite. In case of contact with liquid, warm frozen tissues with water and get medical attention. Remove contaminated clothing and shoes. Wash clothing before reuse.

Eye contact : Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. If irritation persists, get medical attention.

Notes to physician : Do not give adrenaline or similar drugs.

See Section 11 for more detailed information on health effects and symptoms.

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5. Fire-fighting measures

Extinguishing media : Non-flammable.
ASHRAE 34.
In case of fire, use water spray (fog), foam, dry chemical or CO_2 extinguisher or spray.

Special exposure hazards : Possibility of generating hazardous reactions during a fire due to the presence of F and/or Cl groups. In a fire or if heated, a pressure increase will occur and the container may burst. Use water spray to keep fire-exposed containers cool. This product is not flammable at ambient temperatures and atmospheric pressure. However, this material can ignite when mixed with air under pressure and exposed to strong ignition sources.

Hazardous thermal decomposition products : These products are carbon oxides (CO, CO_2), halogenated compounds, hydrogen fluoride, carbonyl halides.

Decomposition Temperature : >250°C (482°F)

Special protective equipment for fire-fighters : Fire-fighters should wear self-contained positive pressure breathing apparatus (SCBA) and full turnout gear.

6. Accidental release measures

Personal Precautions : Immediately contact emergency personnel. Keep unnecessary personnel away. Use suitable protective equipment (Section 8). Provide adequate ventilation. In case of insufficient ventilation, wear suitable respiratory equipment.

Environmental precautions and cleanup methods : Stop leak if without risk. Spillages may evaporate rapidly.

Note: See section 8 for personal protective equipment and section 13 for waste disposal.

7. Handling and storage

Handling : Exercise caution when opening to allow pressure release.Store and use away from heat, sparks, open flame, or any other ignition source. Pressurised container: protect from sunlight and do not expose to temperature exceeding 50°C. Do not pierce or burn, even after use. Provide adequate ventilation. Wash thoroughly after handling.

Storage : Store in original container, protected from direct sunlight. Keep container tightly closed in a cool, well- ventilated place.

Packaging materials

Recommended : Use original container.

8. Exposure controls/personal protection

Ingredient Name	Occupational Exposure Limits
United Kingdom (UK)	
1,1,1,2-tetrafluoroethane. (HFC-134a)	**EH40-OES (United Kingdom (UK), 2002).** STEL: 9740 mg/m^3 15 minute(s). STEL: 1250 ppm 15 minute(s). TWA: 4240 mg/m^3 8 hour(s). TWA: 1000 ppm 8 hour(s).
Ethane, pentafluoro- (HFC-125)	**Honeywell (United Kingdom (UK)).** TWA: 1000 ppm 8 hour(s). **AIHA WEEL (United Kingdom (UK), 2002).** TWA: 1000 ppm 8 hour(s).
Difluoromethane. (HFC-32)	**Honeywell (United Kingdom (UK)).** TWA: 1000 ppm 8 hour(s). **AIHA WEEL (United Kingdom (UK), 2002).** TWA: 1000 ppm 8 hour(s).

Exposure Controls and Personal Protection

Occupational exposure controls : Provide adequate ventilation. Do not enter storage areas and confined spaces unless adequately ventilated.

Respiratory protection : In case of insufficient ventilation, wear suitable respiratory equipment.
Recommended: supplied-air respirator.

Hand protection : Insulated gloves suitable for low temperatures
Recommended: butyl rubber

R-407C

Eye protection : Recommended: safety glasses with side shields, splash goggles.
Possible: face shield.

Skin protection : Recommended: overall. Suitable protective footwear.

9. Physical and chemical properties

General information

Appearance

Physical state : Gas. (Liquefied gas.)

Colour : Colourless.

Odour : Ethereal. (Slight.)

Molecular Weight : Not applicable.

Important health, safety and environmental information

Boiling point : -43.9°C (-47°F)

Flash point : Not applicable.

Relative density : 1.16 g/cm^3

Solubility : Water: 0.15 g/100 ml.

Vapour density : 3 (Air = 1)

Evaporation rate : >1 compared to CCl_4

Other information

Decomposition Temperature : >250°C (482°F)

10. Stability and reactivity

Stability : The product is stable. Hazardous Polymerisation : Will not occur.

Conditions to Avoid : In a fire or if heated, a pressure increase will occur and the container may burst. Pressurised container: protect from sunlight and do not expose to temperature exceeding 50°C. Do not pierce or burn, even after use.

Decomposition Temperature : >250°C (482°F)

Materials to avoid : Strong oxidising materials. Incompatible with magnesium, zinc, sodium, potassium and aluminium.
Incompatibility is more severe if the metal is present as dust or powder or has freshly exposed surfaces.

Hazardous Decomposition Products : These products are halogenated compounds, hydrogen fluoride, carbon oxides (CO, CO_2), carbonyl halides.

11. Toxicological information

Potential Acute Health Effects

Inhalation : Heartbeat irregularity (arrhythmia).

Ingestion : No specific hazard.

Skin Contact : Dermal contact with rapidly evaporating liquid could result in freezing of the tissues or frostbite. Slightly irritating to the skin.

Eye contact : Slightly irritating to the eyes.

Acute toxicity

Ingredient Name	Test	Result	Route	Species
1,1,1,2-tetrafluoroethane. (HFC-134a)	LC50	>500000 ppm (4 hour(s))	Inhalation	Rat
Ethane, pentafluoro- (HFC-125)	LC50	>800000 ppm (4 hour(s))	Inhalation	Rat
Difluoromethane. (HFC-32)	LC50	520000 ppm (4 hour(s))	Inhalation	Rat

Remarks : **1,1,1,2-tetrafluoroethane. (HFC-134a)**: Cardiac sensitisation threshold (dog): 80000 ppm.
Ethane, pentafluoro- (HFC-125): Cardiac sensitisation threshold (dog): 75000 ppm.
Difluoromethane. (HFC-32): Cardiac sensitisation threshold (dog): 350000 ppm.

Subchronic exposure, no-observed-effect level (NOEL) : > 10000 ppm (Rat).

Over-exposure signs/symptoms

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12. Ecological information

Other Ecological Information

Ingredient Name	Persistence/degradability						Bioaccumulative potential		
	BOD_5	COD	ThOD	Aquatic Half-life	Photolysis	Biodegradability	$LogP_{ow}$	BCF	Potential
1,1,1,2-tetrafluoroethane. (HFC-134a)							1.06		low
Ethane, pentafluoro- (HFC-125)							1.48		low

Ozone Depleting Potential (ODP) (R-11 = 1) : 0

Global Warming Potential (GWP) : 1530

Mobility : Practically non-toxic to aquatic organisms.

13. Disposal considerations

Methods of disposal : Dispose of surplus and non-recyclable products via a licensed waste disposal company. Refer to manufacturer/supplier information on recovery/recycling.

Waste Classification : Not applicable.

European Waste Catalogue (EWC) : Not available.

Hazardous Waste : To present knowledge of the supplier, this product is not regarded as hazardous waste as defined by EU Directive 91/689/EC.

14. Transport information

International transport regulations

Regulatory information	UN number	Proper shipping name	Class	Packing group	Label	Additional Information
ADR/RID Class	UN3340	Refrigerant gases, R407c	2	-		Hazard identification number 20
ADN Class	UN3340	Refrigerant gases, R407c	2	-		-
IMDG Class	UN3340	Refrigerant gases, R407c	2.2	-		Emergency Schedules (EmS) 2-09
IATA-DGR Class	UN3340	Refrigerant gases, R407c	2.2	-		-

15. Regulatory information

EU Regulations

Risk phrases : This product is not classified according to the EU regulations.

Product Use : Classification and labelling have been performed according to EU directives 67/548/EEC, 1999/45/EC, including amendments and the intended use.
- Industrial use only.

Additional Warning Phrases : Safety data sheet available for professional user on request.

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16. Other information

HISTORY

Date of printing	:	**9/30/2003.**
Date of issue	:	**9/30/2003.**
Date of previous issue	:	**No Previous Validation.**
Version	:	**1.00**
Prepared by	:	**Honeywell EHS department** **Tel: +31-495-514200 refrigerants.europe@honeywell.com**

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