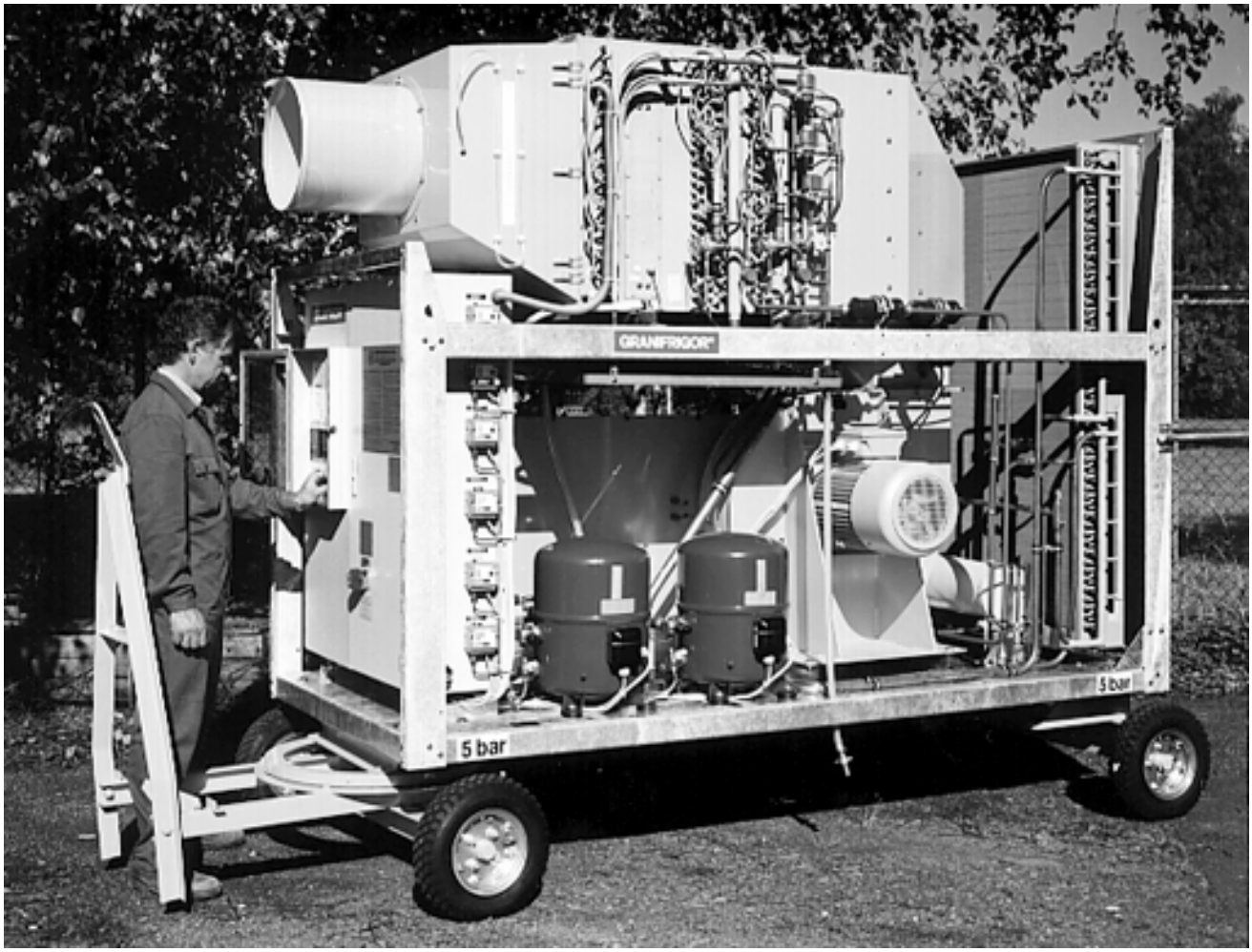
Operating Manual

No. 8829.185.01
for
Grain Cooler

GRANIFRIGOR®

Typ KK 220 AHY



FrigorTec GmbH

Refrigeration Units, Service

Illustration

FRIGOR TEC

Contents

For your kind attention

With the GRANIFRIGOR® grain cooler you have acquired a quality product which has left our works only after strict final inspections and a long trial run. GRANIFRIGOR® grain chillers generate a chilled air stream with controlled temperature and humidity. They are mainly used for cooling of grain stored in bulk but other applications are also possible.
The construction and instructions of the GRANIFRIGOR® units comply with the European safety regulations as is guaranteed by the presence of the CE Stamp on the appliance. Please note the following instructions and observe them, especially those concerning maintenance. This will assure you of reliable and economical operation for many years.
These operating instructions form part of the cooler supply, and in accordance with the accident prevention regulations they should be kept accessible to the operating and maintenance personnel at all times. Operation may be entrusted only to persons who have first familiarized themselves with these instructions. If the cooler is inexpertly handled, the guarantee obligations of the makers no longer apply. In this connection the reader is referred to our current terms of delivery.
Instructions for making use of the GRANIFRIGOR® system are given in the following booklet:

GRANIFRIGOR® – its technology of application
Printed Matter no. 26.11.16

which you have received together with the GRANIFRIGOR® operating manual.

The right is reserved to effect detail modifications within the scope of engineering progress.
No claims of any kind may be construed from these operating instructions. In the event of damage in transit, the transport firm is to be notified at once (truck driver's signature), so that the question of compensation can be taken up with the insurance company.

Attention

**The refrigeration circuit is under pressure (9,4 bar at 20°C room temperature when the compressor is at standstill) and must not be opened in an inappropriate manner.
Interventions into the refrigeration circuit may only be done by a qualified refrigeration technician. Gaseous refrigerant R407C is havarie than air. In case of refrigerant escape it is therefore very important to ventilate the floor area very well to avoid the formation of a layer dangerously poor in oxygen.
Before performing any work on moving parts (compressor and fans) always put the main switch into the „0“position and also , if possible, cut-off the network electrical supply. The max. admissible ambient temperature is +58°C. At higher temperatures there is the risk of bursting an injuries.**

1 Description of the equipment

(See figs. 1 – 3)

1.1 Equipment layout

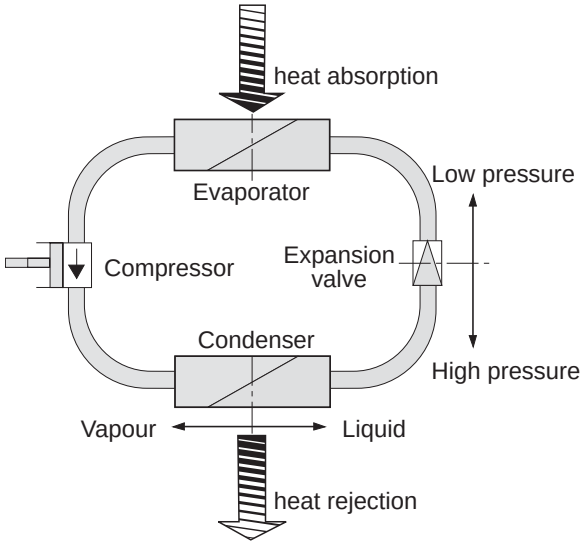
The GRANIFRIGOR chillers are compact, fully assembled, mobile cooling units supplied ready for operation apart from the electrical and chilled air connections.
The standard version has four strong caster wheels fitted under the base frame, enabling the unit to be manoeuvred in a confined space. Wedge chocks are provided to secure its position.
For movement over longer distances or on uneven or unsurfaced ground, a special version may be had on a chassis with pneumatic tyres instead of casters (optional).
To be provided by the purchaser are the power supply cable, the flexible chilled air hose for connecting the grain chiller to the storage facility (this can be supplied extra), and the necessary air distribution arrangements in the silo. Principal dimensions and weights are given in the dimensional drawing, Annex 6.1.

1.2 Refrigeration circuit

GRANIFRIGOR units refrigerate by the principle of cold vapour compression. Working medium is the safety refrigerant R407C, which is scentless, non-flammable, non-explosive und poisonless (Group L1-A1/A1 about EN 378-1). This refrigerant is a zoetrope mixture. The Single-components are R32 (23%) R125 (25%), R134A (52%). R407C has converse to other safety refrigerant R134a a glide of temperature.

Delivered by the compressor, the refrigerant circulates in a closed system between two heat exchangers. In one of these the evaporator (air cooler) it takes up heat from the air, thereby cooling the air streaming through. In the other one the condenser it rejects this heat again to the ambient air, which is heated in the process. In the expansion valve the refrigerant is expanded from

condensing pressure (high pressure) to evaporating pressure (low pressure).
KK 220 AHY units have to separate refrigeration circuits. The capacity control is described in subsection 1.5.



Refrigeration circuit diagram

It is not proposed to enlarge further on the refrigerating circuit here, because according to the Water Resources Act 19 L any **work** on it may be performed **only by qualified refrigeration technicians** on account of safety.

Note for the refrigeration technician:

An injection sub cooler is installed in the liquid line of circuit II for minimisation of the refrigerant filling. The small partial refrigerant flow which is used for sub cooling of the liquid refrigerant via a second small expansion valve, does not reduce the evaporator capacity. Thermodynamically it is made up for by the liquid sub cooling.
With this equipment it is necessary to dose the refrigerant filling very carefully. Overfilling would lead to refrigerant back up in the condenser and, as a consequence, the transfer capacity would be impaired. Please also refer to subsection 5.1.1 “High pressure fault”.

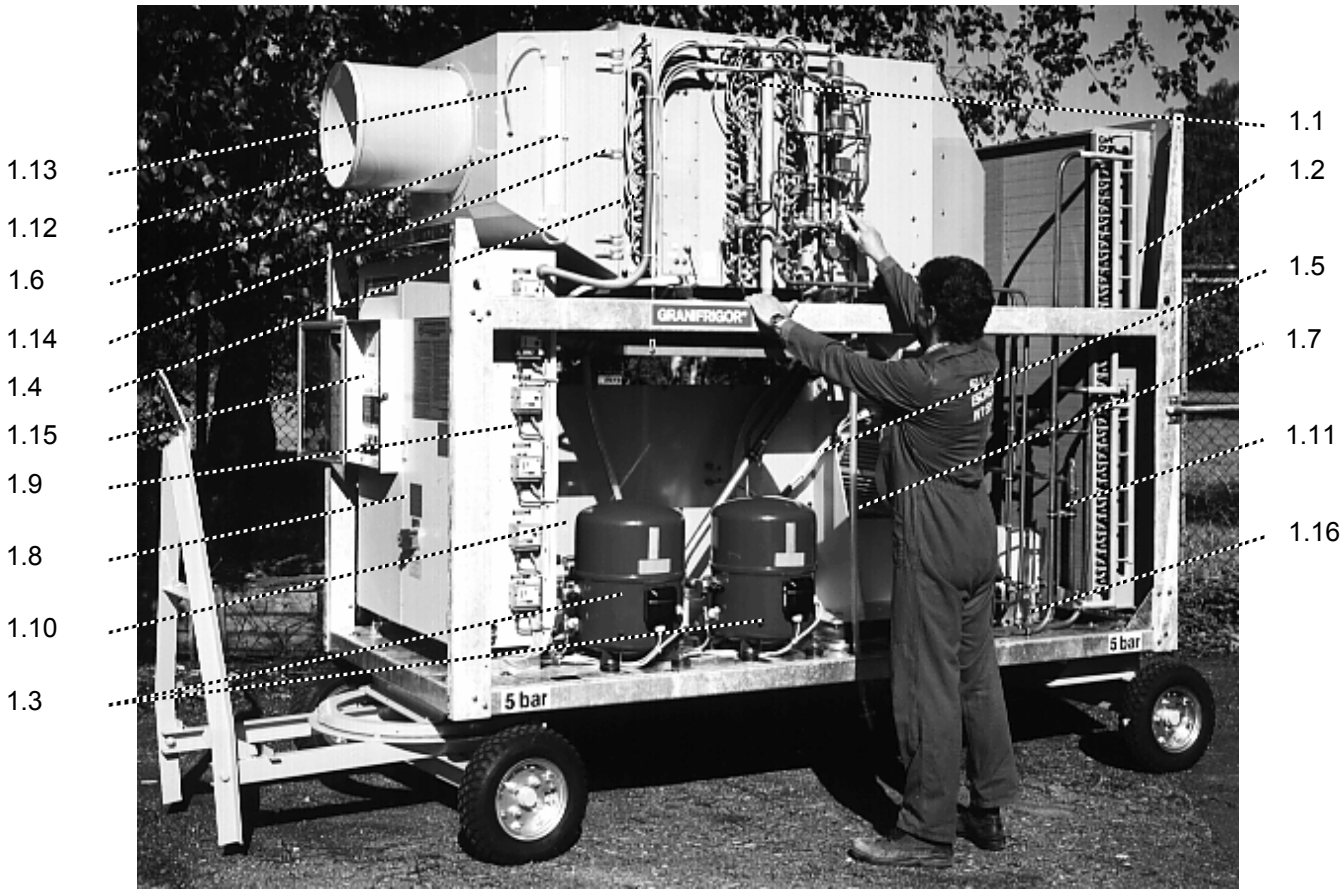


Fig. 1 *Front side of the unit*

Description of parts

1.1 Air cooler (evaporator) - details in Fig. 2
1.2 Condenser
1.3 Compressor
1.4 HYGROTHERM reheating
1.5 Chilled air fan
1.6 U-tube for air counter pressure
1.7 Condensate drain 3/4”
1.8 Switch cabinet (details in Figs. 7 and 8)
1.9 Pressure switches (details in Fig. 5)
1.10 Motorized valve for suction line throttling (not visible)
1.11 Condenser pressure controller
1.12 Chilled air connection diam. 400
1.13 Air outlet duct
1.14 Electrical heater (not visible)
1.15 Lockable window
1.16 Subcooler for circuit II

Important:

The identification numbers in these Operating instructions always refer to the illustration in which the part is shown.

E.g. „Switch cabinet 1.8“ is found in Fig. 1, point

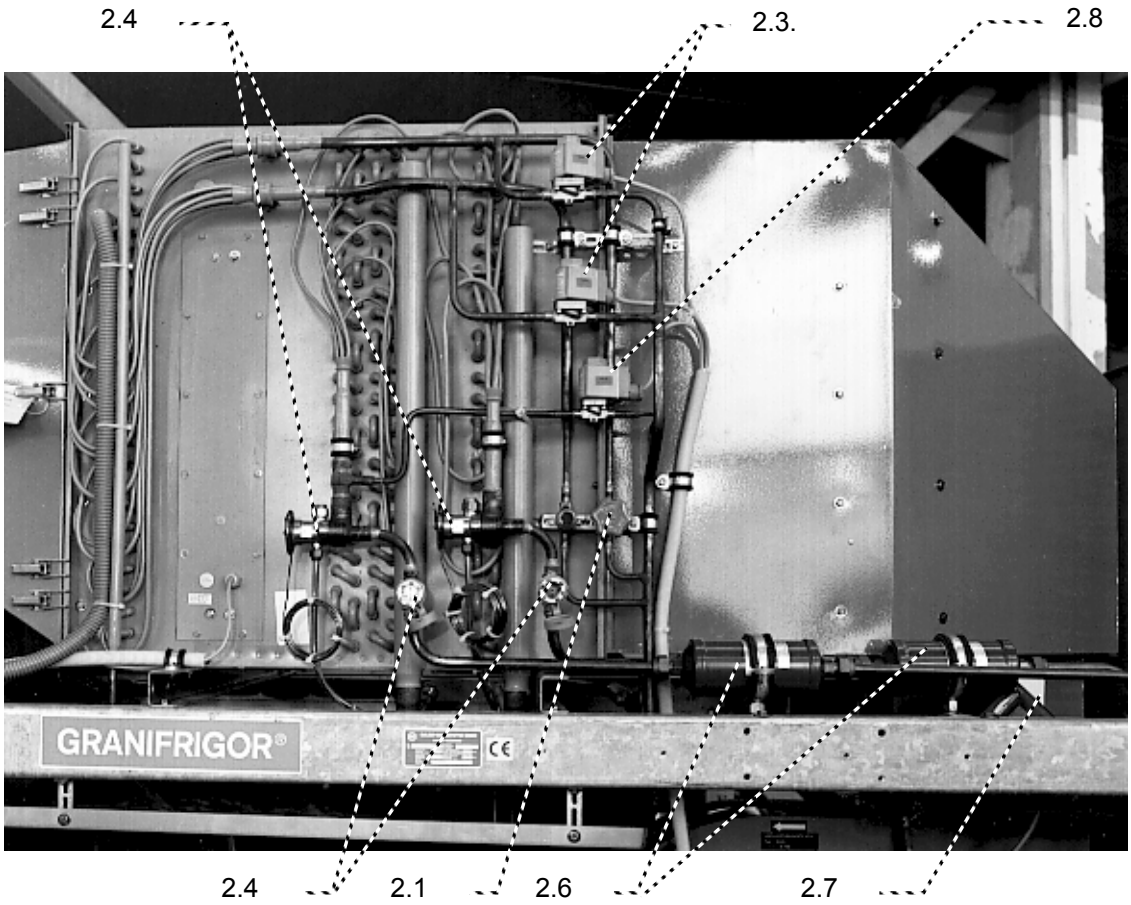


Fig. 2 *Evaporator details*

Description of parts

2.1 Manual HYGROTHERM valve
2.2 HYGROTHERM cap valve (base load)
2.3 Solenoid HYGROTHERM valves
2.4 Expansion valves
2.5 Sight glasses with moisture indicator
2.6 Filter dryer
2.7 Servo motor for air flap
2.8 Solenoid valve for hot gas bypass
(capacity control circuit I)

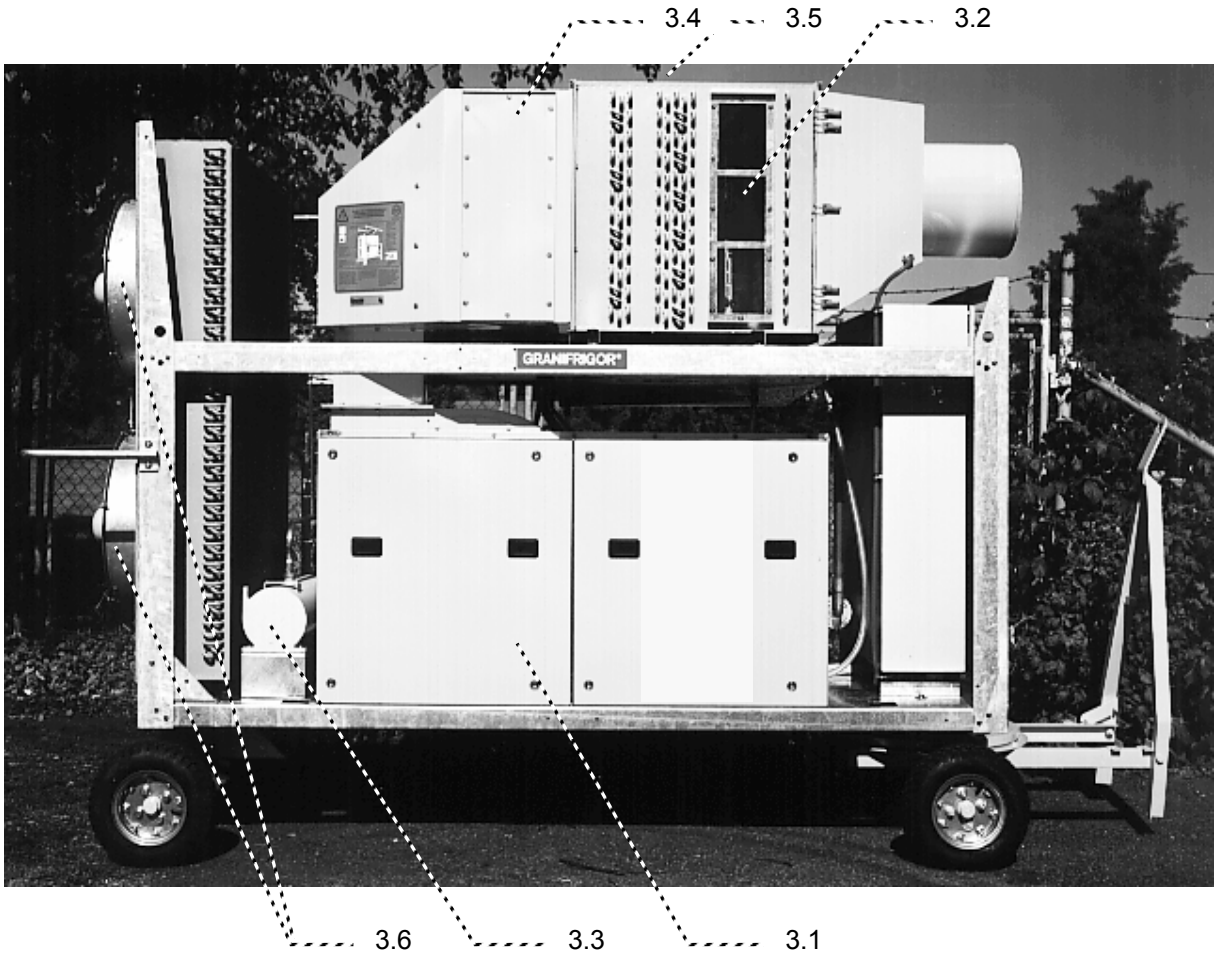


Fig. 3 *Rear side of the unit*

Description of parts

3.1 Air intake silencer and intake filter (details and maintenance see Figs. 11a to 11d)
3.2 Window on evaporator
3.3 Receiver (only for circuit I)
3.4 Cleaning opening
3.5 Cleaning opening on evaporator (not visible)
3.6 Condenser fans

1.3 Air ducting

The air to be cooled is drawn from the environment by the chilled air fan through a large-area intake filter, and forced through the evaporator and the HYGROTHERM reheater to the chilled air connection. This is termed “forced” operation.

This has the advantage that very low chilled air temperatures can be obtained down to just above freezing point, yet safe; adjustable reheating of the chilled air is made possible by the HYGROTHERM reheater of the GRANIFRIGOR units. At very low ambient temperatures the compressor cuts out automatically, making the HYGROTHERM of the refrigeration circuit ineffective. The electrical HYGROTHERM remains in operation and, in addition, there is still the air reheating in the chilled air fan due to thermal equivalent of the fan work (see subsection 1.6).

The condenser fans draw in ambient air likewise. It is heated in the condenser 1.2 and rejected to the atmosphere again as hot exhaust air. The unit must therefore always be positioned where there is adequate space for dispelling this air.
Fouling of the air intake filter is monitored by a differential pressure switch (Fig. 11b) - red LED in the functional diagram on the switch cabinet.

1.4 Condensate discharge

When the air is chilled in the evaporator its dew point is normally understepped, so that its moisture condenses on the cold cooler fins. This water (KK 220 AHY: max. approx. 32 l/h) is led off via a siphon hose from the evaporator to the drip pan, from which it runs off through condensate discharge hose 1.7 (for further drainage of the condensate the purchaser must provide a 3/4” hose).

Free condensate outflow is absolutely essential!

Condensate outflow can be controlled through window 3.2 on the rear side of the evaporator.
The siphon hose must be approx. half full with water so as to avoid escape of chilled air through the condensate outflow.

Attention:
The condensed water is not distilled water and thus **not suitable** for batteries.

1.5 Automatic chilled air and capacity control

The capacity control serves to match the performance of the refrigerating compressor and the delivery of the chilled air fan to the given operating and ambient conditions.

The chilled air temperature setpoint is adjusted on the chilled air temperature controller Figs. 4 and 8. Depending on the operating state this sets either the air flap (with high ambient temperatures) or the compressor capacity stages (with low ambient temperatures) to a certain throttled position. In the former case the air delivery is regulated, in the latter case the refrigeration. The capacity control is sensitive and energy saving since the absorbed power of the motor is in both cases reduced during throttled operation. The two control elements are interlocked electrically, so that mutual interference is ruled out.

The required refrigerating capacity is always determined by the chilled air temperature after the evaporator. The outlet temperature is increased by the amount of reheating of the HYGROTHERM device, see section 1.6.

Compressors I and II work in individual refrigeration circuits. The capacity control is designed in such a way that at high ambient temperatures (high refrigeration demand) both compressors are in operation and at low ambient temperatures (low refrigeration demand at approx. below + 15 °C) only compressor I is in operation (continuous capacity control by means of a motorized valve). This design allows for highly economical operation in autumn.

The controller “Chilled air temperature” is a high-grade set point controller with PI feedback. Light emitting diodes (LED’s) indicate whether the controller happens to be regulating the chilled air temperature down or up.

The controller also has two separately adjustable limit contacts with LED display for the air temperature after the evaporator. The upper limit contact (GW1↑) cuts out the unit automatically after approx. 10 minutes if the actual temperature exceeds the set point by more than 3°C, signalling “chilled air temperature too high”. Please also see section 5 “Troubles”.

The lower limit contact (GW2↓) switches off the compressor II when the set point temperature is understepped by 3°C and later on also

compressor I when the set point temperature is understepped again. The chilled air fan keeps running.

If the upper limit (GW1↑) is exceeded again at rising temperatures, compressor I is restarted automatically first. At further rising temperatures compressor II is also started automatically.

Under special circumstances it may be desirable to provide cooling without automatic control (e.g. so that the serviceman can start up quickly in certain operating modes, or if there is a fault on the automatic capacity control). For this the “Operating Mode Switch” has a manual setting in addition to the automatic control; more about this is given in subsection 3.2.3. “Cooling without automatic control”.

GRANIFRIGOR units KK 220 AHY also have a controller for automatic HYGROTHERM reheating control (Fig. 4b), see subsection 1.6.
The control of the chilled air temperature and of the chilled air reheating with individual controllers and conventional contactors offers some important advantages if compared to a centralized electronic controller:

– more flexibility and easy handling,
– possibility of “Manual” operation, the controllers are out of function,
– easier and cheaper service in case of troubles,
– spare parts for the contactor controls can be had throughout the world in case of need.

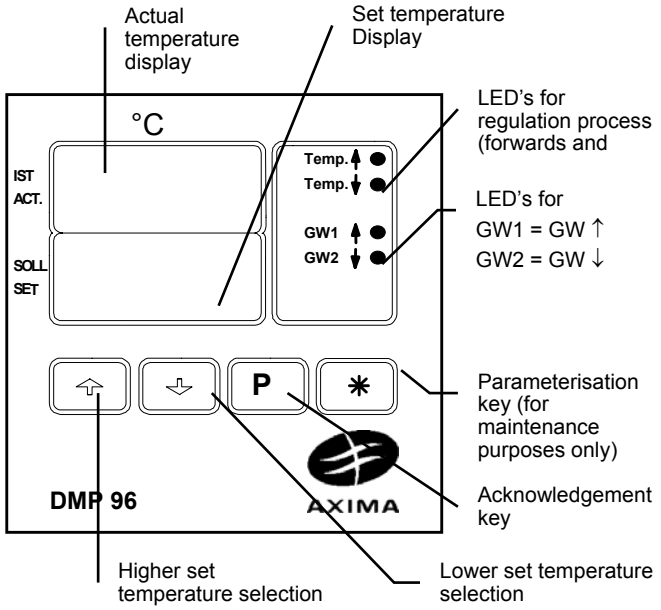


Fig. 4a *"Chilled air temperature controller" DMP 96*

Electronic controller with digital set value entry and impulse outlet

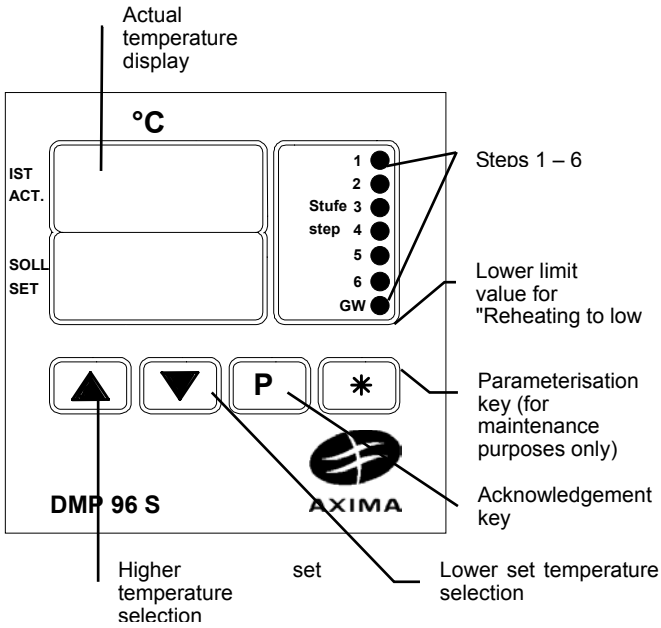


Fig. 4b *"Hygrotherm reheating controller" DMP 96 S*

Electronic controller with digital set value entry and stepped outlet

1.6 HYGROTHERM® reheating

By chilling the air in the evaporator and condensing its moisture on the cold evaporator fins, the absolute moisture content of the chilled air is reduced below that of the ambient air. Nevertheless the relative humidity of this chilled air increases, reaching 90-95% after the evaporator. For cooling dry grain (below 18 %) this nearly saturated chilled air must be dried by reheating. On the GRANIFRIGOR KK 220-AHY units this is made possible by the automatic HYGROTHERM HYGROMAT reheater, which regulates the amount reheating in 5 steps. Steps 1 and 2 operate as a partial condenser, i.e. no additional heat input is claimed (reject heat from the refrigeration cycle is exploited). Stages 3 to 5 are given by an electrical heater, each of the 3 steps having 4 kW. The electrical heating stages are switched on by the HYGROMAT if stages 1 and 2 are not sufficient for the desired reheating. Therefore, do not select excessively high reheating.
The electrical heater is protected against overheating; each stage has its own thermostat.
The chilled air outlet temperature of the KK 220-AHY is set on controller “HYGROTHERM heating”.
The reheating can be gauged from the difference between the two temperature readings

→ ”Chilled air temperature after the evaporator”
= upper indication on controller “chilled air temperature”

→ “Chilled air temperature at the outlet”
= upper indication on controller “HYGROTHERM heating”

The lower limit value (GW↓) of the HYGROTHERM reheating controller controls the amount of reheat. If the set outlet temperature is understepped by more than approx. 3 °C the unit will stop signalling “Reheating too low”. In this case the unit will have to be restarted with the “Operation Mode” switch.

This can, of course, be the case also at very low ambient temperatures without having a true failure - if a high outlet temperature has been selected which cannot be attained by the HYGROTHERM. To avoid this, an additional winter thermostat is needed (optional extra) - also refer to Annex 6.7

At first glance, this type of reheating control with 2 separate controllers may seem complicated, but it is easy to handle and requires no maintenance.

The max. attainable HYGROTHERM reheating depends from various factors (mainly from the airflow volume and the ambient temperature). The max. attainable reheating is approx. 5 to max. 7 °C, which corresponds to a min. chilled air r.h. of 70 to 60 %.

The HYGROTHERM cap valve 2.2 (Fig. 2) is set to the base load reheating of approx. 2 °C at the trial run in our works /valve opened by 1/8th turn. The valve is secured against unauthorized tampering by a red paint dot. Should it be required in exceptional cases to work without any reheat at all, the cap valve must be closed (for this remove the cap and close the valve).

Attention:

If the cap valve is closed we urgently recommend to attach a label or similar sign to this effect to prevent dry grain from being recooled without any reheat.

In addition to the cap valve 2.2 there also is a manual HYGROTHERM valve 2.1 Fig. 2 (marked yellow). This valve is used for manual setting of the refrigerant-operated HYGROTHERM in the case of malfunctions of the controller “HYGROTHERM reheating” - normally it is closed.

At low ambient temperatures, when chilling of the air is not required, there is the possibility to reheat the ambient air with the electrical heater in the operating mode “Ventilation”. The desired reheating must be set on the switch “HYGROTHERM stages manual”, stages 3-5. In this case the refrigerant-operated HYGROTHERM (stages 1 and 2) cannot be used since the compressor is out of operation. Overstepping or under stepping of reheating is not precluded automatically. The risks of uncontrolled ventilation must be taken into account, please also refer to the booklet “GRANIFRIGOR - its technology of application”.

Further heating of the chilled air takes place in the duct to the silo, due to heat in leakage from outside. The total effective reheating is equal to the temperature difference between the air temperature after the evaporator and the silo air inlet temperature. Where longer, non-insulated air ducts are employed it is advisable to provide an additional thermometer at the silo entry (optional extra). The total amount of reheating needed depends on the grain to be cooled. For grain with

marginal moisture content (16-17 %), a total reheating of 3 °C is generally sufficient.

As a rough rule:
1 °C reheating gives about 5% drying of the chilled air.

More information about the proper reheating may be found in the booklet: GRANIFRIGOR its technology of application.

1.7 Condenser pressure regulation

The condenser performance depends on the ambient temperature. Since the condenser has to be dimensioned for summer operation, it is much bigger than necessary for low ambient temperatures; as a consequence the condenser pressure drops. To ensure that the function of the refrigerating circuit and in particular the HYGROTHERM reheater are not impaired by this, a special, automatic pressure regulation is provided to maintain a sufficiently high condensing pressure.

1.8 Electrical control

The electrical equipment conforms to VDE rules applicable in the Federal Republic of Germany. After turning on the main switch the control system is under voltage and the compressor oil heating is switched on.

Particularly important is the special electrical safety circuit on all GRANIFRIGOR units, which prevents warm air getting blown into already cooled grain. If a safety device trips in the refrigerating circuit or the upper limit contact acts on controller “Chilled air temperature” or on the lower contact of the controller “HYGROTHERM reheating”, the entire cooling unit is shut down.

The fault in question is signalled by the LED’s in the functional diagram on the switch cabinet (Fig. 8).
Collective trouble indication is provided in the switch cabinet. Site-side connection of an alarm signal is possible.
A lamp testing button is provided to check the LED’s in the functional diagram.
The operating hours counter is connected to the chilled air fan, i.e. the operating hours indicated represent the fan running time, regardless of compressor operation.
The KK 220 AHY provides for forced chilled air ventilation of the switch cabinet, thus ensuring trouble-free operation even at extremely high ambient air temperatures and limiting dust ingress.

1.9 Safety switches

See Annex 6.3, for control and switch adjustments as set at the works trial run.
If the cooling unit is functioning properly, the pressures in the refrigerating circuit will vary within a certain admissible range, which is safeguarded by pressure switches (Fig. 5).
The pressure limiters PSAH 1.02 resp. PSAH 2.00 shut down the cooling unit if the admissible pressure is exceeded on the high-pressure side, signalling “high pressure”.
The low pressure switches PSAL 1.00 and PSAL2.00 shuts down the cooling unit if the minimum suction pressure is understepped, signalling “low pressure”.
These pressure switches have a restart latch. This must be released by pressing the “reset” button on the switch after putting the fault right.
The pressure switches are protected against unauthorised tampering by:

→ Pressure limiter PSAH 1.02 and PSAH 2.02 - lead seal
→ Low pressure switches PSAL 1.00 and PSAL 2.00 - paint dot
→ Pressure switches PSL 7.03 and PS L7.04 - paint dot

Pressure switch PSAL 7.03 limits the closing movement of the motorized valve and simultaneously opens the hot gas solenoid valve.
Pressure switch PS L7.04 prevents icing up of the evaporator of refrigerating circuit II and activates defrosting, if necessary.
All motors are protected against overload in the usual manner by over current trips, giving a common “motor fault” signal.
The fault is released by pressing the reset button on the corresponding motor protection switch and in the case the compressor motor protection tripped, switch the “Operating Mode” switch on and off briefly.
The electrical heater is protected against overheating. Each stage has its own safety thermostat. The trouble is self-maintained and must be released by switching the “Operating Mode” switch on and off briefly.
An additional temperature sensor with an external cable can be installed in the grain top layer which automatically shuts the GRANIFRIGOR down after reaching of the desired grain temperature (optional extra).

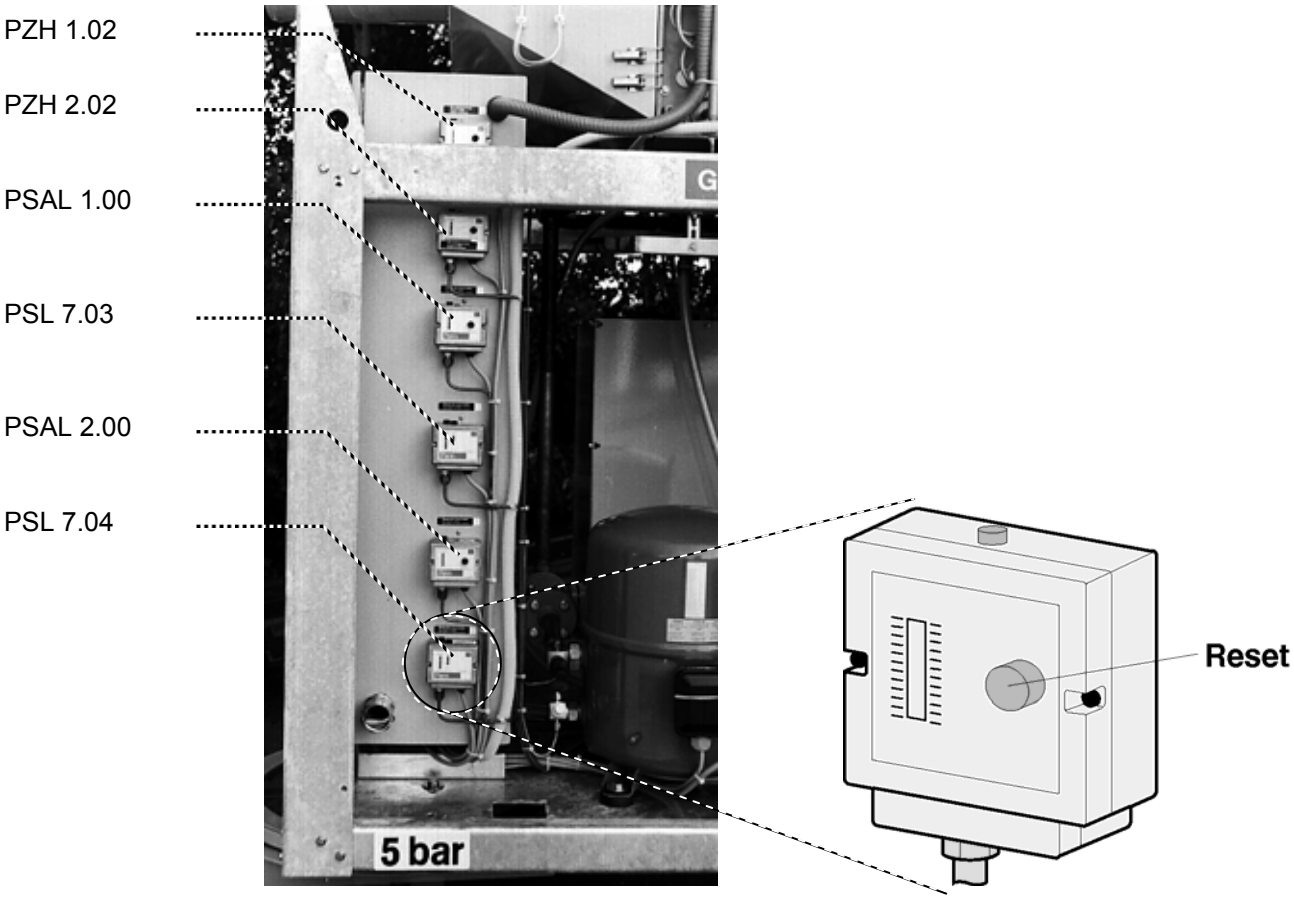


Fig. 5 *Arrangement of pressure switches*

Description of parts:

PZH 1.02	Pressure limiter overpressure compressor I
PZH 2.02	Pressure limiter overpressure compressor II
PSAL 1.00	Low pressure switch for compressor I
PSL 7.03	Pressure limiter for motorized valve closing position and hot gas bypass
PSAL 2.00	Low pressure switch for compressor II
PSL 7.04	Pressure limiter defrosting circuit II

2 Positioning and transport

A patch of firm, level ground is sufficient for positioning the GRANIFRIGOR. Dimensions and weights are indicated in the dimensional drawing. For longer transport movements it is advisable to acquire the special pneumatic-tyred chassis version (optional extra) instead of the standard caster wheel chassis.

The Accident Prevention Rules to VGB 20 must be observed in Germany. In case of indoor installation the room must be of a certain size if there is no special machine room and if access is not limited, to prevent lack of oxygen in case of refrigerant escape.

Minimum room size to VBG 20 for KK 220-AHY: 100 m3

Note: The conditions set out in local Accident Prevention Regulations must be observed. The refrigerant charge is stated in Annex 6.2 “Technical data”.

Gaseous refrigerant R407C is heavier than air and a zone poor in oxygen will form in the floor area. Therefore, it is necessary to provide sufficient ventilation for this space.

If the unit is installed in a room to which only a limited group of persons has access, the above rule must only be observed in basement areas. No special rules are applicable in the upper stories.

Refrigerant escape can be caused by leaks in the circuit. In case of a high pressure fault there will be **no** refrigerant escape (as for example through a safety valve). In such a case the refrigeration machine is shut off by the pressure limiter (please also refer to subsection 5.1.1).

Refrigerant and refrigeration machine oil are hazardous products according to the German Water Resources Act, group 2. It must therefore be ensured that neither refrigerant nor refrigeration machine oil enters into the soil or the sewage water pipes.

It is absolutely indispensable to **place the unit on a level floor** (in relation to the base frame). The refrigeration circuit as such is not extremely sensible to its position but the condensate will only flow out in a proper manner if the unit is well positioned.

For installation outdoors please make sure that the unit is installed in such a way that the condenser fan blows into the mainly prevailing wind direction (otherwise the fan would be driven backwards by the wind at standstill and the motor protection switches would be overloaded at automatic start-up).

In closed rooms, make sure that good ventilation is assured, i.e. that the warm exhaust air from the condenser is led off without being drawn in again by the chilled air fan. Do not place the unit with its condenser against a wall. When leading-off the warm exhaust air through a duct a small pressure loss must be taken into account: max. 20 Pa (approx. 2 mm w.g.).

The condenser exhaust air is approx. 6.2 m3/sec. Any exhaust duct should have a minimum section of 2 m2.

Preference should be given to the shaded side of a building: the unit operates more economically in a cool environment.

Important note:

At the height of summer especially, the switch cabinet must be shielded against direct sunshine: build-up of heat inside may trip the over current relay and cause harm to the electrical equipment. Forced switch cabinet cooling with chilled air is only activated during operation.

When positioning the unit, make sure that the chilled air hose is laid without kinks. Provide additional hose fastenings, if necessary.

An outflow must be provided for the condensate from the evaporator:
3/4” hose, maximum water flow: approx. 32 l/h.

The data for electrical connection may be obtained from the wiring diagram (to be found in the switch cabinet).

The following rules must be observed for transportation of the GRANIFRIGOR®:

→ For transportation by truck or wagon always tighten unit with ropes.
→ In case of rubber tyred chassis secure tyres with wedges (a), in case of steel casters use securing blocks (b) to prevent rolling away of the unit.
→ When using a fork lift mind the gravity centre.
→ For crane transportation use girders, diagonal pull of the belts can damage the unit.
→ In the case of road transportation, drive carefully and slowly so as to avoid vibrations and shocks.

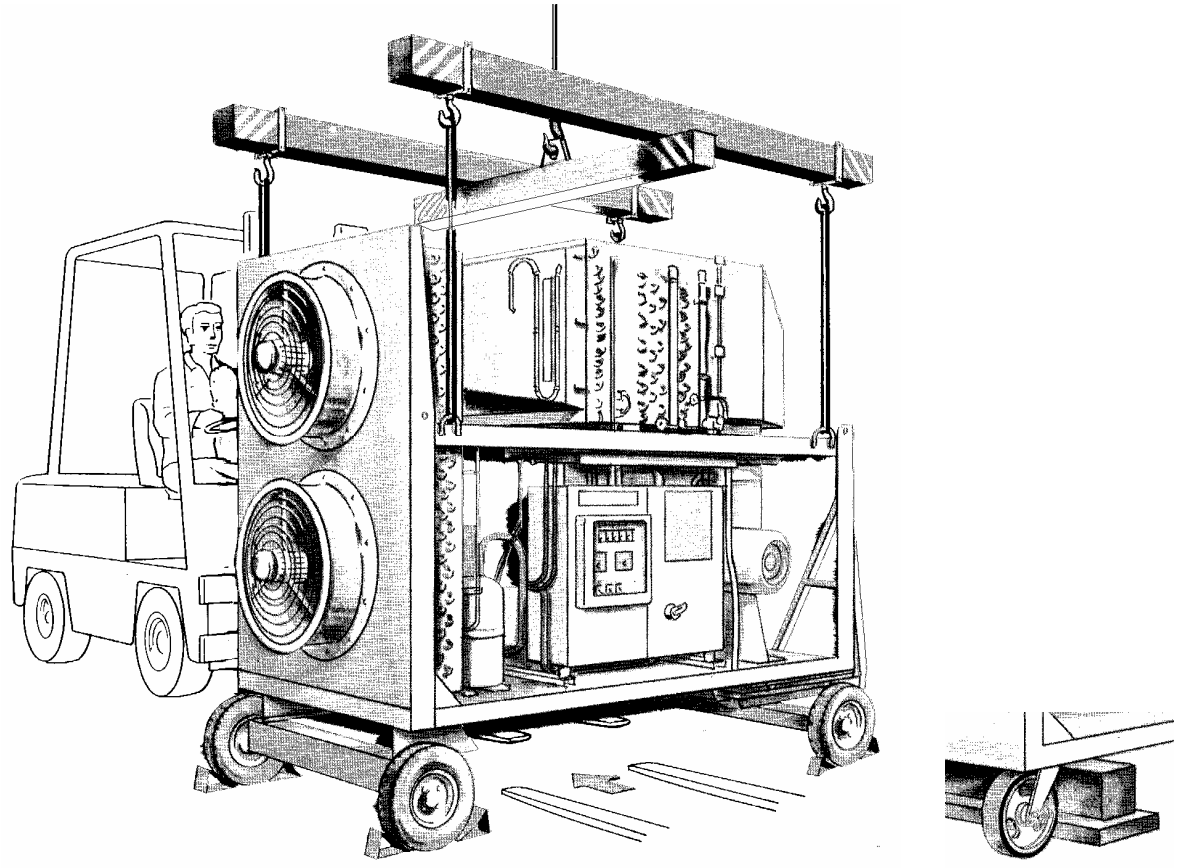


Fig. 6 *Hints for transportation*

safety instruction

The Granifrigor mustn't run in hazardous areas.

3 Operation

3.1 Preparation of commissioning

The controls of the electrics cabinet are covered by a lockable window to prevent unauthorized tampering

→ Examine the cooling unit for outside damage in transit.

→ Make sure that the fans act freely by turning them manually.

→ Compare tension and frequency with the wiring diagram. (Standard 400 V - 3 - 50 Hz).

→ Set all switches as shown on Fig. 7

→ Push reset buttons of over current relay and pressure switches (they may have tripped during transport).

→ Not later than 24 hours before putting into operation, connect-up and verify the direction of rotation of the chilled air fan by switching it on briefly. (Main switch “ON“, “Operating Mode Switch“ briefly on “Ventilation“).

→ Check sense of rotation of the chilled air fan motor.

→ If necessary: Call electrician to switch the poles.

→ After this preliminary testing the main switch must remain on till operation commences, so that the crankcase heater functions. (Preheating is necessary at least 24 h prior to starting; energy input is only approx. 70 Watt). This precaution is indispensable for proper lubrication of the compressor.

→ Connect-up chilled air. Make sure that connections are tight and the hose has no kinks. Tighten the straps on the hose strongly.

→ Connect 3/4" hose for condensate drain.

→ Check water filling of U-tube 1.6 (Fig. 1) , if necessary fill with water so that there are no bubbles (normal level is about mid-scale

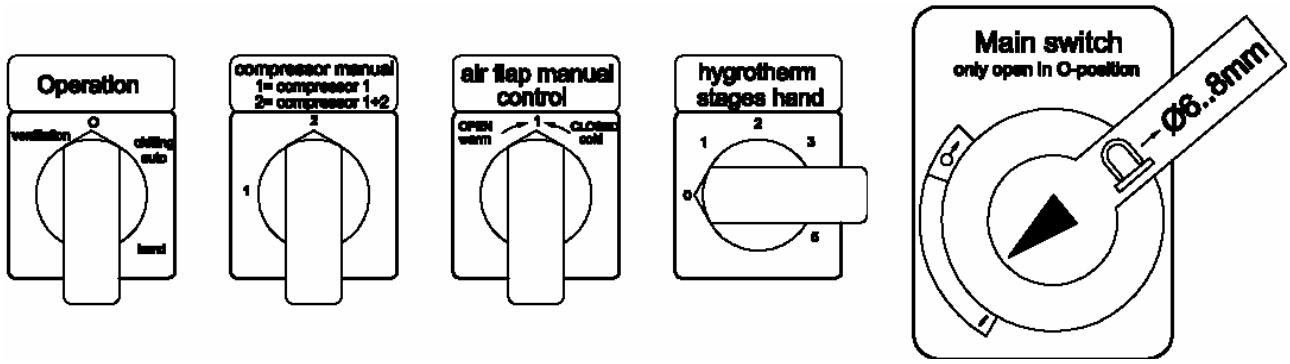


Fig. 7 *Position of switches prior to commissioning*

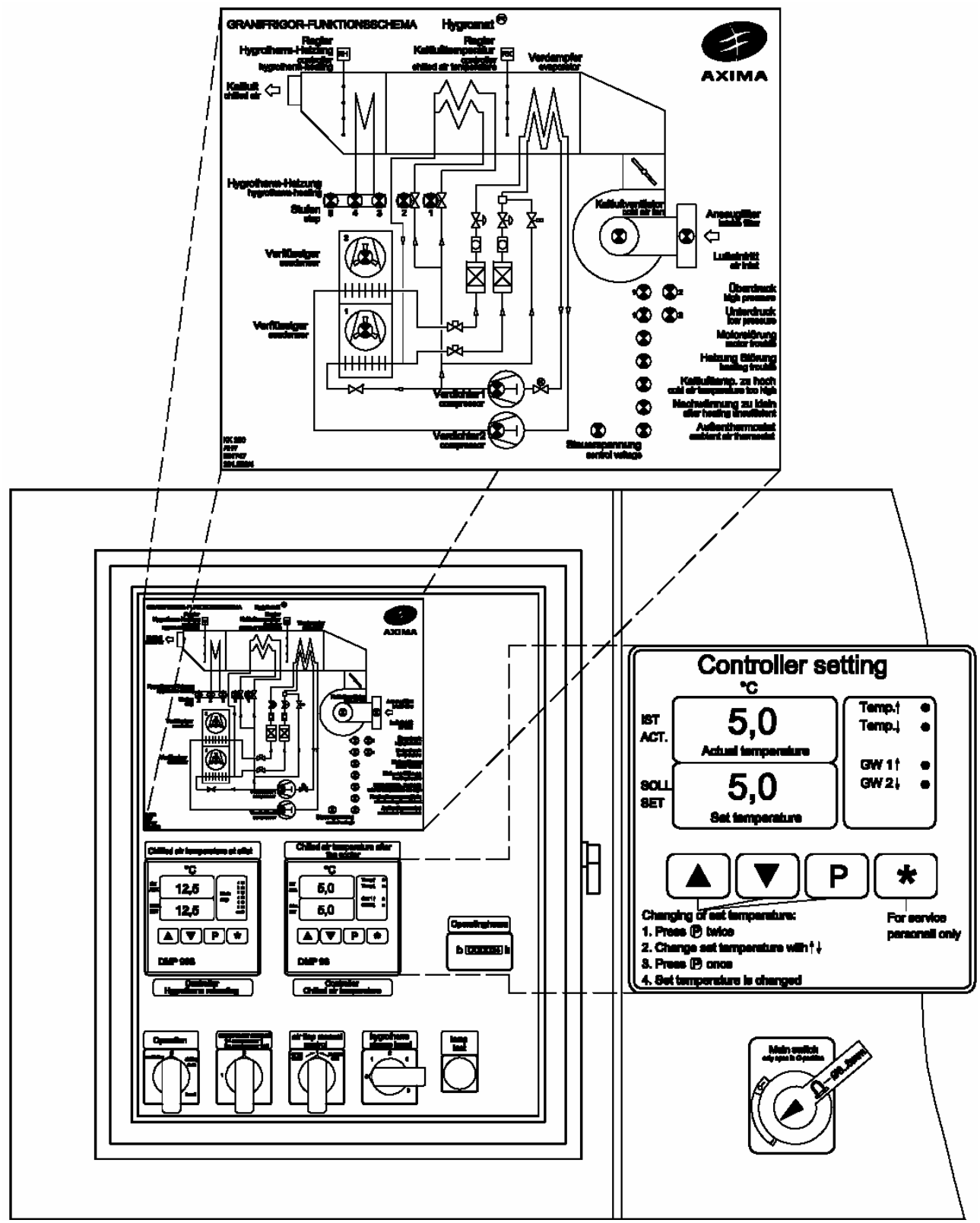


Fig. 8 *Switch cabinet GRANIFRIGOR KK 220-AHY*

3.2 Putting into operation

3.2.1 Temperature setting for automatic operation

→ Set desired chilled air temperature on “Chilled air temperature controller“,
normal adjustment + 7 °C (at works trial run), but not lower than + 4 °C. In hot countries do not set lower than +10 °C.

→ Select air outlet temperature on controller “HYGROTHERM heating“ (normally 3 °C higher than the selected chilled air temperature.
As a rough rule:
1 °C reheating gives about 5 % drying of the chilled air.
Note: The chilled air is never fully saturated with moisture; it leaves the evaporator with approx.
90-95 % r.h.

More information on chilled air temperature selection and reheating is given in the booklet “GRANIFRIGOR - its technology of application“.

Always note:

– **Higher chilled air temperatures lead to higher cooling capacity**.

– **The amount of reheat should not be unnecessarily high**; more than 5 °C are hardly ever requested. Heat in leakage into a non-insulated silo duct must also be taken into account. Excessive HYGROTHERM reheating and unfavourable operating conditions could possibly cause the tripping of the overheating protection without having a true fault.

– **The HYGROTHERM reheating is set to a base load of approx. 2 °C during the works trial run in our works (safety measure)** - setting on cap valve 2.2 (Fig. 2).This base load reheating is not influenced by the controller "HYGROTHERM reheating“.
If, in exceptional cases, no reheating at all is desired, the cap valve must also be closed. In this case we urgently recommend to attach a label or similar sign to this effect to prevent dry grain from being recooled without any reheat.

– **The lower limit value (GW↓) of the HYGROTHERM reheating controller controls the amount of reheat**. If the set outlet temperature is understepped by more than approx. 3 °C the unit will stop automatically signalling "Reheating too low“. In this case the unit will have to be restarted with the "Operation Mode“ switch. This can, of course, be the case also at very low ambient temperatures without having a true failure – if a high outlet temperature has been selected which cannot be attained by the HYGROTHERM.½To avoid this, an additional winter thermostat is needed (optional extra).

– **Never blow warmer air saturated with moisture into colder grain**, otherwise water vapour will condense on the cold grains. In this way considerable amounts of water may get into the grain bed, causing speedy deterioration.

– The admissible deviation on the controller temperature indications is ± 0.5°C.

3.2.2 Switching on automatic cooling

→ Main switch is normally turned on already before preparation.

→ Set operating mode switch to "Autom. Cooling“

Automatic cooling is now initiated. Switching operations follow in this order:

– The chilled air fan starts (Y/D starting).

– After about 10 seconds refrigerating compressor I starts (if there is demand for refrigeration).

– Compressor II is started automatically by the "Chilled air temperature controller“ according to requirements.

– The other control operations are performed by the controllers "Chilled air temperature“ and "HYGROTHERM reheating“.

Further steps:
(See recommended Data Log in the annex)

→ Record temperatures:
– set/actual chilled air temperature after the evaporator
– set/actual outlet temperature
– chilled air temperature at silo entry
grain temperature at approx. 0.5 m below the grain layer top.

→ Record readings of operating hours counter.

→ Record readings of U-tube 1.6 (air counter pressure).

→ Record air flap position in degrees; open = 0°; closed = 90°

3.2.3 Cooling without automatic control

→ Set "Operating mode“ switch to "Manual“.

→ Set required chilled air temperature by means of the controller "Air flap manual“, holding the switch in the "warmer“ or "colder“ position. At "colder“, first the motorized valve is fully opened after this, the air flap is controlled in the closing sense. I.e. the refrigerating capacity is increased , the chilled air rate is reduced, which leads to a lower chilled air temperature. At "warmer“ the control system operates in the opposite sense.

→ Compressor 1 or 1 +2 are started by means of controller "Manual compressor control“ according to requirements.

→ Set HYGROTHERM stages according to requirements by means of controller "HYGROTHERM manual“.

Attention:

The risks of uncontrolled refrigeration must be taken into consideration with „Manual“ operation. Please also refer to the booklet „GRANIFRIGOR – its technology of application“.

3.2.4 Ventilating with outside air, without cooling

→ Set the operating mode switch to "Ventilation“.

→ If necessary, set chilled air reheating on control "HYGROTHERM stages manual“ (stages 3 to 5). The HYGROTHERM from the refrigeration circuit (stages 1 and 2) is not available since the compressor is not running. Understepping or overstepping of the reheating is not automatically precluded in this operation mode.
The risks of uncontrolled ventilation are not to be neglected, please also refer to the booklet: GRANIFRIGOR - its technology of application.

3.2.5 Switching off

→ Set "Operating mode switch“ to "0“.
For shorter interruptions of operation (one to two weeks):
The main switch is left turned on so that the oil heating remains in operation and the GRANIFRIGOR can be put to work at any time.
In the case of longer interruptions of operation, turn on the main switch 24 hours beforehand to activate the oil heating of the compressor, see subsection 3.1.

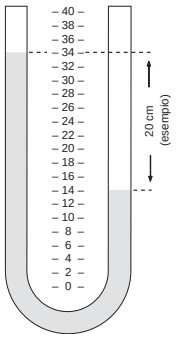


Fig. 9 *U-tube for air counter pressure 1.6 (Detail to Fig.1)*

3.3 Hints for operation

3.3.1 Nominal cooling capacity

The cooling capacity of grain cooling units is subject to a number of influences. No standards exist, consequently the reference conditions must always be noted when stating and comparing cooling capacities.
Under favourable conditions, the cooling capacity of the GRANFRIGOR KK 220 AHY is approx. 220 t/24 h. Depending on the operating conditions, the cooling capacity can vary between approx. 130 t/24 h and 320 t/24 h.
The lower cooling performance relates to summer conditions. Maximum performance is attained in autumn with low ambient air temperatures, low air counter pressure and high grain moisture content

Nominal summer operating conditions are typically:

– Daily mean (24 hours) air conditions ½+23 °C/ 52% rel. hum.*, initial grain temperature + 20 °C
*These air conditions are equivalent to a heat content of 46 kJ/kg or 11 kcal/kg, which in Central Europe is exceeded only on few days in the year.
– Moisture content of the grain about 16%
– Chilled air state including HYGROTHERM reheating + 10 °C, giving grain cooling to +10/+12°C
– Cooling capacity: approx. 150 t/24 h

Considerably higher performance is possible with:

a) lower ambient temperature or less air humidity,

b) lower air counter pressure and hence high chilled air flow, e.g. cooling grain dumped in sheds or several parallel silo cells,

c) higher moisture content of the grain (the enhanced evaporation assists cooling, and the drying action is assisted too), or considerably higher initial grain temperature.

E.g. with ambient air conditions +17 °C/70 % r.h., grain m.c. 18 % and 7 mbar (7 cm w.g.) air counter pressure (this is quite feasible in a Central European autumn) a cooling capacity of 320 t/24 h can be attained.

Lower performance may result from:

a) higher outdoor temperatures or higher air humidity,
b) cooling temperatures much below + 10 °C,
c) grain moisture content less than 16 %,
d) heat in leakage into long, non-insulated air ducts,
e) chilled air losses due to leaks in the air ducts or silo,
f) excessive counter pressure, e. g. due to over-narrow air ducts, badly kinked hose, poor air distribution in the grain, grain pile too high or its cross section too small,
g) excessive pressure drop in the air intake filter.

3.3.2 Start and finish of cooling

As soon as taking the grain into storage commences and the air ducts are covered with grain, cooling should begin. It is quite possible to bring in the grain and cool it at the same time.
Cooling may be terminated when chilled air emerges unmistakably at the top of the bed. The topmost layer can never be cooled down to the temperature at which the chilled air is blown in. Consequently temperature measurements with a probe thermometer are always made at a depth of 0.5 m at least.
Cooling is terminated when the grain temperatures measured in this way are about 2–3 °C higher than the chilled air blown in.
(Exceptions to this and further information are provided in the booklet: GRANIFRIGOR – its technology of application).

3.3.3 Air distribution

For distributing the chilled air in the silo there are various approaches. The best answer for the individual case can be found only by individual consultation. General guidelines may be found in the booklet: GRANIFRIGOR – its technology of application. As a general rule, however: if the chilled air connection of the cooling unit is higher than the air distribution system, a condensate trap should be provided to arrest entrained water

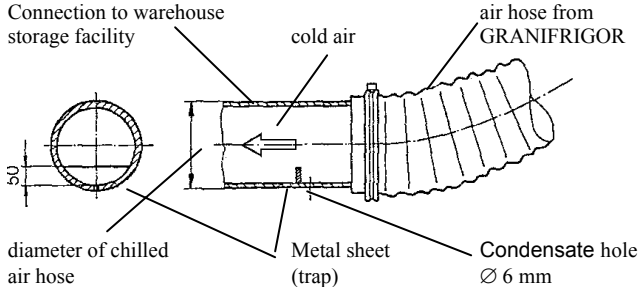


Fig. 10 *Connection to warehouse storage facility*

Normally the condensate is separated in the specially designed evaporator, but this is ineffective if the water outflow on the evaporator is clogged because the cooling unit is not receiving sufficient attention. In view of chilled air losses it is advisable to make the bore no more than 6–7 mm in diameter, and to check it for free passage from time to time.
The air counter pressure effective on the GRANIFRIGOR, i.e. the air pressure needed to force the chilled air through the supply duct and the grain bed, is indicated on the U-tube 1.6. It is stated in mbar or cm water gauge, and corresponds to the difference between the levels of the two water columns in the U-tube (Fig. 9).
To ensure economical cooling an upper pressure limit around 30-35 cm w.g. should not be exceeded. A lower counter pressure with low ambient temperatures (below + 20 °C) gives higher cooling capacity, while higher counter pressure lowers the cooling performance.

3.3.4 Application limits

Max. ambient air temperature
The high pressure switch (pressure limiter) automatically stops the unit at ambient air temperatures exceeding approx. +40°C; signal “High pressure fault“. Shut down of the unit can also take place at much lower ambient air temperatures if the condenser is fouled, also see subsection 5.1. If a lower chilled air temperature is set (chilled air temperature after the evaporator <7°C) automatic shut down of the unit can also take place due to tripping of the upper limit value of “Chilled air temperature controller“ – signal “Chilled air temperature too high“. In this case either select a higher chilled air temperature or wait for the ambient air temperature to drop again to restart the unit.

Min. ambient air temperature
Low ambient air temperatures do not lead to faults. With KK 220 AHY units the chilled air temperature and the chilled air reheating are automatically controlled by the “HYGROMAT“ control system.
An air outlet temperature of approx. +10 °C can be maintained up to an ambient air temperature of approx. + 2 °C (temperature setting on controller “Chilled air temperature“ 7 °C). In the case of higher air outlet temperatures higher temperatures on controllers “HYGROTHERM reheating“ and “Chilled air temperature“ must be selected.
If this is not respected the HYGROTHERM capacity could possibly be too small and the chiller would be shut-off automatically by the lower limit value of the “HYGROTHERM reheating“ controller; please also see section 5.1.5.

Very low refrigeration demand at low ambient temperatures
With less than approx. 3–5 °C difference between the set chilled air temperature and the ambient temperature, larger fluctuations of the chilled air temperature result. Reason: At low temperatures the compressor must still work with a certain residual cooling capacity so as to ensure the suction gas cooling of the compressor motor. Due to this residual cooling capacity the chilled air temperature drops below the set value of the controller before, at approx. 3 °C beneath the lower limit value, the controller trips and shuts off the compressor. As soon as the set value is overstepped by approx. 3°C, the compressor restarts automatically. This chilled air temperature fluctuation is unavoidable, but does not represent a risk of grain humidification, if the approx. 3 °C HYGROTHERM reheating is ensured.

3.3.5 Stepwise cooling

At high ambient air temperatures it is recommended not to choose too low a chilled air temperature. The air flap regulates the air flow rate until the desired chilled air temperature is attained. The highest refrigerating capacity of the GRANIFRIGOR is attained when the max. air flow rate is delivered, i.e. when the flap remains in the fully open position.

It is therefore advisable to set the chilled air temperature to such a value that the air flap only closes during the warmest hours of the day. If a very low chilled air temperature is set, the cooling time could become quite long.

Lower storage temperatures can be attained quicker by cooling in two or more steps, e.g. with a first cooling to 15–17 °C. This temperature, however, does not offer protection from insect activity and grain losses. In a second cooling step the temperature is brought down to the protective temperature of 8 – 10 °C. The total energy input is generally higher with stepwise cooling than with one-time cooling.

The position of the air flap is very often only controlled during the day and it is not noted that it opens further during the night hours. The 24 hour mean value of air delivery is decisive for the cooling capacity.

4 Maintenance

The refrigerating part of the cooling unit is hermetically sealed and needs no maintenance. Attention must be given only to those parts whose functions may be impaired by fouling due to dust or weather. Normal maintenance does not involve interfering with the refrigerating system. The maintenance intervals given are guidelines from practical experience; they may be lengthened or shortened as necessary.

Attention

The refrigeration circuit is under pressure (8 bar at 20 °C room temperature when the compressor is at standstill) and must not be opened in an inappropriate manner.

Interventions into refrigeration circuit may only be done by a qualified refrigeration technician.

Gaseous refrigerant R407C is heavier than air. In case of refrigerant escape it is therefore very important to ventilate the floor area very well to avoid the formation of a layer dangerously poor in oxygen.

Before performing any work on moving parts (compressor and fans) always put the main switch into the „0“ position and also if possible, cut off the network electrical supply.

The max. Admissible ambient temperature is +58°C. At higher temperatures there is the risk of bursting and injuries.

If longer standstill periods are foreseen (several months) we recommend to clean the unit thoroughly - please also refer to maintenance instructions - and to protect it from weather influence covering it with a plastic foil or tarpaulin.

The GRANIFRIGOR is not to be kept together with artificial fertilizer (danger of corrosion due to artificial fertilizer gases).

4.1 Daily checks:

a) **Check the intake filter** 3.1 (Fig. 11a - 11d) for fouling. If, due to fouling, the pressure in the filter exceeds 20 daPa, the LED “Air intake filter“ in the functional diagram will light up.
Switch off the cooling unit, take out the filter and clean it (by beating it or blowing it out with compressed air) or replace it, if necessary. Make sure that filters fit tightly all round.
Never operate the cooling unit without a filter or with a torn one!
Keep spare filters ready.
Information on the type of filter to be used is given in subsection 6.2 “Technical Data“.

b) **Check the function of the cooling unit:**
- → LED’s in the functional diagram (Fig. 8),
- → position of the air flap 2.7
- → chilled air temperature on controller “chilled air temperature“,
- → chilled air reheating on controller “HYGROTHERM heating“,
- → tightness of chilled air connection 1.12,
- → air counter pressure on U-tube 1.6,
- → unusual noises (e.g. from bearings),
- → look for oil traces around the refrigeration system (escape of oil means leakage and loss of refrigerant).

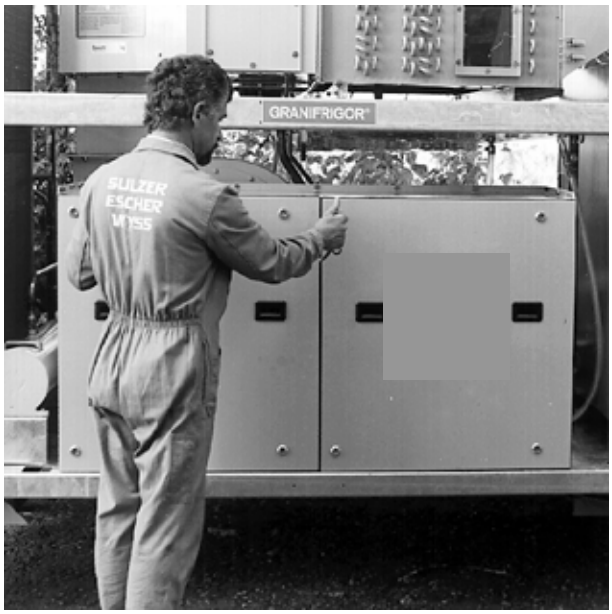


Fig. 11a *Opening the air intake silencer with the switch cabinet key*

Fig. 11c *Removing the filter support (Two hex. nuts, wrench size 14)*

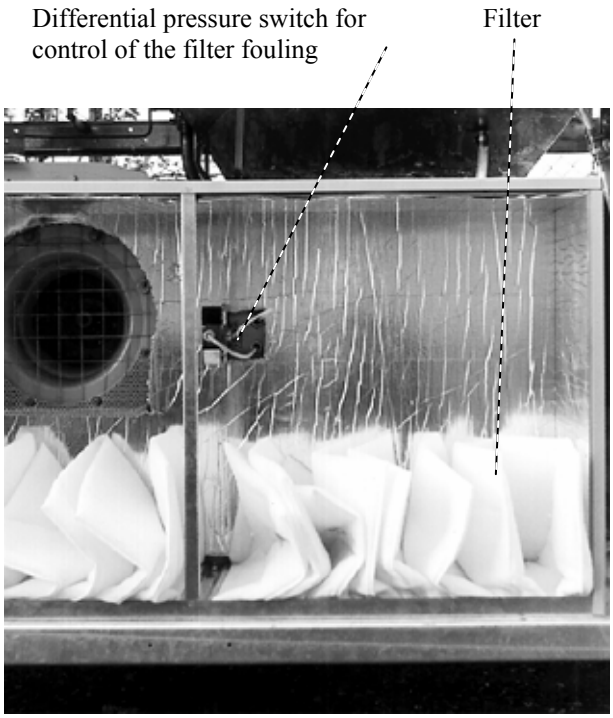


Fig. 11b *Air intake silencer open*

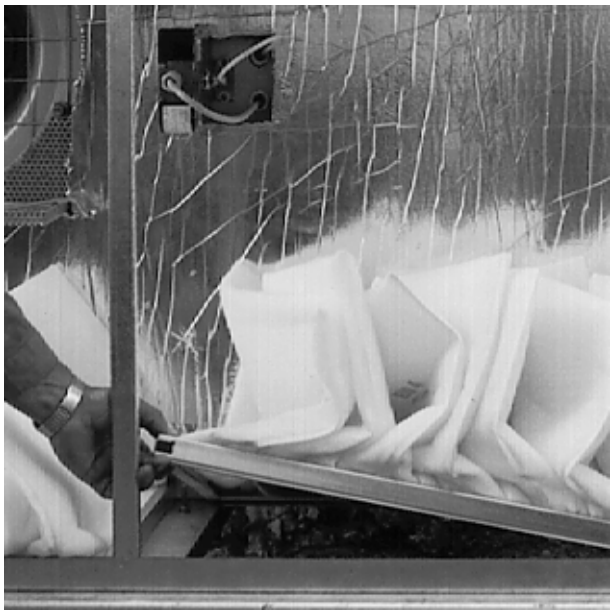


Fig. 11d *Removing the filter element.*

Make sure that the cleaned / new filter fits tightly all round

4.2 Weekly checks

a) Check condenser 1.2 for fouling: the flow-exposed surface is affected first. Brush or blow off if necessary. The cooling unit must be switched off for brushing, but for blowing-out the condenser fan must be running so that the dust is taken away. If fouling is severe, water or steam also may be used for cleaning, though the pressure must not be excessive and the jet must not be directed obliquely onto the evaporator fins, otherwise their leading edges will be bent.

b) Make sure that water is able to drain off freely from the evaporator, the siphon and the drip pan. Water drain off from the evaporator can be checked through window 3.2 (Fig. 3).

Note: The discharge hose must have a continuous inclination from the evaporator to the siphon to avoid the formation of an air bubble at the highest point which would obstruct the water outflow.

When cleaning with water or steam

→ **Cut off power supply, i.e. pull out the plug or turn off the switch on the main.**

→ **Cover motors, switch cabinet and other electrical connection points with plastic foil. Any water that gets in may cause short circuits or malfunctions later on.**

c) Oil the bearings of the air flap 2.7. Switch off the cooling unit for this, otherwise the oil cannot penetrate into the bearings on account of the air overpressure inside.

4.3 Occasional under arduous usage).

a) Check fouling of evaporator 1.1 through window 3.2 and cleaning opening 3.4.
For this remove the window 3.2 or covers 3.4 or 3.5 on the evaporator. If the fouling cannot be flushed away simply with water, hot water or steam may be used. In this case, however, the instructions for cleaning with water and steam must be observed without fail, including the warning in subsection 4.2a about bending the evaporator fins. Attention: Make sure that the chilled air supply to the switch cabinet is shut to avoid ingress of water.
The switch cabinet cooling must be connected to the chilled air duct.

b) The fan motors are permanently lubricated for 3-5 years service. Since the GRANI-FRIGOR does not operate conti-nuously, this time is extended accordingly. If noisy bearings are detected, the affected bearings must be changed. In most cases relubrication is not enough.
The rotor of the chilled air fan is fixed with a Taper-Lock bush (instructions for fitting are given in the annex).

Safety precautions:

Before performing any work on the fans always put the main switch into the „0“ position an and cut off the network electrical supply.

Dismounting and mounting of the chilled air fan rotor e.g. for maintenance purposes, must be done very carefully. Minor mounting mistakes can cause unbalance (to be recognised from strong chilled air fan vibration). The max. admissible unbalance is 6,3 mm/s (quality standard Q6,3 to VDI Guideline 2060). Unbalance resulted from mounting mistakes is hard to repair (in critical cases this can only be solved by the fan manufacturer).

c) Examine the general condition of the cooling unit. Clean it where it is very dirty, remove any rust and touch up the paintwork (saffron yellow RAL 1017 / stone grey RAL 7030 / zinc-dust paint). The air ducts can be taken down after unfastening the clamp or screw fastenings. Check the gaskets of the air duct flange connections and replace them if necessary. Self-adhesive, age-resistant foam plastic strip may be used, such as Tesamoll or similar, or spare gaskets may be ordered from the FrigorTec customer service. When cleaning the cooling unit, be careful with the refrigerant lines and especially the capillary (control) tube lines. The entire refrigerant filling may be lost if they are damaged.

d) After prolonged idleness of the cooling unit (several months), it is advisable to perform a brief test run about 8 - 12 weeks before operation is intended, so that there is sufficient time for overhauls if any defects are revealed. Make sure in particular that the condensate has free outflow from the evaporator. If the outflow is constricted or clogged, remove the window 3.2 on the evaporator and flush the entire condensate outflow, including the hose siphon.

Note: The condensate outflow will function properly only if the cooling unit stands level and if the discharge hose has a continuous inclination from the evaporator to the siphon.

e) Fan blades and hollow hub of the condenser fans 3.6 must be freed from dust deposits at least once a year. Unequal dust deposits will cause unbalance and can cause damage to the bearings or the condenser.

f) Grease motor valve spindle once a year at the lubricating nipple with a grease press (use Molykote grease Longtherm or a similar low-acid grease).

g) According to the German regulations (Elex V) the electrical heater of the KK 220 AHY must be checked by a specialized electrician every three years, whereby the condition and functioning of the safety thermostats against overheating of the heating elements must be inspected. The electrical heater is easily accessible through the chilled air outlet trunk 1.13 (Fig. 1). The safety thermostats must be set to a shut-off temperature of 175 °C so that the surface temperature of 215 °C according to Elex V is not overstepped. Local regulations must also be observed.

5 Troubles

In the event of malfunctions, observe the LED's on the switch cabinet first. When calling in customer service, describe the fault as accurately as possible. The switch cabinet can be opened only with the main switch at "0".

GRANIFRIGOR units are filled with safety refrigerant R407C. It is odourless, non toxic and non explosive. Injuries may possibly result from local frostbite and chemical burns.

Notes for action to be taken in case of refrigerant escape:

→ Do not smoke (toxic decomposition products will be formed, e.g. hydrochloric acid, phosgene).
→ Ventilate the room properly, especially the floor area.
→ It is recommended to wear protective goggles.

For reasons of environmental protection it is not allowed to dissipate refrigerant to the atmosphere.

When performing any work on the low pressure side of the compressor the refrigerant must be transferred to the high pressure side of the refrigerating circuit. For work on the high pressure side the refrigerant must be filled into suitable pressure vessels.

The refrigeration machine oil contains fluorohydrocarbons and must therefore be disposed off according to legal regulations. Normally it must only be changed in case of a compressor fault, otherwise it can remain in the compressor for all its durable life.

Safety data sheets for refrigerant R407C and refrigeration oil "White Oil 160 P" can be supplied on request.

FrigorTec GmbH is a specialized company within the meaning of the Water Resources Policy Act and has specially trained refrigeration fitters at its disposal.

Fachbetriebsgemeinschaft Maschinenbau e.V.
FGMA
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überwacht

Attention

The refrigeration circuit is under pressure (8 bar at 20°C room temperature when the compressor is at standstill) **and must not be opened in an inappropriate manner.**

Interventions into the refrigeration circuit may only be done by a qualified refrigeration technician.

Gaseous refrigerant R407C is heavier than air. In case of refrigerant escape it is therefore very important to ventilate the floor area very well to avoid the formation of a layer dangerously poor in oxygen.

Before performing any work on moving parts (compressor and fans) always put the main switch into the "0" position and also, if possible, cut-off the network electrical supply.

The max. admissible ambient temperature is +63 °C. At higher temperatures there is the risk of bursting and injuries.

5.1 Signalised troubles

(These faults are indicated on the functional diagram, Fig. 8, with red LED's)

5.1.1 High pressure fault

Causes:

- Condenser 1.2 fouled
- condenser fans 3.5 not running
- inadequate heat dissipation from the room
- air in the refrigeration system (to be determined by refrigeration technician only!)
- Overfilling with refrigerant, e.g. after the performance of repair work (to be determined by refrigeration technician only!)
- too high ambient temperatures (above +35/40°C)
- chilled air temperature setting too high (above +20°C),
- condenser pressure controller 1.11 sticking,
- subcooler 1.16 (Fig. 1) not functioning, (to be determined by refrigeration technician only!)

Remedy:

→ Press reset button on pressure limiter PSAH1.02 and PSAH2.02 (Fig. 5).

→ Inspect condenser for fouling and clean if necessary.

→ If the trouble recurs: Check adjustment of pressure limiters (see Annex 6.3).

→ Provide better ventilation to dispel hot air if there is heat accumulation in the room.

→ Discharge refrigerant and fill in correct quantity observing the sight glass (only by refrigeration technician!)

→ Install summer thermostat for automatic shutoff at high ambient air temperatures.

→ Select lower chilled air temperature setting.

→ Turn setting screw of condenser pressure controller 1.11) several times and gently tap the casing to losen the valve cone. Be sure to memorize the number of turns in order to find the original position back.
If the trouble recurs: Replace the condenser pressure controller (only by refrigeration technician!)

→ Check function of the expansion valve on the sub-cooler (only by refrigeration technician!)

5.1.2 Low pressure fault

Causes:

- Evaporator 1.1 or air intake filter (Fig. 11b) fouled,
- lack of refrigerant (bubbles in one of the sight glasses 2.5),
- defective expansion valve 2.4, e.g. sensor line broken,
- inadequate air throughput (air counter pressure excessively high, air intake filter clogged, evaporator iced up),
- pressure switch PSL7.03 for closing position of motorized valve defective or not set to the correct value.

Remedy:

→ Press reset button on low pressure switch PSA1.00 and PSAL2.00.

→ Inspect evaporator for fouling or icing, clean or defrost if necessary.
For this unfasten chilled air hose and run the GRANIFRIGOR for approx. 15 - 30 min. in the operating mode "Ventilation". Check through window 3.2 if the evaporator is free of ice, observe thawing water outflow too. Icing up of the evaporator normally only occurs if the chilled air temperature setting is too low (<+4 °C)

→ Check refrigerant sight glasses 2.5 (remove protective cap) for bubble free flow. Strong, persistent bubbling indicates lack of refrigerant or one of the dryers 2.6 is clogged, (rectify leak before filling. Only by refrigeration technician).

→ Check expansion valve setting, suction overheating and sensor line (only by refrigeration technician).

→ Check U-tube readings. If the chilled air ducts or the air supply in the silo is clogged, counter pressure indication on U-tube 1.6 will be too high.

→ Check air intake filter for fouling, check LEDs in the functional diagram (Fig. 8).

→ Check setting of pressure switch PSL7.03 (Fig. 5) for closing position of motorized valve according to Annex 6.3.

→ Check setting of low pressure switches PSA - 1.00 and PSAL2.00 (Fig. 5) according to Annex 6.3.

5.1.3 Motor fault

Remedy:

→ Check power connection and motor protection switch, reset, if necessary.
→ Call electrician to measure out the motor windings.
→ If the compressor motor is defective, the whole compressor must be changed (only by refrigeration technician). It is usually necessary to renew the dryer and refrigerant filling at the same time.
→ Owing to the high starting torque of the chilled air fan 1.5, after several starting attempts the over current relay may trip although there is no real fault. In this case, wait a few minutes before pressing-in the over current relay and starting again.

5.1.4 Chilled air temperature too high

Causes:

→ Refrigerating capacity insufficient due to a fault in the refrigerating circuit,
→ chilled air temperature setting very low at extremely high ambient air temperature,
→ “chilled air temperature controller“ defective.

Remedy:

→ Set operating mode switch briefly to “0“ and restart.
Check adjustments or function of the following parts:
→ Chilled air temperature controller, Fig. 8
→ Motorized valve 1.10
→ Servomotor for air flap 2.7
→ Refrigerant filling
→ Compressor 1.3
→ Expansion valve 2.4

only by refrigeration technician

5.1.5 Reheating too low

Causes:

- Difference between the setting on controllers “Chilled air temperature after the evaporator“ and “HYGROTHERM reheating“ too big (> 8 °C),
- Electrical heater defective, or safety thermostat tripped due to high temperature,
- Controller “HYGROTHERM reheating“ defective,
- HYGROTHERM solenoid valves 2.3 not activated or defective

Remedy:

→ Set operating mode switch briefly to “0“ and restart.
Check adjustments or function of the following:
→ Controller “HYGOTHERM“ reheating (Fig. 8).
→ Solenoid HYGROTHERM valves 2.3 (compressor must be in operation).
→ Electrical heater (in the air outlet duct).
→ Also refer to hints given in sub-section 5.1.6.

5.1.6 Heater fault

The fault "Heater fault" occurs when the motor protection switches off the electrical heater due to over-current or high temperature thermostat tripping. These faults are self-held and must be reset by pressing the corresponding reset button or by brief off/on switching of the "Operating mode" switch.

Remedy:

→ Call an electrician to find the cause for over-current or high temperature.
→ Check if perhaps the "HYGROTHERM reheating" is set too high.
→ Check air flow (in case of air duct obstruction the air flow around the heating register could be too small and as a cause the high temperature thermostat trips).

Note:

After a "Heater fault" the GRANIFRIGOR will first continue to work on automatic operation. Automatic shut-down will only be ensued when the lower limit of the controller "HYGROTHERM reheating" trips with a 10 min. delay. Signal: "Reheating too low". The fault indication "Heater fault" will remain lit for information purposes until it is reset.

5.1.7 External thermostat

(optional equipment)

This is not a fault. The LED only indicates that the unit has switched off by the external thermostat 4.8 (Fig. 4). The temperature was too high (summer thermostat) or too low (winter thermostat).
The GRANIFRIGOR will restart automatically as soon as temperature is within the set limits again (adjustments are given in annex 6.3).

5.2 General troubles (not signalled)

5.2.1 Compressor or fans do not run

Remedy:
Check power supply and current path with electrical diagram, check also adjustments and functions of safety and switching devices.

5.2.2 Cooling capacity noticeably less than before

Cause:
- evaporator fouled,
- lack of refrigerant,
- condenser fouled,
- air intake filter badly fouled,
- air distribution system in the silo clogged.

The remedy is evident from the cause.

5.2.3 Condensate leaking from evaporator flange connections

Cause:
- discharge opening in evaporator or siphon hose clogged (also see subsection 5.2.7),
- the cooling unit is not level,
- gasket on flange connection defective,
- counter pressure too high.

The remedy is evident from the cause.

5.2.4 High counter pressure on U-tube

Although the silo filling is only small, or only a much lower pressure has been indicated previously in this operation.

Cause:
- air supply clogged,
- strongly kinked hose,
- main air duct clogged or unsuitable air supply layout.

The remedy is evident from the cause.

5.2.5 Evaporator iced up

External ice accretion on the pipe bends of the evaporator system is of no importance, but internal icing of the evaporator (ascertainable through the rear window 3.2 on the evaporator) will obstruct the air passage and therefore lead to trouble in the long run.
Icing starts at the lower part of the evaporator and moves up slowly. A fault must be expected as soon as approx. 1/3 of the evaporator is iced up (low pressure fault). Actual damage to the cooling unit will not occur.

Cause:
- controller “Chilled air temperature” set too low or defective,
- air flap 2.7 resp. motorized valve 1.10 not functioning,
- counter pressure on U-tube 1.6 too high,
  Remedy: check adjustments and functions of the control devices and reset if necessary (see Annex 6.3 “Adjustments”). Clear air distribution, if necessary.

  Defrosting of the evaporator is described in subsection 5.1.2.

5.2.6 Air flap or motorized valve does not regulate

Remedy:
→ Check function of the air flap and the motorized valve by operating the air flap switch “Manual control”.
→ Check functions of “Chilled air temperature controller” and of control circuit.
If the servomotor has to be changed, make absolutely sure that the settings of the limit switch dogs and the limit switch connections are the same. It is best to do the exchange only when the replacement motor is at hand.

5.2.7 Condensate not flowing out of the evaporator

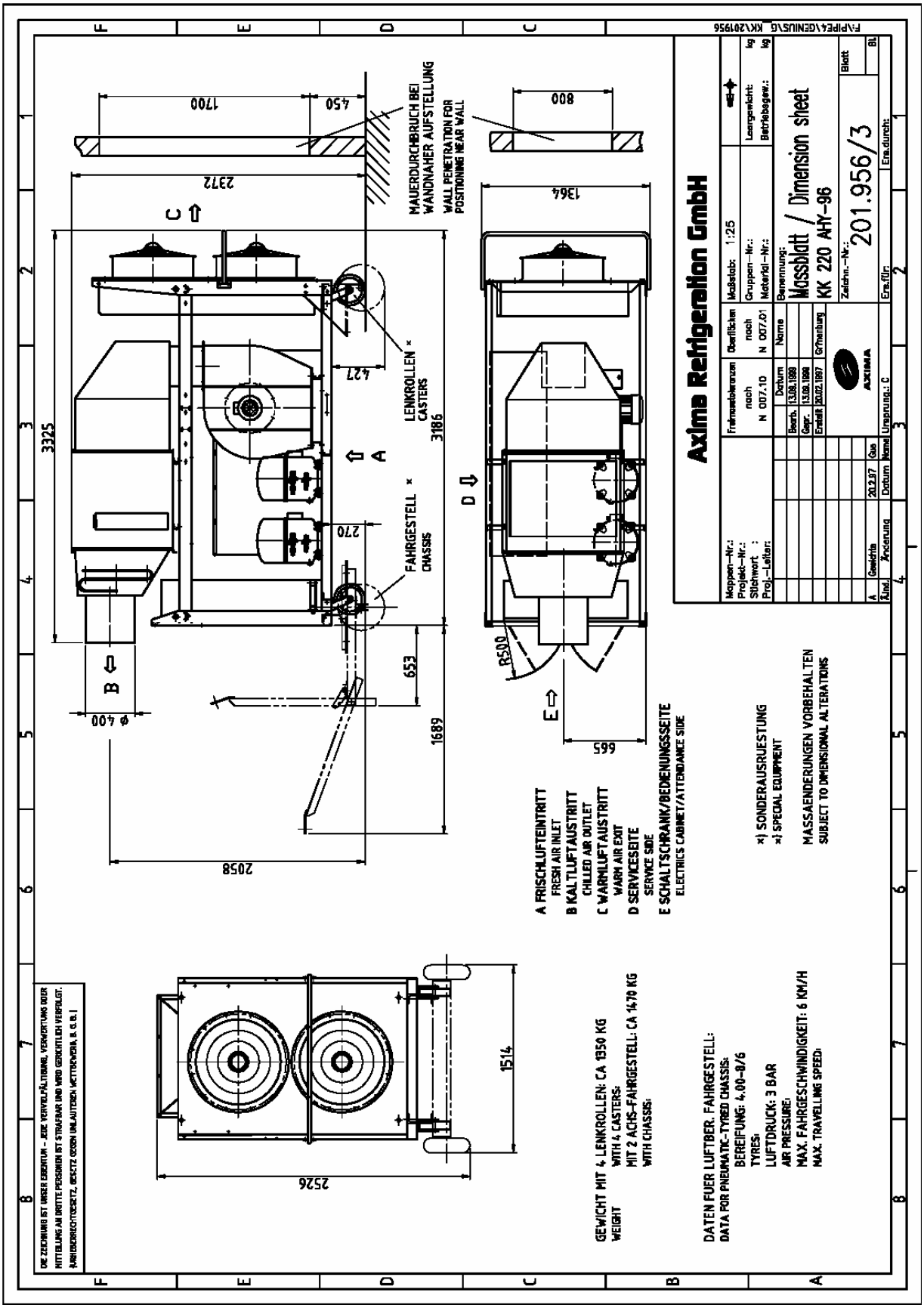
Causes:
- Outflow from the evaporator clogged (visible through window on cleaning opening 3.2, Fig. 3),
- hose between evaporator and siphon sagging. An air bubble is formed in the hose and the water cannot flow out.

Remedy:
→ Clean outflow, rinse siphon thoroughly.

→ Lay hose tautly and with a continuous inclination toward the siphon (provide for additional fastenings if necessary).

6 Annex

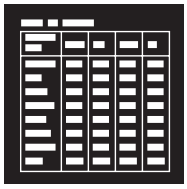
6.1 Dimensional drawing no. 201.956/3



Technical data:

(subject to technical modifications)
Dimensions and weights according to sheet 201.956/3 in annex
Values are to be found in the wiring diagram enclosed in electric cabinet.

Power supply data	standard ..... 400 V – 3 – 50 Hz (special execution see wiring diagram)
Power input	max. (without electrical heating) .....34 kW eff.* (without electrical heating) ..... 29 kW max. (with electrical heating) .....46 kW
Operational current input	max. without electrical heating ..... 73 A max. with electrical heating ..... 91 A
Max. starting current*	(Direct starting 1 compressor, without electrical heating) 105 A
Compressor:	motor power max. (direct starting) ..... 2 x 10,8 kW refrigeration cap. at ±0/+30 °C ..... 65,4 kW refrigeration cap. at ±0/+40 °C ..... 56,4 kW
Chilled air fan:	motor power (Y/ Ð starting) ..... 11 kW speed ..... 2900 min–1 motor protection (Motor / terminal box) ..... IP 54/55 motor pattern ..... B 5
Condenser fan	.....2 Stück motor power ..... 0,55 kW speed .....960 min–1 motor protection ..... IP 54
Electric heater	.....3 x 4 = 12 kW
max. admissible operating overpressure .....25 bar max. admissible ambient temperature .....63°C	
max. condensing temp. (pressure limiter trips at 25 bar) .....63°C	
Application limit (max. admissible ambient temperature for operation) ..... 40°C	
R407C refrigerant filling*	circuit 1 = ... 22,0 kg
Refrigerating machine oil* P.O.E160Pz Mat.-Nr. 211486	2 x4,0 l
Noise level at 7 m distance under nominal operating conditions 0/40°C, VL = 7300 m3/h .....71 dB (A)	
Air intake filter:	2 Filters POF 35/8S – 430 x 800 x 360, Stock no. 1043252
*Safety data sheet available on request.	



6.2 Adjustments for control and safety devices for KK 220-AHY

	Item no. in Op. Instr. El. diagram	Settings*	Admissible deviations remarks
Pressure limiter	PZH 1.02 PZH 2.02	OFF 28 bar ON 24 bar	+0 bar –1 bar
Low pressure switch	PSAL 1.00 PSAL 2.00	OFF 0,9 bar (–22°C) ON 3,5 bar (+/–0°C), Reset	+/– 0,1 bar +/– 0,5 bar
Differential pressure switch for oil	PDSAL 1.04	OFF 0,7 bar Delay 120 sec.	+/– 0,1 bar +/– 15 sec.
Expansion valve Suction overheating**	2.4	7,5 K (min. 6 K)	+/– 0,5 K
Servomotor for air flap	2.7 Y 7.30	OPEN 90° CLOSE 0°	+/– 5°
Condenser pressure control	1.11	14,5 bar (+40°C)	+/– 0,5 bar
Receiver pressure control		opens Dp > 1,4 bar open Dp > 3 bar	fixed setting, not to be adjusted
Motorized valve closing limit contact	1.10 Y 7.31	valve 11 turns open (Evaporating temp. tV1 = –25°C)	
Pressure switch for MV closing position and hot gas bypass	PSL 7.03	OFF 2,0 bar (–15°C)	(adjust min. switching diff.)
Contr. “Chilled air temp.“ Contr. “HYGROTHERM-reheating“	4a / 9N1 4b / 13N1	works adjustment +7°C works adjustment +10°C	Setting hints see annex 6.4
Differential pressure switch	Bild 10b	Signal Dp > 20 daPa	+/– 2 daPa
for air intake filter	PdA H 9.26		
Pressure switch for defrosting of circuit II	PS L 7.04	OFF 2,0 bar (–15°C) ON 4,31 bar (+ 2°C)	+1 K +1 K
Summer thermostat (optional extra)	TSAH 9.03	OFF +30°C ON +27°C	+/– 1 K
Winter thermostat (optional extra)	TSAH 9.04	OFF +1°C ON +6°C	+/– 1 K
Safety thermostat for electrical heater	TSAH 7.10	OFF 175°C	+/– 5 K

6.3 Adjustments for micro-processor DMP 96 and DMP 96 S

Controller function
DMP 96: Impulse outlet for control of the motorized setting devices (motorized valve, servo motor for air flap)
DMP 96S: Stepped outlet for control of individual setting devices (e.g. heating stages)

Setting procedure:
It takes a few seconds after starting the GRANIFRIGOR until the temperature displays appear.

Modification of the set value:
(The setting is identical for DMP 96 and DMP 96S)

1. Press "P" key twice briefly →"SP.1" indication appears in the upper display
2. Modify the set value in steps of 0,1°C by means of "↑" or "↓" keys.
3. As soon as the desired set value appears in the lower display → press "P" key once briefly.
4. The newly selected value is now set → it appears in the lower display. The actual temperature reappears in the upper display.
5. If the "P" key is pressed by mistake, without wanting to modify the set value, the normal temperature indication will reappear after approx. 20 sec.

Parameterisation key

The parameterisation key " * " is **only used by the maintenance personnel.**
If this key is pressed by mistake, "cod" will appear in the upper display. To return to the set value modification again press "P" key briefly → "SP.1" will reappear in the upper display. The normal temperature indication will reappear after approx. 20 sec. if the set value is not to be modified.

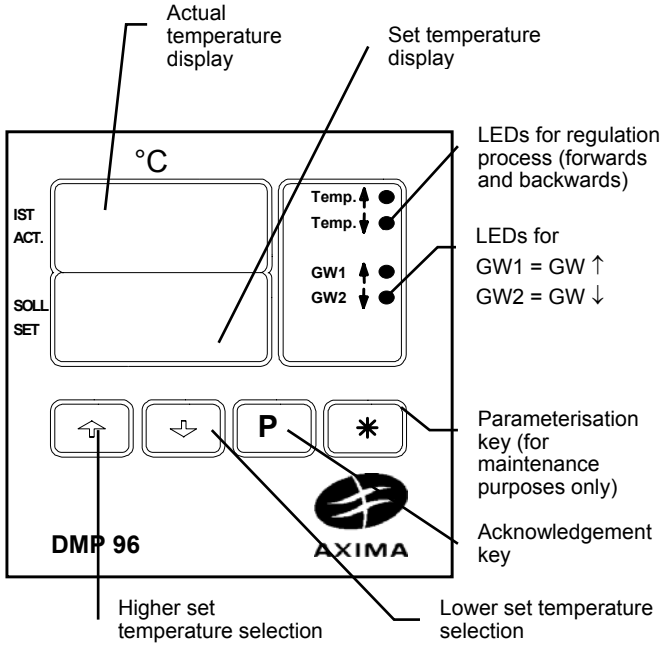


Fig. 12a *Microprocessor system DMP 96*

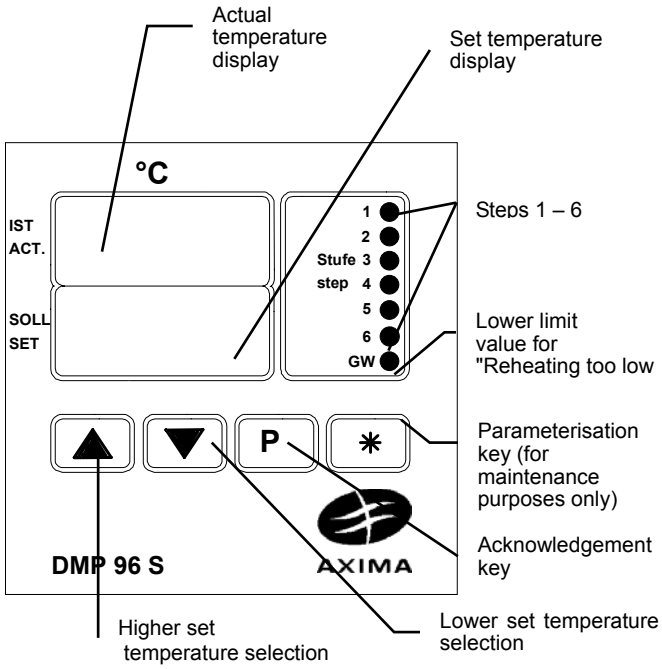
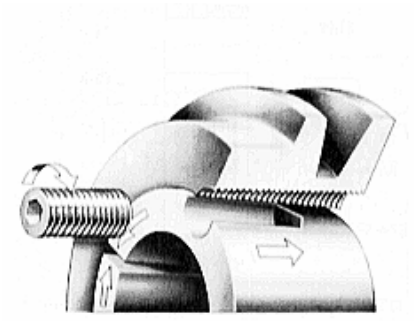
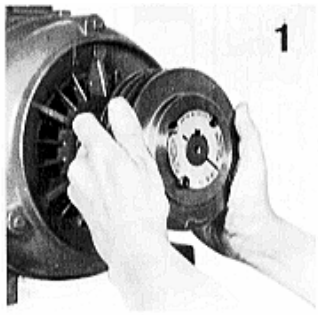


Fig. 12b *Microprocessor system DMP 96S*

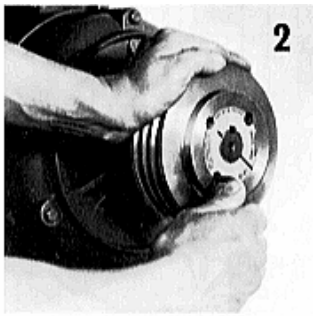
6.4 Instructions for fitting of Taper-Lock



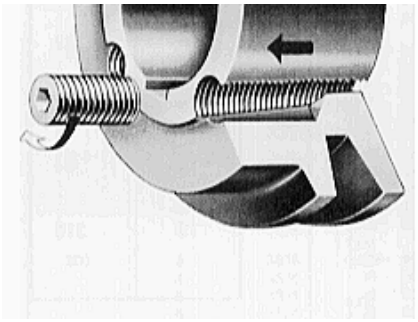
Fitting



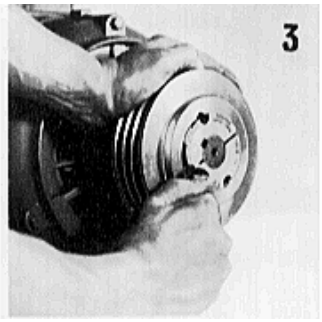
Clean and degrease all bright surfaces. Fit the disk and bush into each other, make the holes coincide and turn the screws in loosely



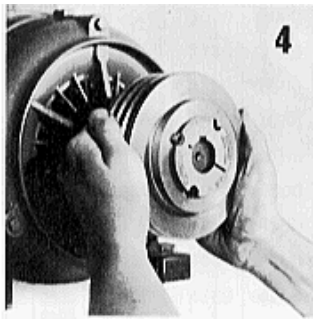
Push disk with bush onto the shaft, align, tighten screws evenly and securely.



Removing



Take out the screws, insert one of them into the hole with half thread in the bush as a forcing screw, and tighten it. This will release the Taper-Lock bush.



Take off the now loosened disk unit by hand, without striking it or damaging the machine.

1. Hammer against large-end of bush, using a block or sleeve to prevent damage. (This will ensure that the bush is seated squarely in the bore.) Screws will now turn a little more. Repeat this alternate hammering and screw tightening once or twice to achieve maximum grip on the shaft.
2. Fill empty holes with grease to exclude dirt.

6.5 GRANIFRIGOR data log (specimen)

GRANIFRIGOR Data Log

Unit-No.:____________________

Silo-No.: ______________________________

Warehous-No.:___________________________

Quality / Goods: ________________________

M.C.: ______________________________

Temp.: _____________________________

Quantity: ___________________________

Date	**Time**	**Outdoor air**		**Chilled air temperature**					**Airflap**	**Betriebsstunden**		**kWh-meter**	**Remarks**
		temp. °C	rel. hum %	**setting.** after evaporat. °C	**setting** at outlet °C	actual after evaporat. °C	actual at outlet °C	silo emtry °C	angle "	low speed	high speed	consumed	

6.6 External thermostats (optional equipment)

6.6.1 Summer thermostat

The function of the summer thermostat is to switch off the GRANIFRIGOR during cooling operation at extremely high ambient temperatures to avoid uneconomical operation during the hot hours of the day. The summer thermostat is especially convenient in hot countries and where low chilled air temperatures are required.

6.6.2 Winter thermostat

The function of the winter thermostat is to switch off the fan of the chilling unit during cooling operation (in addition to shut-down of the compressor) to avoid under cooling of the grain down to temperatures which cannot be reached by the chiller later on. The fan restarts its operation with rising ambient temperatures.
The winter thermostat is shunted when operating mode “ventilation“ is selected.

6.6.3 Thermostat for automatic shut off

Unit switch-off after finishing of the cooling process can be controlled by an automatic thermostat, whereby the probe is installed in approx. 0.5 m depth under the surface of the grain pile. This thermostat must be set approx. 2 – 3 degrees higher than the chilled air inlet temperature to the silo.
The optimum setting for economical operation must be found by practical experience since it can vary slightly with the piling height, product, chiller model or sensor position.

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