MANUFACTURER´S INSTRUCTIONS

For Defrosting of Finned Heat Exchangers,

II. Hot-Gas-Defrosting

(for Evaporators)

Original version
This manual was created in several languages. The German version is an installation instruction in its original version. All other languages are translations of the original version.

Disclaimer
If problems arise in connection with the assembly and / or operation of the unit, which are not described in these instructions, the operator / installer is obliged to contact thermofin® immediately. Further assembly and / or operation of the unit is not permitted until the facts have been completely clarified.

thermofin® declines liability for any damage resulting from its non-observance. Furthermore, thermofin® reserves the right to reject any further warranty claims on this unit that can be attributed to this.

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1. EVAPORATOR DESIGNS

The following manufacturer's instructions show the typical structure of an evaporator and provide information about working principle, structure and operation of defrosting systems.

The following accessories are important for defrosting:

- damper combined with Shut-up (figure 1)
- suction hood combined with Shut-up (figure 2)
- Shut-up (figure 3)

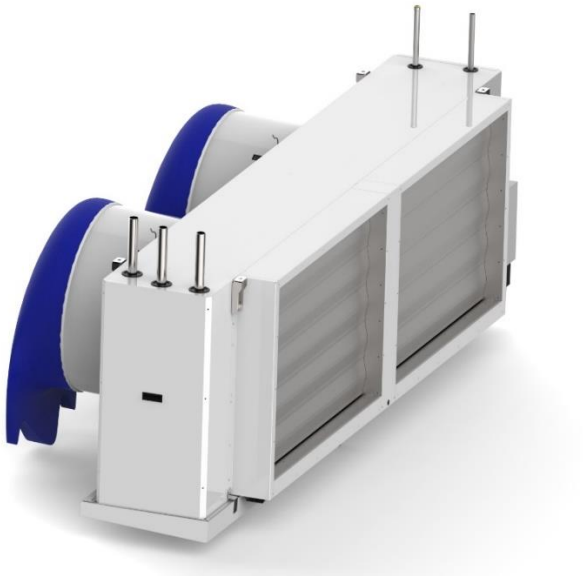

figure 1: damper combined with Shut-up (recommended design)

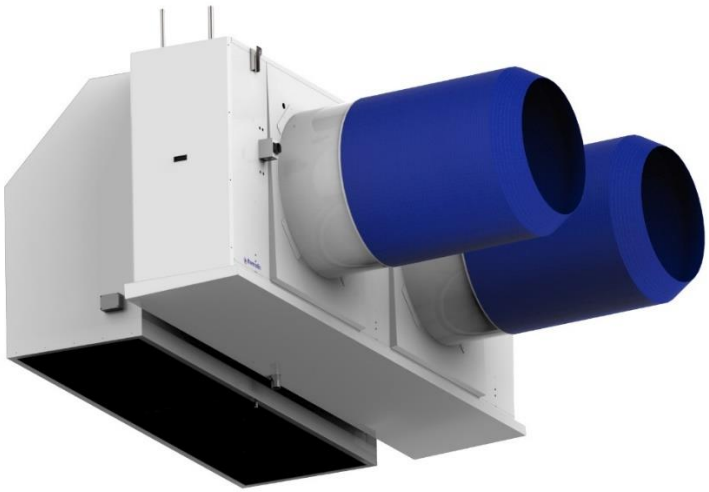

figure 2: suction hood combined with Shut-up

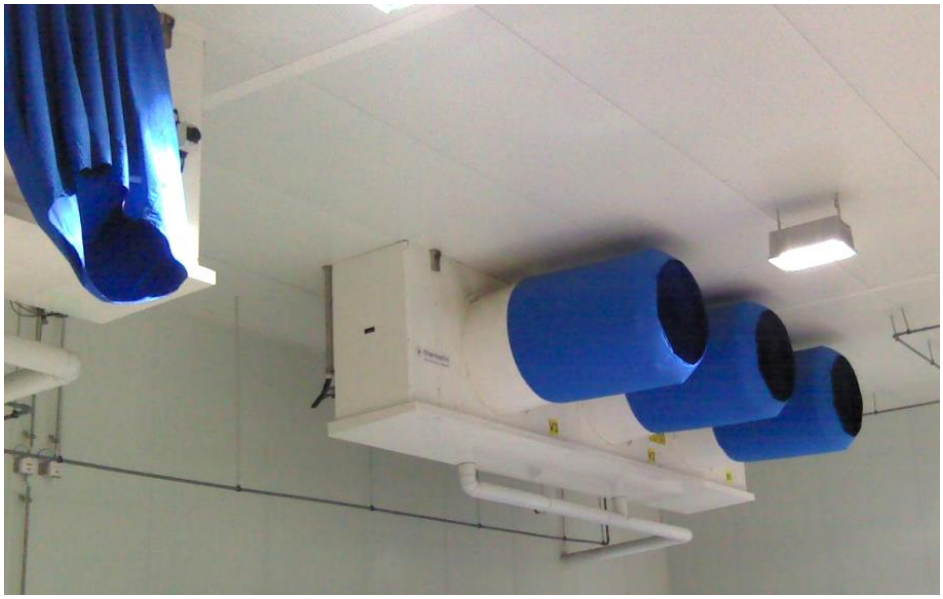

figure 3: Shut-up (left: fan out of operation; right: fan in operation)

table 1: disadvantages and advantages of the individual accessories

accessory	advantage	disadvantage
damper	low heat loss and faster defrosting	damper drive motors with integration in the control are necessary
	avoidance of icing on the ceiling which is near the air outlet	additional heating on the multi-leaf necessary
	very reliable, even under high moisture condition in the cold room	additional Shut Up recommended
Shut-up	low heat loss and faster defrosting	increasing pressure drop on air side
	avoidance of icing on the ceiling which is near the air outlet	risk of contamination
suck-in hood	low heat loss and faster defrosting	icing in the hood possible, due to high moisture condition in the cold room, or high defrosting temperature
	avoidance of icing on the ceiling which is near the air inlet	additional Shut Up necessary

2. WORKING PRINCIPLE

- Piping for hot gas in the tray

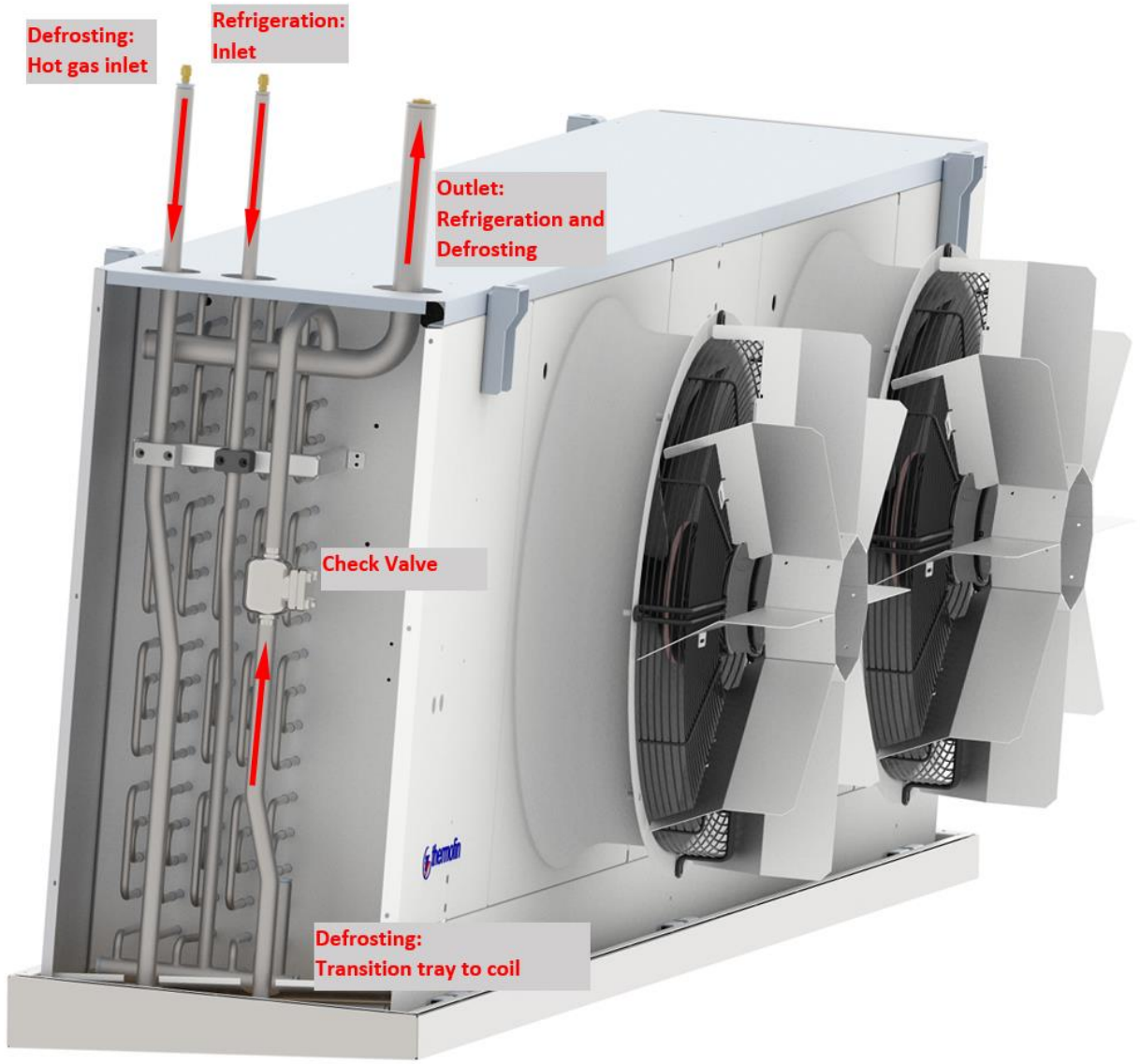

figure 1: prepared connections on the flooded evaporator

3. EXECUTION

Complete defrosting:

- no ice residue in the heat exchanger block or condensate tray.
- Minimization of the water vapor generated to avoid condensation and subsequent icing on unheated surfaces.

Recommendations provided by thermofin®:

- all recommendations given refer to normal ice build-up from one refrigeration cycle (2-3 defrosts per day)
- previous defrosts must be complete (see above)
- Refrigerant valves **must** close tightly during defrosting → Filter **required** before each solenoid valve (Figure 7); beware of trapped liquid when valves are shut off!

- figure 5:
  - Hot gas flows backwards through the heat exchanger, first through the condensate pan, then through the coil
  - Provide connection line incl. check valve between injection line and suction line for hot gas recirculation

- figure 6:
  - Hot gas flows through the defrost pan first
  - Hot gas is led via connection line and check valve into injection line and flows through the evaporator as in refrigeration mode

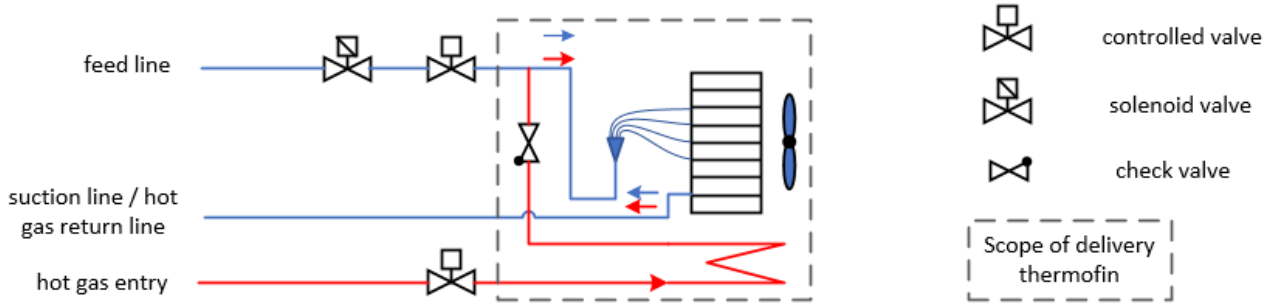

figure 2: Defrosting arrangement with regular flow through the evaporator

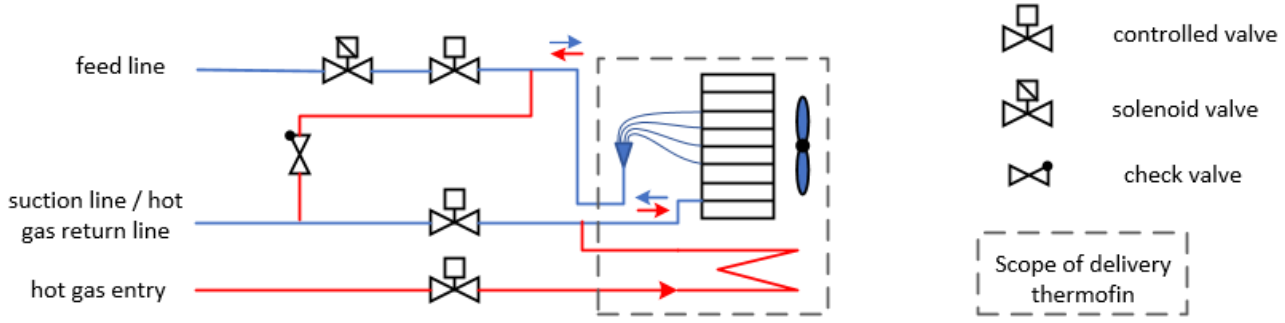

figure 3: Defrosting arrangement with reverse flow through the evaporator

Suction gas piping (figure 7):

- correct design of suction gas piping with overbend & slope
- correct dimensioning of the riser

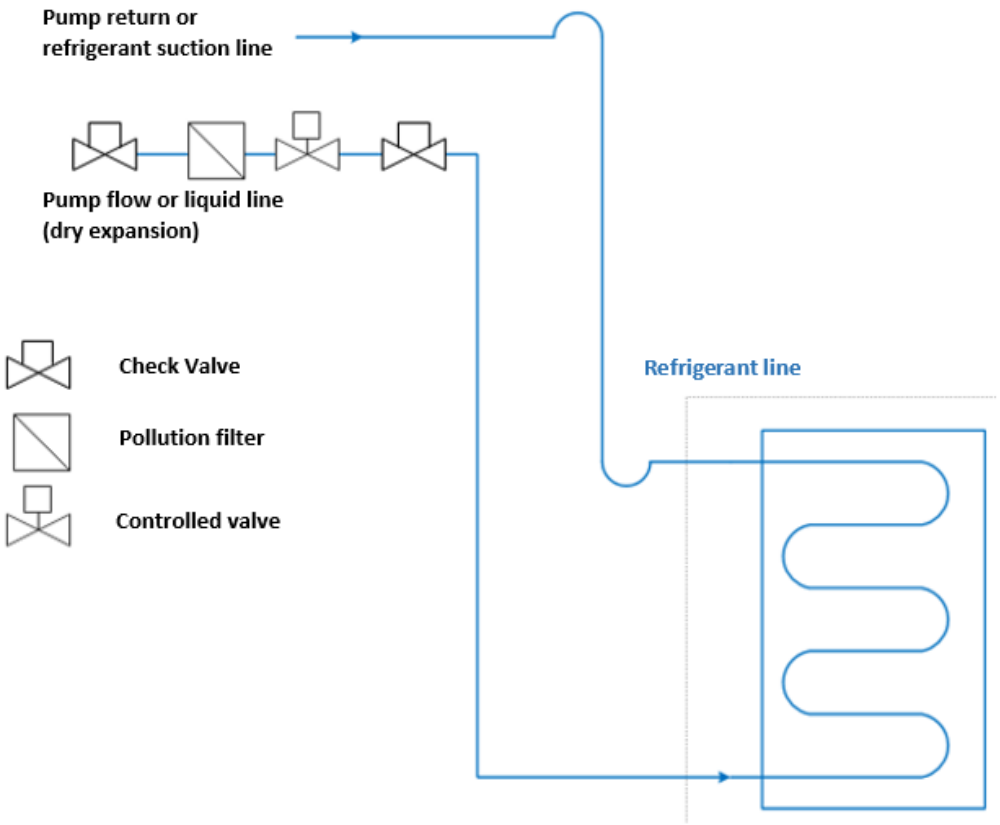

figure 4: Suction gas piping

- Gates and doors must be closed as much as possible
- fluctuating loads, changes between summer and winter months, and other site conditions must be considered; recommendations below do not apply to all conditions, but may need to be adjusted for site conditions

Frequency of defrosting must be evaluated by the system designer. The following aspects of the evaporator require increased defrosting:

- high moisture entry into the cold room due to:
  - of open access doors and gates.
  - high air exchange between docking stations, pre-cooling rooms and freezing rooms
  - lack of dehumidification of the air in the pre-cooling room
  - of goods with increased transpiration.

Defrosting can be started according to fixed times or on demand. With demand defrosting (e.g. ice thickness measurement, monitoring waste cooling capacity; air temperature difference or similar) the highest energy efficiency values are achieved.

3.1 Arrangement defrost sensors

I. **Two defrost sensors – Recommendation**

figure 8: Position sensor 1

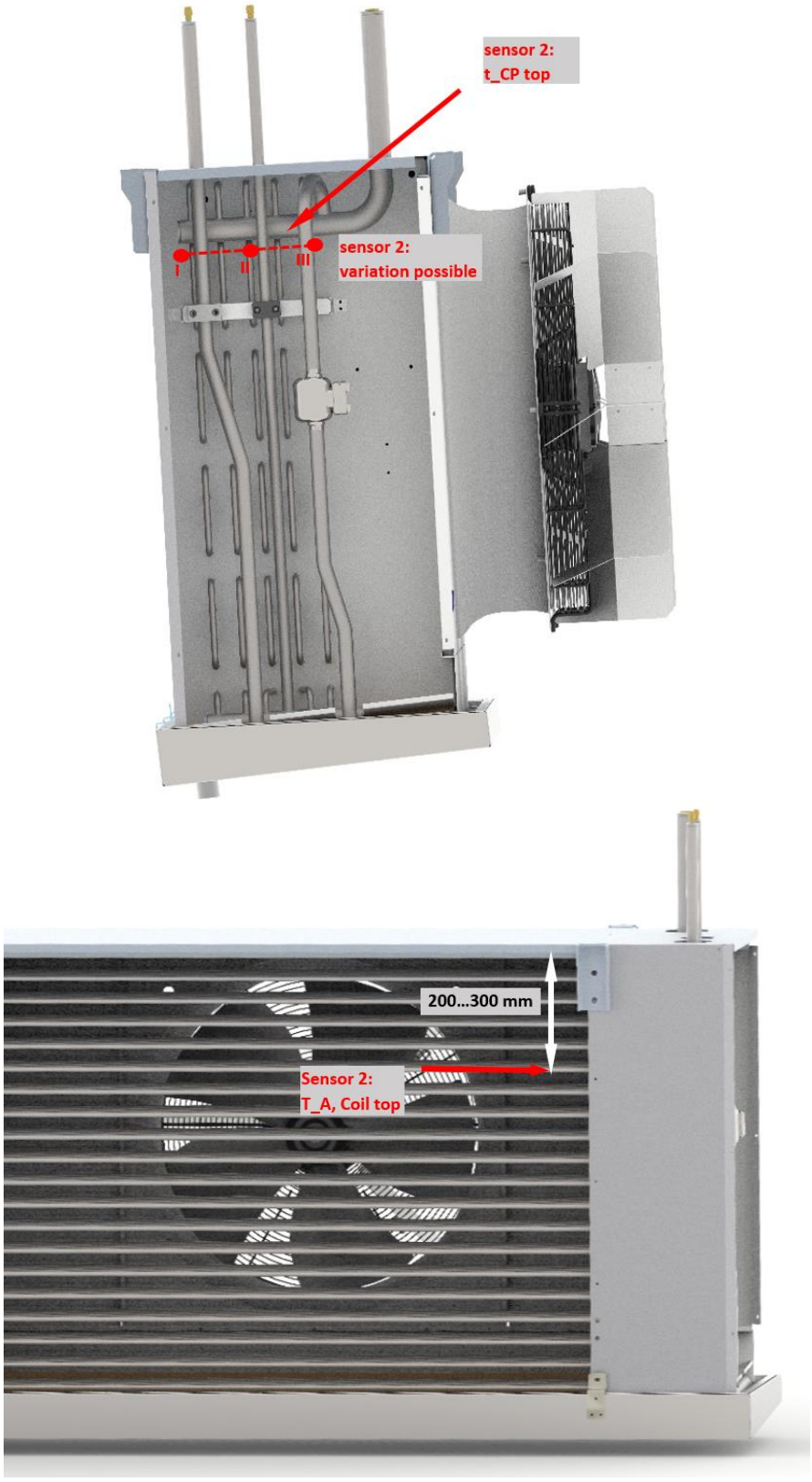

figure 9: Position sensor 2

Sensor 1 (figure 8):

- positioning: bottom of the lower core tube of the refrigerant-carrying pipe
- function: monitoring of residual refrigerant during defrost phase
  - during pump down, the temperature at the sensor must rise to the level of the air temperature; if the temperature remains close to the evaporating temperature, action must be taken
    (see "S1-a" table 3)
  - during defrosting phases, the sensor must reach a minimum temperature; this temperature must be maintained for a certain period of time
    (see "S1-b" table 3)

Sensor 2 (figure 9):

- positioning: upper area of the heat exchanger (measuring air temperature)
- function: monitoring of the air temperature during the defrosting phase.
  (see S2-a table 4)
  - Monitoring and limiting of air temperature during defrosting phase to avoid icing up
  - Clocking hot gas inlet temperature (if necessary)

II. <u>One defrost sensor</u>

- Recommendation only for cold room temperatures above 0 °C

Use of sensor 1 (figure 8)

Sensor 1 (figure 8):

- positioning: bottom of the lower core tube of the refrigerant-carrying pipe
- function: monitoring of residual refrigerant during defrost phase
  - during pump down, the temperature at the sensor must rise to the level of the air temperature; if the temperature remains close to the evaporating temperature, action must be taken
    (see "S1-a" table 4)
  - during defrosting phases, the sensor must reach a minimum temperature; this temperature must be maintained for a certain period of time
    (see "S1-b" table 4)

- danger of icing of housing parts, fan and cold store ceiling due to missing sensor 2 at cold store temperatures < 0 °C
- in case of ice formation on unheated surfaces, the following measures must be carried out (in compliance with the specifications sensor 1):
  - limit condensing temperature to < 15 °C
  - hot gas temperature < 50 °C if possible
  - cycle the supply of hot gas, or reduce the condensing temperature, in order to limit the air temperature in the housing to max. +12 °C
  - different settings between summer and winter months if required
- increased maintenance likely, therefore 2 sensors are preferable

3.2 Defrost control

(figure 5 & figure 6):

table 2: Defrost control

Action	Duration [min]	Check
Closing the valves - Refrigerant supply	-	
Fan run down - Refrigerant extraction (Pump Down)	10… 20	S1-a
Fan shutdown	-	
Initiate hot gas defrosting via tray and block	20…30	S1-b S2-a
Dripping phase	1…2	
Open valve refrigerant supply; freezing phase	1…2	
Start fan	-	

Time specifications increase under the following conditions:

- flooded evaporation
- large evaporator
- low condensing temperature hot gas
- high efrigerant charge due e.g. long rising suction lines

Testing defrost sensors:

table 3: Testing defrost sensors

Sensor	Check	Consequence if chek is not succsessful
S1-a	Temperature at sensor 1 must reach approx. the cold store temperature (or be significantly above the evaporating temperature), otherwise liquid refrigerant is still present is still present in the evaporator	Output error message and shutdown □ Acknowledgement may only be made on site (not via remote access) after checking the evaporator; further measures: – Extend fan overrun – Check valve refrigerant inlet for tightness – Check design of suction line, if necessary check refrigerant returning (Figure 7)
S1-b	Temperature at sensor 1 must reach > + 5 °C for at least 10 min, otherwise complete defrosting is not guaranteed.	Output error message and shutdown □ Acknowledgement may only be made on site (not via remote access) after checking the evaporator; further measures: – Extend fan overrun – Check valve refrigerant inlet for tightness – Check design of suction line, if necessary check refrigerant returning (Figure 7) – Extend defrosting time – Observe temperature of sensor 2 – Check line regulation
S2-a	Temperature at sensor 2 should not exceed + 12 °C, otherwise check condensing temperature of hot gas or reduce condensing temperature of hot gas.	Output warning message when the temperature of sensor 2 is exceeded; monthly check of icing on the evaporator.