



**TECHNICAL MANUAL**

We care about healthy air

## **Modular air handling units**

Connection, start-up and  
commissioning manual

# Connection, start-up and commissioning manual

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## 1 General

- Prior to performing any work on the unit, please study the connection, start-up and commissioning manual.
- Please note, that some components from sub-suppliers, such as fans, filters, recuperators, etc. are equipped with additional commissioning instructions, which are enclosed inside the section (Figure 1), where the component is installed. Please ensure that all instructions are removed from the inside of the air handling unit before start-up.



Figure 1

## 2 Warnings & Tips

- The air handling unit may only be commissioned by trained personnel, who must observe engineering standards and local safety regulations.
- The air handling unit must only be used for the purpose and under the operating conditions specified in this manual and the technical sheets, generated by the selection software AirCalc++.
- The unit manufacturer shall not be held liable in case of failure to observe the information provided in the instructions or in cases of alterations of electrical or mechanical unit components without prior approval by the manufacturer.
- During operation ensure that the safety chain on the fan section door is secured (Figure 2).

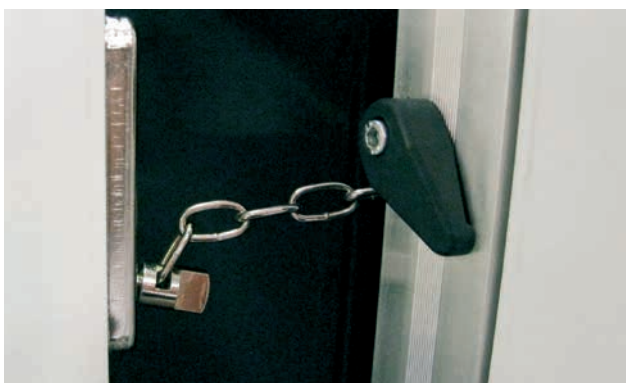


Figure 2

- The overpressure doors and de-mounting service covers are attached to the housing by blocators. To remove / attach the blocators use imbus key size 4 (Figure 3).



Figure 3

- **CAUTION:** Depending on the working medium, the heater connection piping and the collector and distribution manifold may reach high surface temperatures; do not touch these surfaces when working close to the heater, wear personal protection (leather gloves), or stop the air handling unit, shut off the supply of hot water and let the heater and the piping cool down prior to performing any work.
- Please observe the hazard warning signs (Figure 4).



High voltage



Machinery pinch points

Figure 4

## 3 Functional sections

### 3.1 Fan section

- The following procedure is applicable for belt driven fans or plug fans.

#### 3.1.1 Electric motor connection

- Prior to commissioning, check the conformity of the connection parameters specified on the electric load nameplates or in wiring plans of the electrical control cabinet with the site parameters of the electrical network.
- The electric motor connection must be carried out in accordance with the electric design specifications and following the electric motor manufacturer's instructions. The instructions may be found either inside the connection box for the motor, or attached to the motor's casing.

- The electric motor grounding is already prepared in the factory and stated in the wiring diagram (Figures 5, 6, 7).

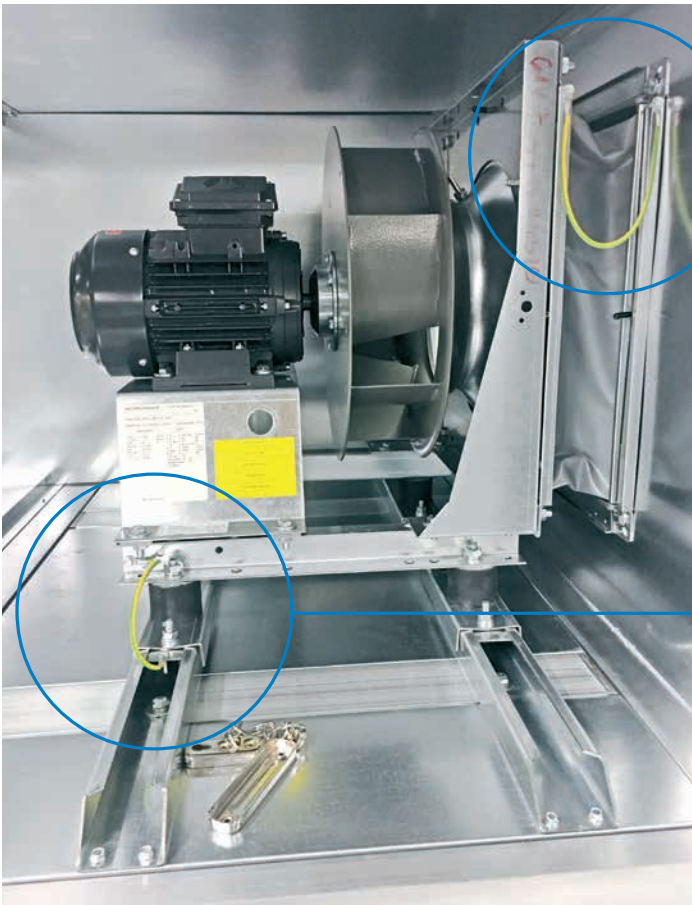


Figure 5



Figure 6

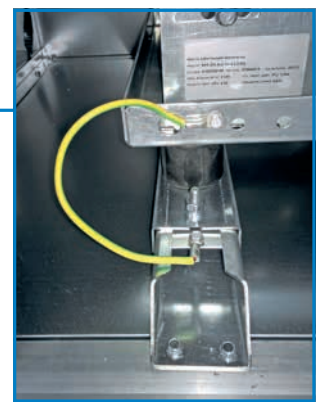


Figure 7

### 3.1.2 Commissioning and testing

- Prior to checking the correct fan installation and operation, switch off the repair switch of the fan section and lock it in the off position to disconnect the power supply from the drive electric motor.
- **IMPORTANT:** Prior to start-up of the fan, remove the mechanical blocker from the vibration insulators, if not already done during assembly.
- Blocks may be wooden (Figure 8) or red coloured steel joint brackets (Figure 9) screwed on the bottom to the housing frame and on the top to the fan-electric motor assembly section.

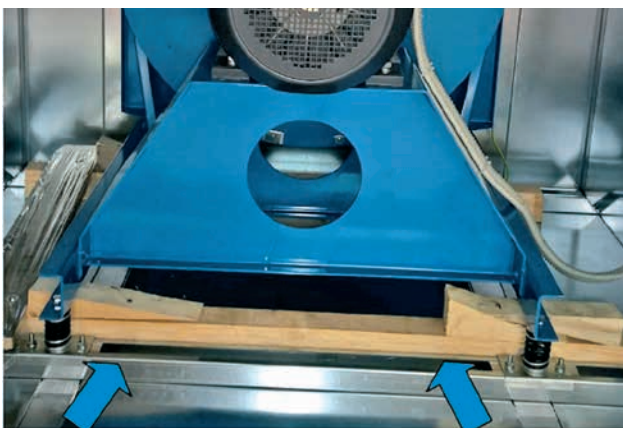


Figure 8

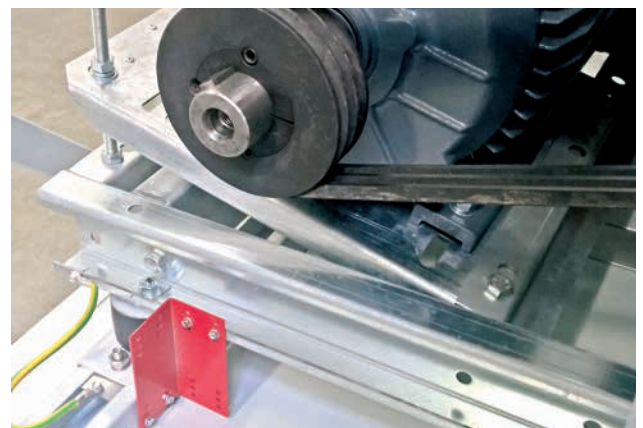


Figure 9

Check list prior to commissioning plug fan	Checked
Check for gap between rotor and cone – see fan manufacturer’s instructions	
Check for uninterrupted rotation in the housing	
Check the vibration insulator	
Check for correct grounding	
Check for correct electric connections and their function according to the wiring diagram	
Remove any tools or other materials in the housing	
Close and fasten all covers and doors	

Check list prior to commissioning belt driven fan	Checked
Check the fastening of the fan and motor to the baseframe	
Check the belt tension	
Check that the electric motor and fan shafts are parallel	
Tension the belt – if required	
Check the vibration insulator	
Check for correct grounding	
Check for correct electrical connections and function according to the wiring diagram	
Remove any tools or other materials from the housing	
Close and fasten all covers and doors	

- By briefly switching the motor on, check for correct rotation direction of the fan impeller. The impeller must rotate in the direction of the arrow on the fan housing (Figure 10). In case of incorrect rotation direction, interchange two phases on the contactor terminals.
- Following start-up, the fan should operate at all loads free of vibrations and noise. If it does not, stop the fan and search for a solution.
- The air handling unit is equipped with measurement nipples (6 mm tube) from the fan inlet cone to outside of the unit’s panel for airflow measurement (Figure 11). The nipples are intended for use with differential pressure and/or flow meters (U-tube type).

Air flow can be calculated according to:

$$V = K \times \sqrt{\frac{2}{\rho} \times \Delta p}$$

V ... air-flow [m³/h]

K ... calibration factor [m²s/h]

p ... density of air [kg/m³]

Δp ... pressure difference at cone [Pa]

The calibration factor is stated in the fan supplier’s instructions or on the fan type plate.

 positive pressure side connection


 negative pressure side connection



Figure 10

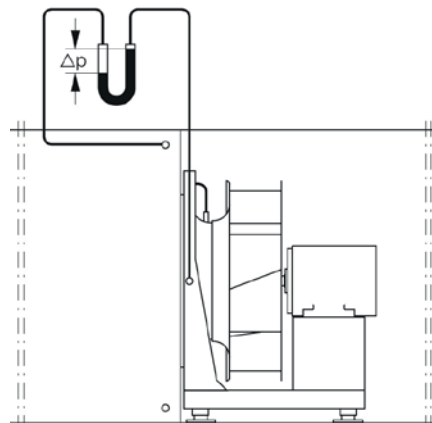


Figure 11



### 3.2 Heater section with water heater

#### 3.2.1 Connection

- As standard, pipes from the heating coil are accessed from outside the casing. Be careful not to run any piping in front of doors to be opened and in a way that withdrawal of components can still be performed.
- The connection of the heating circuit piping is done by means of threaded (Holland) nuts, acc. ISO standard 68-1,
- When tightening threaded joints, apply counterforce with an appropriate tool (pipe wrench – padded), to avoid damaging the heater piping circuit (Figure 12).
- Optionally, the coils may be supplied with flanges (and counter flanges) mounted on the coil.
- When arranging the two piping connections to the water heater observe the air flow direction, so that the air inlet to the heater is closer to the return pipe, to ensure medium/air counterflow, see also red/blue arrows on the casing (Figures 13, 14, 15).

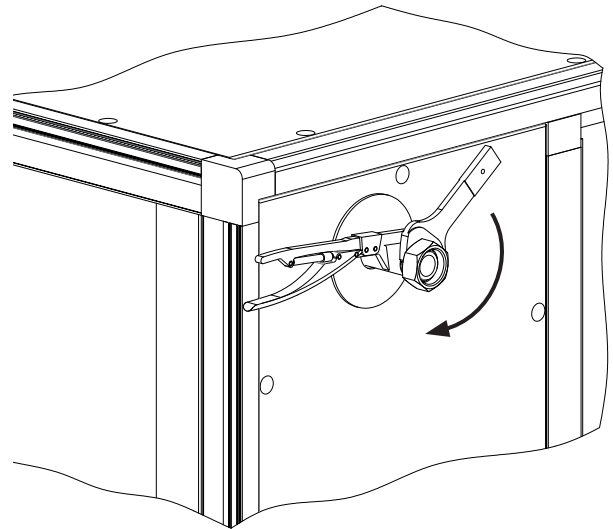


Figure 12



Figure 13



Figure 14





HEATING FUNCTION		COOLING FUNCTION	
MEDIUM ENTRY RED COLOUR	MEDIUM EXIT BLUE COLOUR	MEDIUM ENTRY BLUE COLOUR	MEDIUM EXIT RED COLOUR
			

Figure 15

- The heating coils are already fitted with a bleeding valve and drain cock.
- **OPTION:** For outdoor installation of air handling units, an empty section connected to the heating coil can be supplied. In this empty section it would be possible to install a coil pipe connection and arrange valves, thereby protecting the system from freezing during winter.

- The heater connection piping is accessed inside the casing at the back (Figure 16). It may be necessary to dismantle the back panel to arrange the connection.
- Please ensure air-tight penetration of the air handling unit's casing when heating pipe connections are carried out on site. Penetration through a panel or floor of the air handling unit is shown in Figure 17.

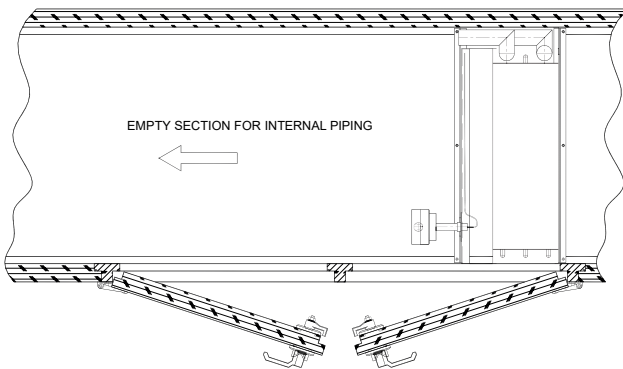
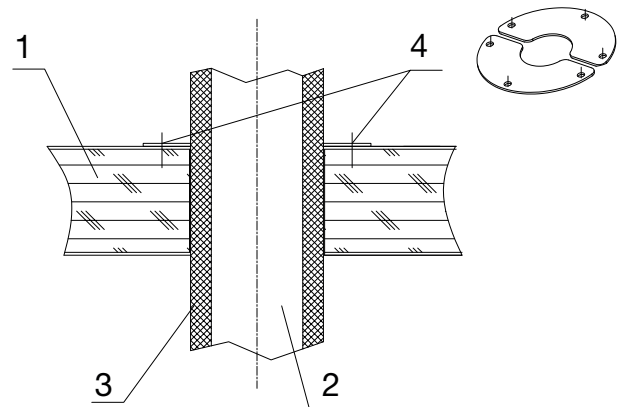


Figure 16



1 - Panel, 2 - Pipe, 3 - Insulation, 4 - Half-flange (2 pcs)

Figure 17

### 3.2.2 Overheating protection

- Check medium temperature. When applying a high temperature heating medium (water above 70 °C), the electric motor must be protected against overheating by means of an automatic shut-off of the heating medium supply. The fan must remain in operation for a certain period after the shutdown (3 to 5 minutes).

### 3.3 Antifreezing protection

- Lindab offers two different solutions for antifreezing protection, as listed below.

#### 3.3.1 Antifreezing protection on the airflow side

- The protection of the heater against freezing consists of an air flow thermostat with a capillary installed in a separate section on the “warm” side of heater. The capillary and thermostat are fixed onto a removable frame (Figure 18).
- In outdoor units the thermostat is mounted inside the air handling unit's housing.
- Check that the air flow thermostat is set to 5 °C.

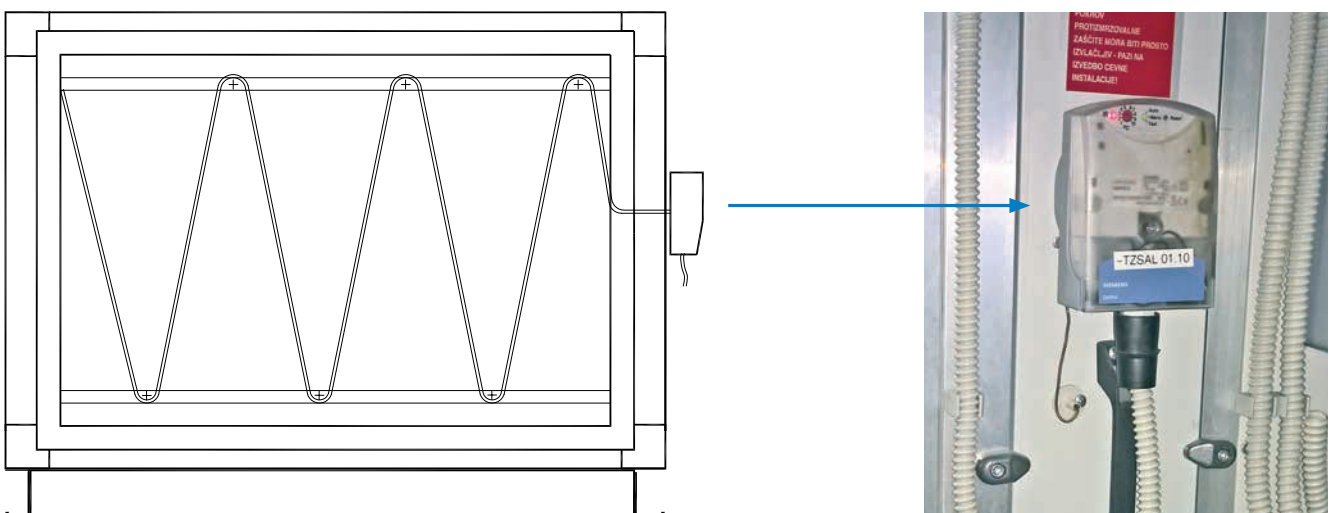


Figure 18

### 3.3.2 Antifreezing protection on the waterflow side

- The coil is prepared for mounting of a medium flow thermostat in a connection tube. It is to be mounted inside the connection tube in the heating coil (Figure 19).
- The temperature sensor delivery is part of the control system. The control system will protect the heater against freezing.
- Check that the medium flow thermostat is set to 14 °C.

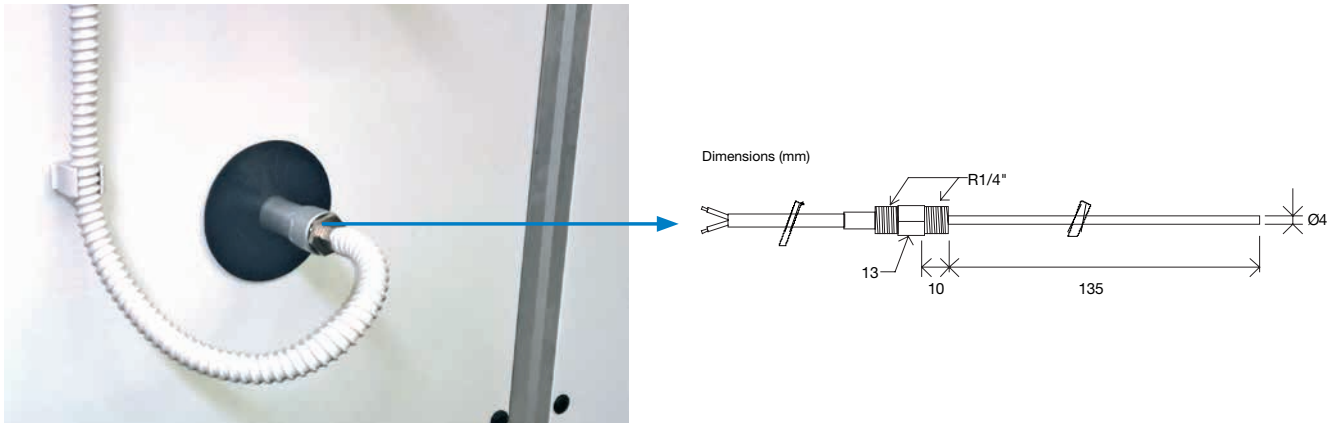


Figure 19

### 3.4 Heater section with steam heater

#### 3.4.1 Connection

- **NOTE:** For proper steam heater function, always provide dry saturated steam at the inlet.
- When connecting the steam heater, ensure a tight connection.
- Connect the steam supply line on the top, inclined towards the heater. The connected pipes should allow for thermal expansion of the heater.

### 3.5 Heater section with electric heater

#### 3.5.1 Connection

- Connection of the electric heater must be performed by a properly qualified electrician, in conformance with local applicable regulations.



**WARNING:** Electric heating coils are connected to a 1x220 V or 3x380 V power supply. During operation the surface temperature of the heater may reach 350 °C.

#### 3.5.2 Operation check

- The electric air heater must only start with the fan already running, and with an adequate air flow volume.
- After the heater has switched off, the fan must continue to operate for 3 to 5 minutes in order to cool the heater coils.
- The electric air heater is not water-tight; hence the electric heater section must not be installed so as to be exposed to water or steam.
- See also the heating coil manufacturers's instructions and wiring diagram, located inside the heater connection box.

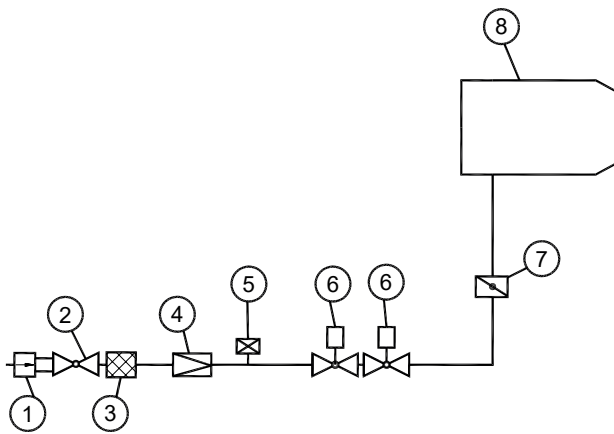
### 3.6 Heater section with indirect gas heater

- Connection to the gas supply and burner commissioning must be carried out by authorised and qualified personnel, following the gas burner manufacturer's instructions, design specifications and regulations.
- Gas valve train – diagram (Figure 20):

#### 3.6.1 Connection and commissioning

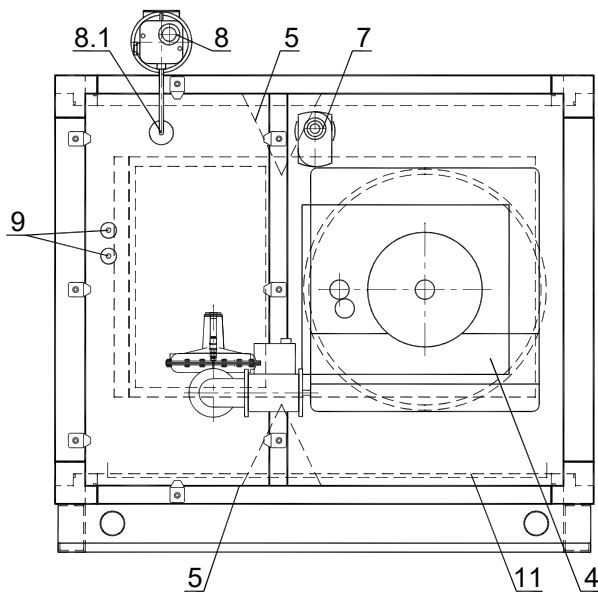
- An indirect gas heater section must always be located in the positive pressure part of the air handling unit – in order to prevent mixing of the supply air and flue gas, in case of damage to the heat exchanger.



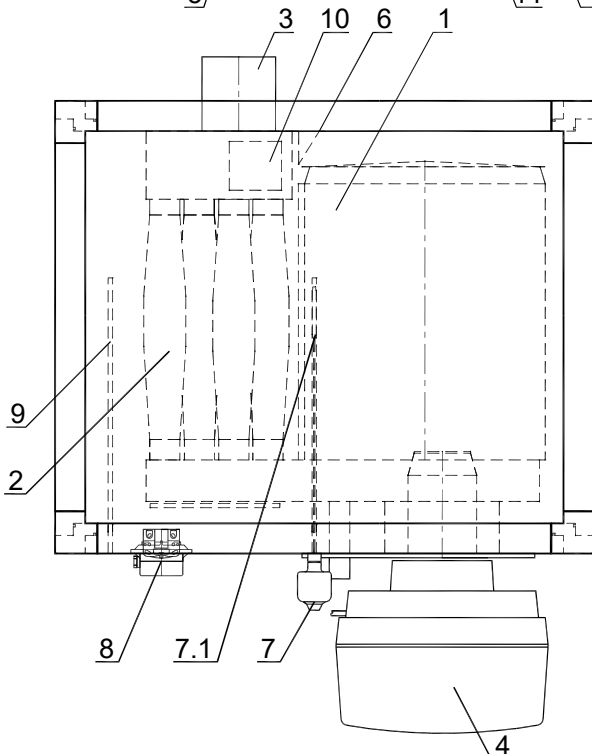


1. thermal guard
2. shut-off cock
3. gas filter
4. gas pressure controller
5. gas pressure switch
6. gas solenoid valve
7. gas throttle damper
8. gas burner

Figure 20



1. combustion chamber
2. tubing register
3. connection to stack
4. gas burner with continuous control of thermal output
5. air flow director between the ceiling and the heater, and the bottom and the heater
6. air flow director between the back panel and the heater
7. safety thermostat – set to 80°C, and safety temperature limiter – set to 90°C
- 7.1 safety thermostat and safety temperature limiter sensors
8. differential pressostat – range to 500 Pa
- 8.1 measuring tube – pressure pickoff
9. sensor entry sleeve (400 mm length)
10. condensate drain from the heater tube register collection chamber
11. pan with floor drain



- The differential pressostat (Figure 21, Pos. 8), safety thermostat and temperature limiter, and the operation thermostat (Figure 21, Pos. 7) must be installed on the outside of section housing. If installing the unit outdoors, insulate it, complete with the burner, by means of a water tight and thermally insulated protection chamber.
- The gas burner must be mounted on the combustion chamber opening from the outside of the section housing. Apply the flange, which is provided to suit the type and size of gas burner.
- With indoor installation type air handling units, always ensure adequate combustion air volume, natural ventilation of the machine room, and flue gas exhaust.
- If installing the air handling unit outdoors, construct a watertight and thermally insulated protection chamber for the burner, fitted with a free opening at the bottom, for the supply of combustion air. The protection chamber must be large enough to also accommodate

Figure 21

the safety pressostat, safety thermostat, temperature limiter and the operation thermostat. The chamber must be spacious enough (to the left and right of the gas burner) for installation of the gas train.

- Consult a competent chimney sweep service with regard to the design of the flue gas exhaust. If the unit is ordered complete with stack, the stack must be sized and constructed in compliance with applicable regulations, laws and standards. For the purpose of acquiring consent from the fire service, a stack design file is required, which must specify the draining and neutralisation of the flue gas condensate.
- The gas burner connection to the stack must be in accordance with the requirements applicable to gas fired systems. The stack connector to the stack joint must be water-tight, to prevent any uncontrolled leakage of condensate to the environment, in case of flue gas condensation.
- No laying of electric cables inside the section housing is allowed. If installing the air handling unit outdoors, the gas burner protection chamber may be used for the laying of electric cables, provided that the cables are laid so as not to obstruct the servicing of the section; or the cables may be laid on the free outside surface (back panel, bottom etc.), in consultation with the designer/customer.
- Arrange the gas supply train so as not to obstruct the servicing of functional sections and to allow the drawing out of any functional element from the A/C unit housing when required.
- For a gas heater section, the design file must specify a natural air connection (for the purpose of cooling)

between the section interior and the environment. The top or side opening must be fitted with a drive and spring louvre and connected, through a duct, to the building environment. The louvre and the duct must be fitted with thermal insulation of incombustible material. In the event of a mains power outage or any other failure that interrupts the cooling of the section, the louvre must open and thus ensure natural cooling of the gas burner.

- The seal between the frame and the panels of the left and right adjacent sections, and the sealing of contact joints between the left and right adjacent sections and the gas heater must be provided by means of a ceramic fibre sealing tape 19 x 5 mm, temperature resistant in the range -20 to +1200°C. If sealing with putty, apply a high temperature resistant glue-seal material with a temperature resistance range -40 to +250 °C (short term, +300°C).
- All the electric cables laid inside the housings of the right and left sections adjacent to the gas heater section must be high-temperature resistant and insulated. The same applies to cable sleeves and protection tubes.
- To equalise the potential of the fan upstream of the gas heater, apply an uninsulated Cu lead.
- The volume flow rate of air passing the combustion chamber and across the coil set must never be allowed to fall below the minimum value required for the cooling of the heat exchanger walls. To ensure this, carry out the following checks prior to commissioning of the section:

Prior to commissioning, check for	Checked
the installation and operation of the thermostat provided to monitor and maintain the heat exchanger outlet air temperature within the 50 °C to 60 °C range	
the installation and operation of the electric motor drive and its limit switch of the louvre, which in an event of mains power outage or any other failure leading to overheating, opens and thus ensures natural cooling of the gas burner	
the motor drive limit switch actuated shut down of the gas burner, and disabling of its operation in the event of 80% closure of the louvre, controlling the cooling air flow through the heat exchanger	
the installation and operation of the safety air flow rate gauge provided to shut down the gas burner in the event of inadequate air flow across the heat exchanger	
the operation of the pressure switch provided to shut down the gas burner in the event of exceeding positive pressure in the combustion chamber	
the installation and operation of the protection thermostat provided to automatically shut down the gas burner in the event of an air temperature in the chamber above the heat exchanger exceeding approx. 70 °C	
the installation and operation of the protection thermostat (limiter) provided to shut-down and disabling of the gas burner in the event of an air temperature in the chamber above the heat exchanger exceeding approx. 90 °C; re-ignition of the gas burner must be possible only upon manual reset	
the installation and operation of the time relay that prolongs the running of the supply fan for a period after the switching off of the gas burner	
the tightness of the heat exchanger and flue gas exhaust installation	

### 3.6.2 Operation check

- The gas burner operates properly down to -15 °C, ambient temperature. At lower temperatures please ensure the proper protection of an insulated cabinet.

## 3.7 Humidifying section with steam humidifier

### 3.7.1 Connection and commissioning

- In case of on site installation of the steam distributor, observe the instructions provided by the manufacturer of the steam distributor.
- Ensure that an adequately sized siphon is installed in the condensate collection pan drain line. See also the separate Transport and Assembly Manual for Lindab air handling units.

### 3.7.2 Operation check

- The steam generation water supply must meet the minimum quality criteria for potable water.
- The air-conditioning unit control system must operate the unit so as to keep the relative humidity in the air-conditioning system below 90%.
- The steam humidifier must only start upon the establishment of adequate air velocity and temperature.
- The steam humidifier must shut down 3 to 5 minutes before the fan stops.

## 3.8 Humidifying section with contact humidifier

### 3.8.1 Connection and commissioning

- For commissioning observe the instructions provided by the manufacturer of the contact humidifier.
- The supply water must meet the minimum quality criteria for potable water.

### 3.8.2 Operation check

- Check that the water supply is within the parameters given in Table 1.
- Check water quality.

Supply water requirements		
	Circulation water	Direct water
Minimum pressure	500 kPa	150 kPa
Maximum pressure	1000 kPa	1000 kPa
Temperature	0 °C – 40 °C	0 °C – 40 °C

Table 1

## 3.9 Humidifying section with high-pressure humidifier

### 3.9.1 Connection and commissioning

- Observe the instructions provided by the manufacturer of the high-pressure humidifier.

### 3.9.2 Operation check

- The supply water must meet the minimum quality criteria for potable water.
- Check that the water quality meets the required water values, stated in Table 2.
- The high-pressure humidifier must shut down 3 to 5 minutes before the fan stops.

Parameter	Symbol	Unit	Limit values	
			Min	Max
pH	pH		6,5	8,5
Specific conductivity (at 20°C)	σR, 20°C	μS/cm	0	50
Water hardness	TH	mg/l CaCO <sub>3</sub>	0	25
Current water hardness		mg/l CaCO <sub>3</sub>	0	15
Total amount of dissolved substance	cR	mg/l	(*)	(*)
Dry residue at 180°C	R180°C	mg/l	(*)	(*)
Iron + manganese		mg/l Fe+Mn	0	0
Chlorides		Ppm Cl	0	10
Silicon dioxide		mg/l SiO <sub>2</sub>	0	1
Chlorine ions		mg/l Cl	0	0
Calcium sulphate		mg/l CaSO <sub>4</sub>	0	5

Table 2

### 3.10 Cooling section with water cooler

#### 3.10.1 Connection

- Connection of the water cooler will be performed in a similar manner as connection of the heating coil. See chapter 3.2 Heater section with water heater.
- Water coolers are supplied with a fitted bleeding valve and drain cock.

#### 3.10.2 Antifreezing protection

- If the unit is shut down, always drain the cooler to avoid its freezing. Alternatively use a fluid frost protected with glycol and water mixture.

### 3.11 Water droplet eliminator

- Check the water droplet eliminator for proper installation, and check for damage.
- Ensure unimpeded withdrawal from the air handling unit's housing.

### 3.12 Cooling section with direct expansion coil (DX)

#### 3.12.1 Connection

- Connection of the DX cooling system may only be carried out by a qualified person.
- The most common pipe connection methods are soldering and fast joints.
- The cooling section with a direct expansion coil (DX) is mounted inside the casing, while the connections are accessed from the outside - see Figure 22.

- 1 – refrigerant distributor;
- 2 – capillary;
- 3 – inlet piping;
- 4 – outlet piping

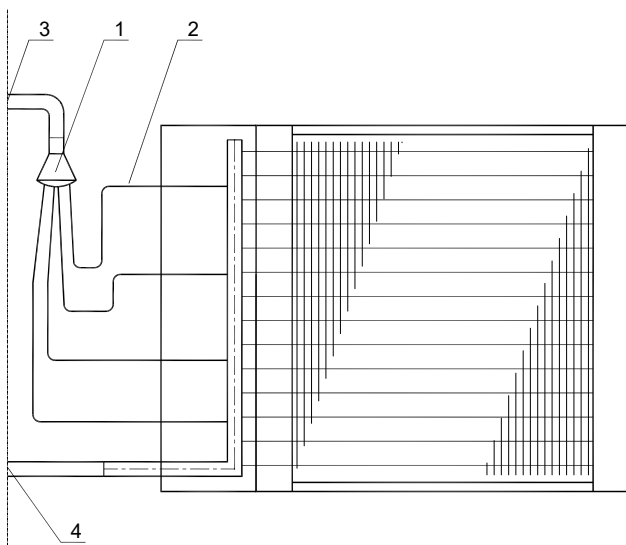


Figure 22

### 3.13 Dampers

#### 3.13.1 Connection

- Ensure that the duct connection on the damper is airtight. Also check for a 90° rotation of the damper.

### 3.14 Filter section

#### 3.14.1 Installation of panel filters

- Panel filters are usually installed in the factory. If not, install the panel filters through the door opening. Then push the profile into the locking position (Figure 23).

#### 3.14.2 Installation of bag filters

- Bag filters, if not already installed, should be inserted into the frame. They are supplied with the AHU in a separate box. The filters can be mounted from either the clean side or the contaminated side, depending on the application.
- From the clean side, mount the bag filter through the door opening. Then push the profile into the locking position – the same procedure is to be applied as for panel filters (Figure 23).
- From the contaminated side, the filter is inserted into the filter section and pressed against the frame seal. The filter is locked by a spring clamp fastener at each corner (Figures 24, 25).
- Check the connection of the pressure gauge tubes to the pressure measurement nipples on the external side of the housing and connect as required (Figure 26).

### 3.15 Metal filter section

#### 3.15.1 Installation

- Filters are factory installed into the frame.
- Prior to commissioning check the connection of pressure tubes to the pressure measurement nipples.

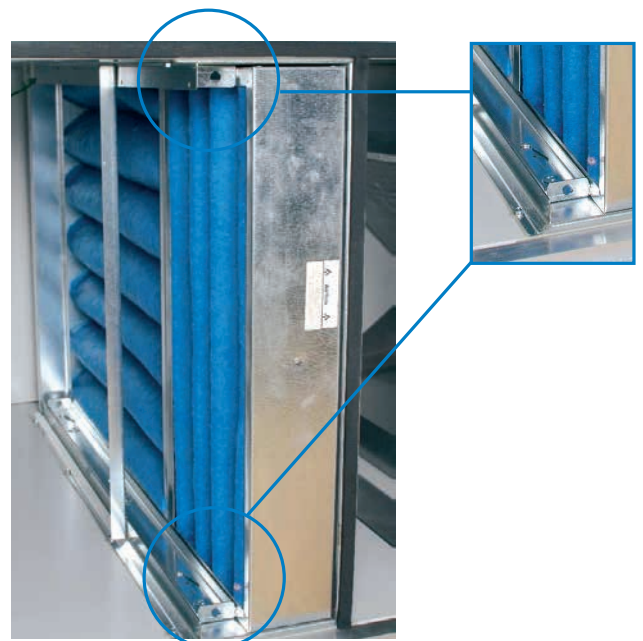


Figure 23

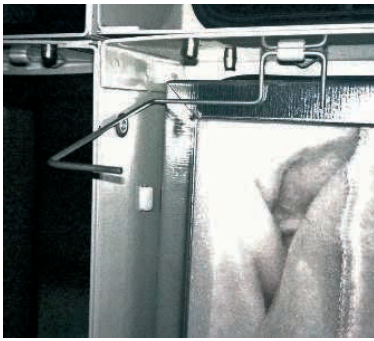


Figure 24

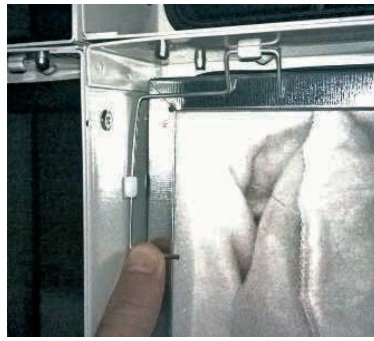


Figure 25



Figure 26

### 3.16 Active carbon filter section

#### 3.16.1 Installation

- The filters are mounted in the section through the open door. Filter cartridges are inserted into the base plate at the back of opening (Figure 27).
- Push and click the cartridge into the base plate, then turn it in the direction of the arrow on the cartridge for correct placement.
- Repeat the procedure to fill all the positions on all the base plates.

### 3.17 Absolute filter section

#### 3.17.1 Installation

- Absolute filters are always delivered separately, carefully packed in a protective box.
- The filter section includes an empty section to allow a person to properly access the space during filter tightening.
- Before inserting the filters check that the sealing tape along the filter frame is not damaged (Figure 28).
- Insert the absolute filters into the frame along the guide profiles (Figure 29).

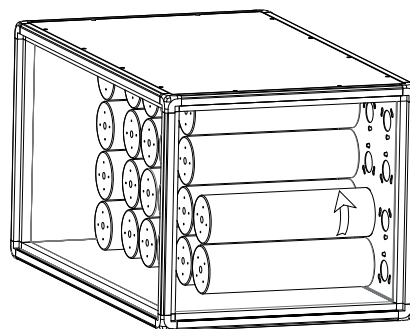
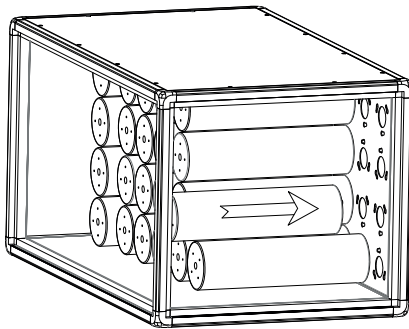


Figure 27



Figure 28



Figure 29

- Ensure that the sealing tape fits firmly against the section base frame
- Each filter frame cell is equipped with four fixing elements (Figure 30) at the corners.
- Stick the fixing elements (Figure 31) at the filter frame corners.
- Adjust the screw of each to ensure air-tight contact between the section base frame and the absolute filter. Recommended gasket compression is 50%.
- Prior to commissioning, check the connection of the pressure measurement nipples (Figure 26) to the pressure measurement points.

### 3.18 Fin recuperator section

- Description, connection and commissioning: see the document chapters
  - 3.2 Heating section with water heater and
  - 3.10 Cooling section with water cooler

### 3.19 Plate recuperator section – single or double

#### 3.19.1 Commissioning check

- Check for cleanliness of the drain pan and condensate outlet.
- Check for the correct opening and closing (0-90°) of the bypass damper.

### 3.20 Rotational regenerator section

#### 3.20.1 Connection

- Observe the manufacturer’s instructions for the motor and controller.
- If the height of the rotational regenerator housing exceeds 2.5 m, the regenerator is split and supplied to the building separately from the air handling unit housing. In this case, additional instructions for assembling the rotational regenerator are enclosed in the regenerator section.

### 3.21 Final adjustment of hinges

#### 3.21.1 Tools

- In order to ensure proper housing stability and airtightness the hinges have to be checked before start-up and adjusted if needed by using the following tools (Figure 32):
  - allen key No. 2.5
  - allen key No. 4
  - flat screwdriver

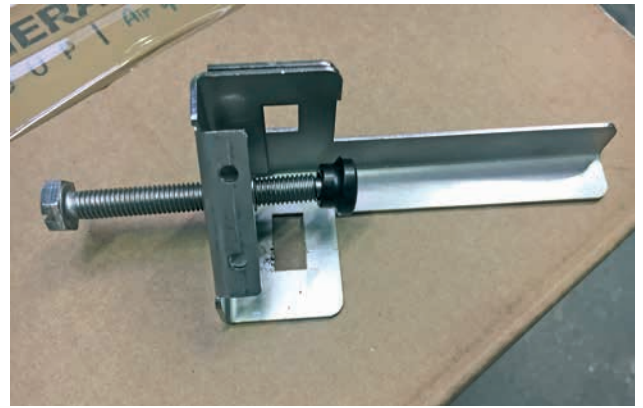


Figure 30



Figure 31



Figure 32

### 3.21.2 Vertical door position adjustment

- For adjusting the door position in vertical direction, adjust the screw in the lower part of the hinge as in Figure 33.
  - Loosen the screw (1)
  - Adjust the height (2)
  - Tighten the screw (1)

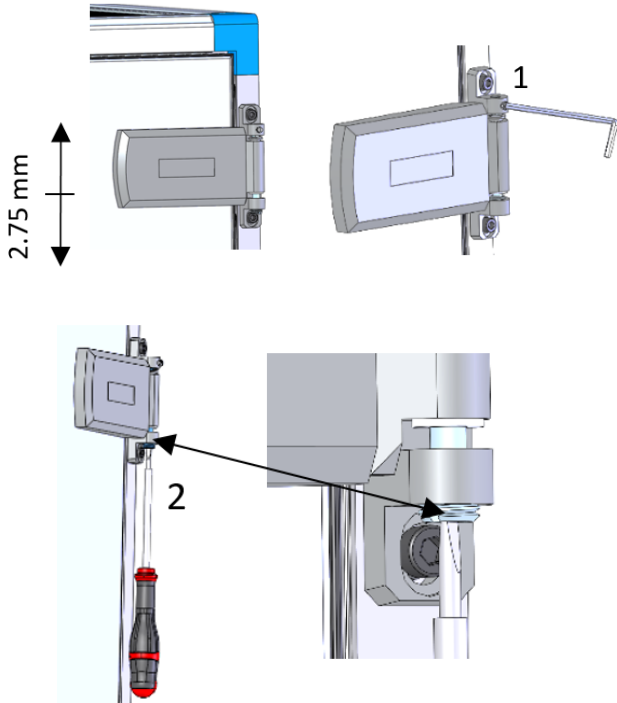


Figure 33

### 3.21.3 Horizontal door position adjustment

- Follow the steps in Figure 34.
  - Remove protective PVC cover from the hinge (1)
  - Unscrew screws (2)
  - Move the door panel in horizontal direction
  - Tighten screws
  - Place PVC cover back on the hinge (3)

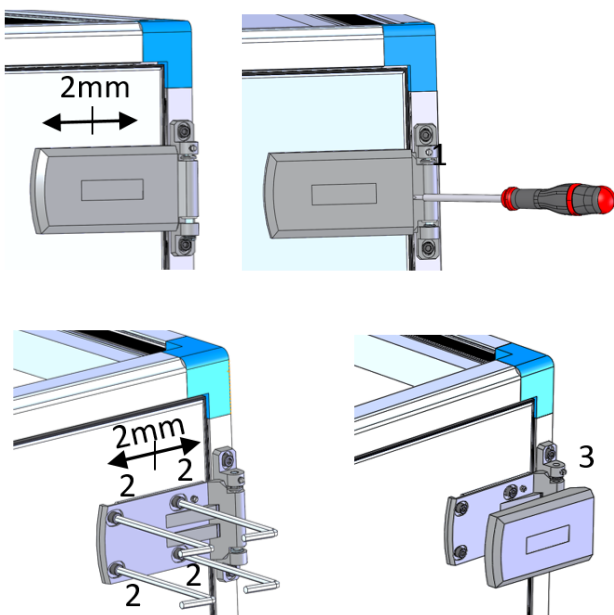


Figure 34

### 3.21.4 Door tightness adjustment

- In case the sealing is not fitted between door panel and housing with the optimum pressure to ensure tightness, proceed as shown in Figure 35.
  - Remove protective PVC cover from the hinge (1)
  - Loosen screws (2)
  - By loosening / tightening the screws adjust sealing (3)
  - Tighten screws (2)
  - Place PVC cover back on the hinge (4)

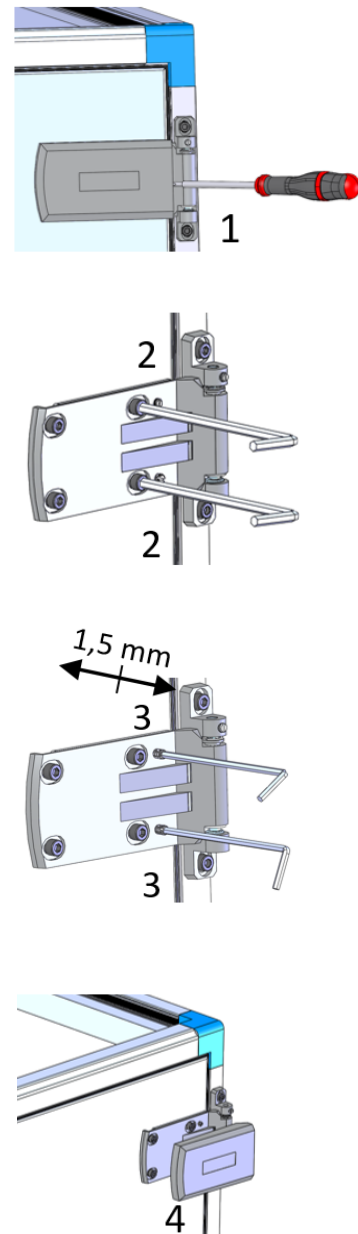


Figure 35

## 4 Start-up checklist

Section	Components	Check points	Start-up
<b>General</b>			
	All functions	Remove obstacles and loose debris	
	Doors / access covers / hinges	Close and lock before start-up, adjust hinges	
	Earthing	Ensure correct earthing	
	Roof (outdoor installation)	Check for complete water tightness	
	Duct connections	Check for complete air and water tightness	
<b>Fan</b>			
	Transport protection brackets	Remove transport brackets before start-up	
	Impeller	Check for the correct direction of rotation	
	Motor	Check for correct connection	
	Belt drive	Check the belt tension	
<b>Heaters</b>			
	Water heater	Check all connections	
		Frost protection thermostat must be connected	
	Electric heater	Check for heater earthing	
		Check for correct fuse size	
		Check for correct wiring	
	Steam heater	Check all connections	
<b>Humidifier</b>			
	Steam humidifier	Check connection and operation	
		Refer to the manuals supplied with the section	
	Contact humidifier	Check connection and operation	
		Refer to the manuals, supplied with the section	
	High-pressure humidifier	Check connection and operation	
		Refer to the manuals, supplied with the section	
<b>Coolers</b>			
	Water cooler	Check for correct connection	
	Droplet eliminator	Check for correct installation	
	Siphon	Check for correct siphon installation	
<b>Dampers</b>			
		Proper operation	
		Check for the 90° rotation.	
<b>Filters</b>			
		Correct installation of filters	
		Check for correct filter type and class	
<b>Rotational regenerator</b>			
	Rotor	Check for correct direction of rotation	
	Seal	Check for proper seal towards the rotary wheel	
	Drive	Check for correct electrical connection	
	Belt drive	Check the belt tension	
	Controller	Check for correct operation	
<b>Plate heat exchanger</b>			
	Damper	Check for correct operation	
	Siphon	Check for correct connection	
<b>Lighting</b>			
	Lamp	Check for correct connection voltage	
	Switch	Check the connection	





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