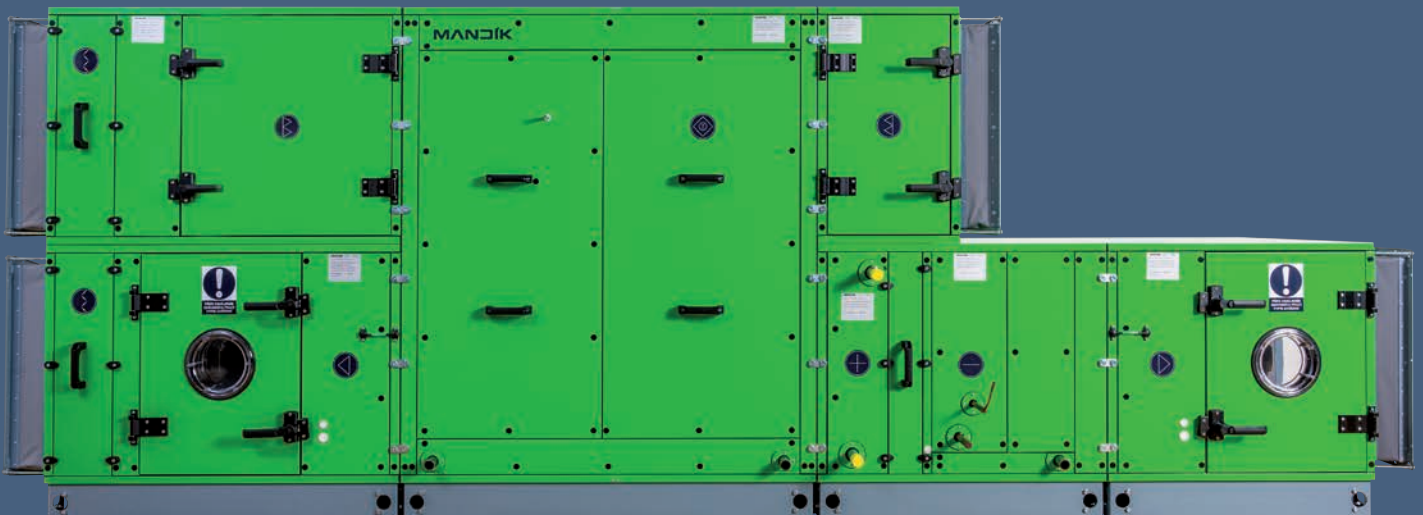


# AIR CONDITIONING UNITS MANDÍK



**MANDÍK®**



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# COMPANY PROFILE

Established in 1990, MANDÍK, a.s. is a pure Czech, family owned company. At present it is one of the most significant manufacturers of air-handling and firefighting components, air handling units and industrial heating systems. The company wins recognition on the European market above all by its focus on high quality, flexibility and services to support the delivered products. The current level of the company's technical ability is documented by supplies for subways, tunnels and nuclear power plants in many European countries.

The company observes the rules of quality management according to ISO 9001, KTA 1401, 10CFR50, and is a member of RLT, the German association of air-handling equipment manufacturers. The company has all the required certificates according to European standards, and has been certified by TÜV SÜD Industrie Service GmbH according to EN 1886.

In addition to the domestic market, the sales activities of MANDÍK, a.s. also cover a number of other European countries, where its products are delivered in collaboration with our foreign partners.

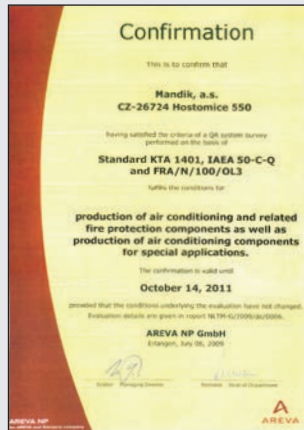
At everyday work the company places emphasis on environment protection and occupational safety. Observance of strict European environmental and OHS standards is a common rule, which is uncompromisingly required by the company management. The company contributes to environment protection also by operating its own renewable energy resources and by the widest possible use of energy-saving appliances.

**Our objective is maximum satisfaction of our customers, and last but not least creating comfortable working environment for our employees.**

## Certificates



ISO 9001



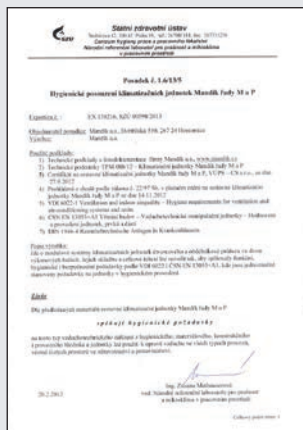
KTA 1401



10CFR50



Product certificate



Hygienic assessment



Membership of the RLT



Certificate TÜV SÜD

# 1. PERFORMANCE RANGE OF THE UNITS

- Performance range of the units according to ČSN 12 7001.
- Height of the foundation frame:
  - up to the size of M16/P16 – 120 mm,
  - up to the size of M20/P20 – 150 mm.

*Sizes of MANDÍK unit of M series – square cross-section*

size	size A x B [mm]	nominal flow of the air [m <sup>3</sup> /hour]
M2	550 × 550	2,000
M2.5	600 × 600	2,500
M3.15	650 × 650	3,150
M4	730 × 730	4,000
M5	800 × 800	5,000
M6.3	900 × 900	6,300
M8	1,000 × 1,000	8,000
M10	1,100 × 1,100	10,000
M12.5	1,200 × 1,200	12,500
M16	1,350 × 1,350	16,000
M20	1,500 × 1,500	20,000
M25	1,700 × 1,700	25,000
M31.5	1,900 × 1,900	31,500
M40	2,100 × 2,100	40,000
M50	2,300 × 2,300	50,000

*Size of MANDÍK unit of P series – rectangular cross-section*

size	size A x B [mm]	nominal flow of the air [m <sup>3</sup> /hour]
P4	1,100 × 550	4,000
P5	1,100 × 650	5,000
P6.3	1,100 × 730	6,300
P8	1,200 × 800	8,000
P10	1,350 × 900	10,000
P12.5	1,500 × 1,000	12,500
P16	1,700 × 1,100	16,000
P20	1,900 × 1,200	20,000
P25	2,100 × 1,350	25,000
P31.5	2,300 × 1,500	31,500
P40	2,600 × 1,700	40,000
P50	2,600 × 2,100	50,000

\* On customer's request, Mandík can deliver air conditioning units for air flow from 800 up to 100 000m<sup>3</sup>/h.

## 2. DESCRIPTION OF THE UNIT

### 2.1 Terminology

**Chamber** – metal box fitted with thermal insulation and in-built element for air treatment or an aggregate unit to be used for air transfer. You may set up compacts (or unit) by using several separated chambers.

**Air conditioning unit** – the unit resulting from chamber assembly; it is intended for treatment and transport of the air (hereinafter referred to as the unit). Individual chambers may be assembled by using connection elements, then it is possible to create special design according to customer's requirements.

**Supporting frame** – the installed structure with the height of 120 mm, or also 150 mm, which includes a separated chamber or compact block.

**Adjustable foot (leg)** – component mounted to the base frame of the chamber, allowing to eliminate minor roughness of the base (alignment of the unit in horizontal position).

**Supporting leg** – component mounted to the base frame of the chamber. It allows to increase the overall height of the unit by the maximum of 600 mm.

**Solid panel** – supporting element of the chamber providing its walls and sheathing.

**Service panel** – removable panel which is fitted with closing elements and handles.

**Assembly panel** – removable panel attached with bolts.

**Doors** – panels fitted with closing elements and hinges.

### 2.2 Use and working conditions

Air ventilation and air conditioning units of MANDÍK, series M (square cross section) and P (rectangular cross section) are intended for central distribution and treatment of the air in venting and conditioning systems. The air transferred by the unit must be absolutely free of mechanical impurities and gaseous additives that could result in clogging of the built-in elements or corrosion of material the unit is made of. The units are intended for the non-explosive environments, with the ambient temperatures ranging from -30 °C

to +40 °C. The outdoor units are fitted with the elements or construction measures which allow location in the outdoor environment (e.g. shelters, flaps inside chambers).

The units must be placed on a solid horizontal surface to which they have to be firmly anchored. It is advisable to place buffer material (rubber, cork) under the base frame of the unit, at the place of installation. There shall be free space on the side of the operator, according to the type and size of units (see the installation and operation regulations).

### 2.3 Parameters of the unit's sheathing

Thickness of the sheathing panels: 50 mm

**Parameters of the unit's sheathing in accordance to ČSN EN 1886. Tests carried out in laboratory: TÜV SÜD Munich:**



Class of mechanical strength of the sheathing: D1 (M)

Class of sheathing thickness: L1(M)

Tightness of filters: < 0,5 % – F9 (M)

Heat insulation of T3: (when using the standard unit of insulation with a density of 50 kg/m<sup>3</sup>)

Thermal bridges: TB2

Downturn in the casing zone:

Hz:	125	250	500	1000	2000	4000	8000
dB:	15,8	23,6	31,3	37,3	39,5	39,7	43,2

### 2.4 Description of the structure

The chambers are assembled by using the separated sandwich-type panels made of steel galvanized metal sheet with the thickness of 0.8 mm – Z275 EN10346. The panels are interconnected by screws. Upon special request, we can use stainless steel metal sheet (AISI 304, ČSN 17240) or lacquered metal sheet with any colour tone, according to the scale of RAL. The panels are filled with thermal and acoustic insulation. There are service, assembly or door panels fitted on the service side of the unit, according to the type of chamber. Sealing between the panels is per-

formed by self-sticking EPDM sealing with closed pores. In standard versions, chambers are placed on a galvanized base frame. Upon request, we can supply adjustable feet or fixed feet made of galvanized steel.

Discharge and suction openings of the units are fitted with elastic inserts of standard sizes to provide connection to the pipelines.

There are no materials containing silicone used in the whole structure of the unit.

## 2.5 Servicing side of the chamber and side of connecting necks of the exchangers and drain of the condensate

Servicing side of the chamber is the side on which the service doors or removable panels allowing access to the chamber for inspection, maintenance or installation; or other elements used to operate the unit (e.g. MaR devices) are located. It is being determined by looking in the direction of the air stream as right, left, top or bottom. Interconnecting the chambers may result in a unit having the same side of the operator as a whole, or some chambers

in the unit or parts of the unit that may have different side of operation. A side used for connection of exchangers and discharge of condensate is the side on which necks of exchangers are located (or condensate discharges). It is being determined by looking in the direction of the air stream as right or left. The side of exchangers connection and condensate discharge may and need not be identical to the side of operation.



Fig. 2.5.1: Servicing side of the unit

## 2.6 Accompanying technical documentation includes the following items:

- installation and operation regulations,
- declaration of conformity,
- diagram of the unit,
- technical information – installation and operating regulation of gas burners (if the burner is supplied in the delivery), installation and operating regulation of moistener (if supplied in the delivery),
- installation of MaR system (if supplied in the delivery of MaR) and a wiring diagram.

## 2.7 Standards

- EN 13053 – Ventilation of buildings – Air conditioning units – Evaluation and implementation unit's elements and parts
- EN 13779 – Ventilation of residential buildings – Basic requirements for ventilation and air conditioning equipment.
- EN 1886 – Ventilation of the building – Duct elements – Mechanical properties
- VDI 6022 – Ventilation and quality of indoor air – Hygiene requirements for ventilation and air conditioning systems and equipment

## 3. TRANSPORT, HANDLING, STORAGE

3.1 The units are transported as individual chambers or compact blocks. Roofs for the outdoor units are supplied as pre-assembled together with the unit.

3.2 Units are supplied as packed ones in plastic foil; larger chambers and units intended for export are placed and wrapped on pallets. Ways of packaging may be consulted individually.

**WARNING:** Plastic foil is a transport packaging material intended for protecting the chambers during transport. They must not be used for long term storage of the chambers. Any changing temperature during transport can result in condensation of water vapours inside the package and consequently there may occur conditions suitable for corrosion of materials used on the chambers (e.g. white rust on the galvanized elements). Therefore it is necessary to remove this transport wrap immediately after finishing the transport in order to allow air coming to the chambers and in order to allow drying of the surface of the chambers.

3.3 During transport and movement, the individual chambers must only be transported by using forklifts or conveyor belts. It is necessary to comply with the relevant safety regulations (ČSN ISO 8792). Chambers may only be lifted up from the bottom side. When lifting them by a crane, you must use belts which are put under the unit. Regarding larger items, you should strut their belts at the top side to prevent the chambers from deformation. When using a forklift, chambers should be supported across the width to prevent the chamber bottom side from getting damaged.

3.4 When taking the product over, it is necessary to check whether the product has been delivered in design and scope agreed and whether it has not been damaged during transport. If it was damaged during transport, then the transferee must record the extent of the damage while using a delivery note of the carrier. Failure to do so may result in risk of rejection of any reclamation claim for damage caused by the transport.

3.5 Units should be stored in dry, dust-free areas which are protected against rain and snow and whose ambient temperature never drops below +5 °C. They must be protected against mechanical damage, contamination and corrosion caused by continuous condensation of water vapour on the surface.

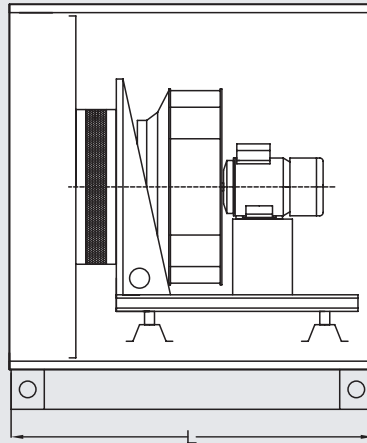


# 4. TYPES OF BUILT-IN UNITS USED

## 4.1 FAN CHAMBERS WITH FREE IMPELLER

They are used for air transport in the unit and in the attached ventilation pipeline.

*View from the side of servicing staff*



size	length of the chamber L [mm]	size	length of the chamber L [mm]
		P1	725
M2	760	P2	725
M2.5	760	P2,5	740
M3.15	840	P3,15	835
M4	840	P4	835
M5	950	P5	840
M6.3	950	P6.3	840
M8	1,100	P8	950
M10	1,100	P10	950
M12.5	1,180	P12.5	1100
M16	1,210	P16	1130
M20	1,400	P20	1220
M25	1,400	P25	1400
M31.5	1,740	P31.5	1420
M40	1,740	P40	1740
M50	1,880	P50	1740

### Design

- The fan impeller with backward curved blades (fitted with a hub) is attached directly on the motor shaft.
- The impeller is statically and dynamically balanced (intensity of vibration is lower than 2.8 mm/s, according to DIN ISO 14694).
- Fans with the motor are stored on common frame which is secured to the casing of chamber via the vibration isolators.
- Access to the fan's aggregate unit is allowed through the servicing door.
- Probes for measuring static pressure.
- Motor is controlled by a frequency inverter, protection IP20 – inverter attached.
- The motor includes PTC thermistor.

### Non-standard equipment (according to customer's requirements)

- Chamber lighting system
- Service visor
- Service switch
- Protective perforated cover behind the servicing door
- Frequency converter with protection IP54
- Motors with higher thermal resistance
- Thermocontact

### Design recommendation

- Due to the thermal resistance of the electric motor, the temperature of air transported through the fan must not exceed +40 °C
- The electric motor must be controlled by a frequency converter of the rotation speed, due to ensuring proper starting and stopping times of individual fans, see the installation and operating instructions

### Motors used:

- Three-phase asynchronous motors with short rotor, in aluminium or cast iron frame, according to DIN-IEC and EN 60034-1
- Efficiency class IE2 (up to power of 0.55 kW and 8 pole motors, class IE1)
- Rated voltage up to 3 kW: 230 VD / 400 VY, 50 Hz // 460 VY
- Nominal voltage over 3 kW: 400 VD / 690 VY, 50 Hz // 460 VD
- Number of poles: 2, 4, 6, 8
- Temperature class of the insulation F
- Grade of protection IP55 according to DIN EN 60529
- Motors are shipped together with terminal plate
- All the motors are equipped with lifetime bearings (lifetime of the bearings at the maximum load equals 20 000 working hours at least)
- Motors of the types from the axial height of 315 up are fitted with open bearings with lubrication device
- All the motors are balanced according to DIN EN 6034-14
- Temperature resistance: -20 / +40 °C

### Fans used – free impellers:

#### Composite impeller

- Impellers with the diameter of 250 to 630 mm, fitted with hubs and inlet diffuser with a measuring nozzle
- The impellers are balanced according to DIN ISO 8821
- Temperature resistance: -20 / +80 °C

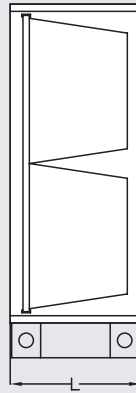
#### Steel impeller

- Impellers in sizes from 225 to 1120 mm, fitted with hubs and inlet diffuser with a measuring nozzle
- The impellers are powder coated (RAL 5002)
- The impellers are balanced according to DIN ISO 8821
- Temperature resistance: max. +80 °C

## 4.2 FILTRATION CHAMBERS WITH POCKET FILTERS

They are used for separation of the solid polluting additives out of the transferred air.

*View from the side of servicing staff*



size	length of the chamber L [mm]*	length of the chamber L [mm]**	length of the chamber L [mm]***	size	length of the chamber L [mm]*	length of the chamber L [mm]**	length of the chamber L [mm]***
				P1	450	590	720
M2	450	590	720	P2	450	590	720
M2.5	450	590	720	P2,5	450	590	720
M3.15	450	590	720	P3,15	450	590	720
M4	450	590	720	P4	450	590	720
M5	450	590	720	P5	450	590	720
M6.3	450	590	720	P6.3	450	590	720
M8	450	590	720	P8	450	590	720
M10	450	590	720	P10	450	590	720
M12.5	450	590	720	P12.5	450	590	720
M16	450	590	720	P16	450	590	720
M20	450	590	720	P20	450	590	720
M25	450	590	720	P25	450	590	720
M31.5	510	650	780	P31.5	510	650	780
M40	510	650	780	P40	510	650	780
M50	510	650	780	P50	510	650	780

\* chamber with the pocket filter, length 360 mm

\*\* chamber with the pocket filter, length 500 mm

\*\*\* chamber with the pocket filter, length 630 mm

### Filtration classes used

Eurovent	EU3	EU4	EU5	EU6	EU7	EU8	EU9
ČSN EN 779:2011	G3	G4	M5	M6	F7	F8	F9
Length of inserts [mm]	360	360	500/630	630	630	630	630

### Design

- Filters comply with standards according to ČSN EN 779:2011
- Filtration chamber is fitted with clothing pocket filters, filtration class G3 to F9
- Lengths of the chambers vary according to the filtration class used
- Plastic frame of the filter – temperature resistance up to 75 °C
- The filter elements are mounted on skids or in storage frames. They may be removed through the door from the service side of the chamber.

### Non-standard equipment (according to customer's requirements)

- Metal frame of the filters – temperature resistance up to 100 °C
- Differential manometer
- Liquid manometer with inclined tube intended for visual check of filter clogging
- Service visor
- Higher classes of filtration according to EN 1822:2010 – E10 to H13, they should be consulted with a manufacturer

### Design recommendation

- The second grade of filtration shall be located behind the fan chamber
- You may use chamber modification for the frame and pocket filters, containing both the filtration grades

### Composition of filtration inserts

#### Square-type cross section

size	composition of filtration inserts			
M2	1 × 440 × 440			
M2.5	1 × 490 × 490			
M3.15	1 × 540 × 540			
M4	1 × 592 × 592			
M5	1 × 287 × 287	1 × 402 × 287	1 × 287 × 402	1 × 402 × 402
M6.3	1 × 490 × 490	1 × 287 × 490	1 × 490 × 287	1 × 287 × 287
M8	4 × 440 × 440			
M10	4 × 490 × 490			
M12.5	1 × 592 × 592	1 × 490 × 592	1 × 592 × 490	1 × 490 × 490
M16	4 × 592 × 592			
M20	1 × 402 × 897	2 × 490 × 897	1 × 402 × 490	2 × 490 × 490
M25	2 × 592 × 897	1 × 402 × 897	2 × 592 × 592	1 × 402 × 592
M31.5	9 × 592 × 592			
M40	4 × 490 × 897	4 × 490 × 592	4 × 490 × 490	
M50	2 × 592 × 897	2 × 490 × 897	4 × 592 × 592	4 × 490 × 592

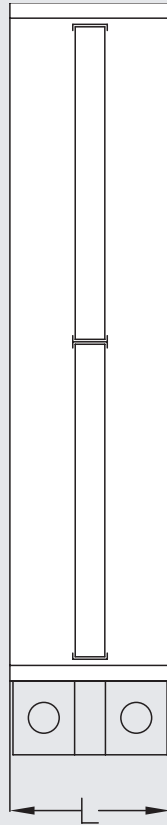
#### Rectangular cross-section

size	composition of filtration inserts			
P4	2 × 440 × 440			
P5	2 × 440 × 540			
P6.3	2 × 490 × 592			
P8	1 × 592 × 402	1 × 490 × 402	1 × 592 × 287	1 × 490 × 287
P10	2 × 402 × 490	1 × 402 × 490	3 × 402 × 287	
P12.5	1 × 402 × 287	2 × 490 × 287	1 × 402 × 592	2 × 490 × 592
P16	4 × 592 × 490			
P20	3 × 592 × 592			
P25	8 × 490 × 592			
P31.5	2 × 592 × 897	2 × 490 × 897	2 × 592 × 490	2 × 490 × 490
P40	4 × 592 × 897			
P50	4 × 592 × 897	4 × 592 × 592	4 × 592 × 402	

## 4.3 FILTRATION CHAMBERS WITH FRAME FILTERS (pre-filters)

They are used for separation of the solid polluting additives out of the air transferred.

*View from the side of servicing staff*



size	length of the chamber L [mm]	size	length of the chamber L [mm]
		P1	260
M2	260	P2	260
M2.5	260	P2,5	260
M3.15	260	P3,15	260
M4	260	P4	260
M5	260	P5	260
M6.3	260	P6.3	260
M8	260	P8	260
M10	260	P10	260
M12.5	260	P12.5	260
M16	260	P16	260
M20	260	P20	260
M25	260	P25	260
M31.5	320	P31.5	320
M40	320	P40	320
M50	320	P50	320

## Filtration classes used

Eurovent	EU3	EU4	EU5
ČSN EN 779:2011	G3	G4	M5
Length of inserts [mm]	48	48	48

## Implementation

- Filters comply with standards according to ČSN EN 779:2011
- The filter elements are mounted on skids or in storage frames. They may be removed through the door from the service side of the chamber.
- A chamber is fitted with frame filters (pre-filters) of filtration class G3, G4 and M5
- Cardboard frame of the filter – temperature resistance up to 80 °C

## Non-standard equipment (according to customer's requirements)

- Plastic frame of the filters – temperature resistance up to 80 °C
- Differential manometer
- Liquid manometer with inclined tube intended for visual check of filter clogging

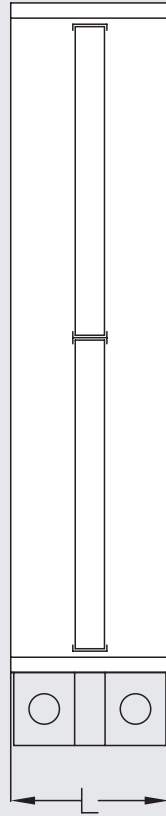
## Design recommendation

- They are used as the first stage of filtration

## 4.4 FILTRATION CHAMBERS WITH METAL FILTERS

They are used for separation of outdoor and circular air from oil and grease aerosols or for detection of high concentrations of the coarsest dust particles.

*View from the side of servicing staff*



size	length of the chamber L [mm]	size	length of the chamber L [mm]
		P1	260
M2	260	P2	260
M2.5	260	P2,5	260
M3.15	260	P3,15	260
M4	260	P4	260
M5	260	P5	260
M6.3	260	P6.3	260
M8	260	P8	260
M10	260	P10	260
M12.5	260	P12.5	260
M16	260	P16	260
M20	260	P20	260
M25	260	P25	260
M31.5	320	P31.5	320
M40	320	P40	320
M50	320	P50	320

## Filtration classes used

Eurovent	EU3
ČSN EN 779:2011	G3
Length of inserts [mm]	25

## Implementation

- Filters comply with standards according to ČSN EN 779:2011
- A chamber is fitted with metal filters – filtration class G3 (regenerative)
- Aluminium frame of the filters – temperature resistance up to 200 °C
- The filter elements are mounted on skids or in storage frames. They may be removed through the door from the service side of the chamber.

## Non-standard equipment (according to customer's requirements)

- Stainless steel design
- Chambers may be fitted with a bath, aiming to collect grease and fat
- Differential manometer
- Liquid manometer with inclined tube intended for visual check of filter clogging

## Design recommendation

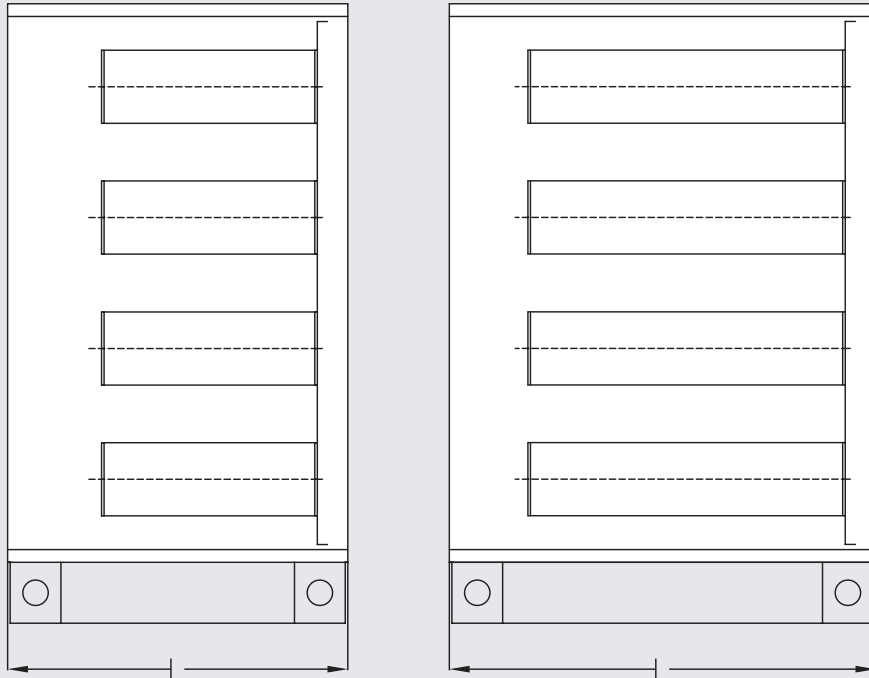
- It is used to capture grease and oil aerosols in the exhaust from kitchens, baking rooms, smoke houses or cookeries
- Capture of the coarsest dust particles in foundries, smelters and in steel processing industry



## 4.5 FILTRATION CHAMBERS WITH ACTIVE COAL

They are used for separation of molecular pollution of the transferred air.

*View from the side of servicing staff*



size	length of the chamber L [mm]*	length of the chamber L [mm]**	size	length of the chamber L [mm]	
			P1	670	840
M2	670	840	P2	670	840
M2.5	670	840	P2,5	670	840
M3.15	670	840	P3,15	670	840
M4	670	840	P4	670	840
M5	670	840	P5	670	840
M6.3	670	840	P6.3	670	840
M8	670	840	P8	670	840
M10	670	840	P10	670	840
M12.5	670	840	P12.5	670	840
M16	670	840	P16	670	840
M20	670	840	P20	670	840
M25	670	840	P25	670	840
M31.5	730	900	P31.5	730	900
M40	730	900	P40	730	900
M50	730	900	P50	730	900

\* chamber with short cartridge [450 mm]

\*\* chamber with long cartridge [625 mm]

## Implementation

- Cartridges with active coal are mounted in storage frames fitted with bayonet mount
- The cartridges are removable through a door
- Non-impregnated active coal, granules (regenerative)
- Iodine value, minimum 1,050 mg/g
- Length of cartridges 425 or 625 mm

## Non-standard equipment (according to customer's requirements)

- Impregnated active coal (no regeneration)
- Service /access door

## Design recommendation

- Non-impregnated active coal is suitable for adsorption of organic hydrocarbons, odours and harmful gases
- Impregnated active coal is applied for adsorption of such gases and vapours which are very little or not at all adsorbed by standard active coal. These are low molecular and polar substances with low concentration and toxic effects.
- Use of a right kind of active coal should be consulted with the manufacturer (concentration and type of contaminants)
- The maximum temperature if the air being filtered must not exceed 40 °C and 70 % of relative humidity
- Before entering the chamber with the active coal, it is necessary to filter the air by using a filter of the class at least F7
- To ensure required separation of pollutants, the air flow through cartridges with active coal is limited. The maximum flow in different sizes is listed in the tables, according to number of the cartridges in use.

### Cartridges, length 450 mm:

size	number of cartridges [pieces]	filling [kg]	flow [m <sup>3</sup> /h]	size	number of cartridges [pieces]	filling [kg]	flow [m <sup>3</sup> /h]
				P1	4	8	750
M2	9	18	1,650	P2	8	16	1500
M2.5	9	18	1,650	P2,5	8	16	1500
M3.15	9	18	1,650	P3,15	10	20	1870
M4	16	32	3,000	P4	15	30	2,800
M5	16	32	3,000	P5	15	30	2,800
M6.3	25	50	4,650	P6.3	24	48	4,500
M8	25	50	4,650	P8	28	56	5,250
M10	36	72	6,750	P10	40	80	7,500
M12.5	19	98	9,150	P12.5	45	90	8,400
M16	64	128	12,000	P16	60	120	11,250
M20	81	162	15,150	P20	77	154	14,400
M25	100	200	18,750	P25	96	192	18,000
M31.5	121	242	22,650	P31.5	117	234	21,900
M40	144	288	27,000	P40	130	260	24,350
M50	196	392	36,750	P50	192	384	36,000

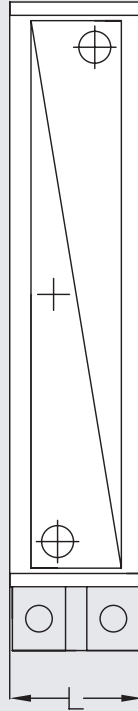
### Cartridges, length 625 mm:

size	number of cartridges [pieces]	filling [kg]	flow [m <sup>3</sup> /h]	size	number of cartridges [pieces]	filling [kg]	flow [m <sup>3</sup> /h]
				P1	4	10	900
M2	9	22.5	2,000	P2	8	20	1800
M2.5	9	22.5	2,000	P2,5	8	20	1800
M3.15	9	22.5	2,000	P3,15	10	25	2250
M4	16	40	3,600	P4	15	37.5	3,350
M5	16	40	3,600	P5	15	37.5	3,350
M6.3	25	62.5	5,600	P6.3	24	60	5,400
M8	25	62.5	5,600	P8	28	70	6,300
M10	36	90	8,100	P10	40	100	9,000
M12.5	19	123	11,000	P12.5	45	113	10,000
M16	64	160	14,400	P16	60	150	13,500
M20	81	203	18,200	P20	77	193	17,300
M25	100	250	22,500	P25	96	240	21,600
M31.5	121	303	27,200	P31.5	117	293	26,300
M40	144	360	32,400	P40	130	325	29,250
M50	196	490	44,100	P50	192	480	43,200

## 4.6 HEATING CHAMBERS – WATER

They are used for heating the air (pre-heating and post-heating).

*View from the side of servicing person*



size	length of the chamber L [mm]*	length of the chamber L [mm]**	length of the chamber L [mm]***	size	length of the chamber L [mm]*	length of the chamber L [mm]**	length of the chamber L [mm]***
				P1	220-400	330-480	660-840
M2	220-400	300-480	660-840	P2	220-400	330-480	660-840
M2.5	220-400	300-480	660-840	P2,5	220-400	330-480	660-840
M3.15	220-400	300-480	660-840	P3,15	220-400	330-480	660-840
M4	220-400	300-480	660-840	P4	220-400	330-480	660-840
M5	220-400	300-480	660-840	P5	220-400	330-480	660-840
M6.3	220-400	300-480	760-940	P6.3	220-400	330-480	760-940
M8	220-400	300-480	760-940	P8	220-400	330-480	790-970
M10	220-400	300-480	760-940	P10	220-400	330-480	790-970
M12.5	220-400	300-480	760-940	P12.5	220-400	330-480	790-970
M16	220-400	300-480	760-940	P16	220-400	330-480	790-970
M20	220-400	300-480	930-1,110	P20	220-400	330-480	960-1,140
M25	220-400	300-480	930-1,110	P25	220-400	330-480	960-1,140
M31.5	280-460	360-540	990-1,170	P31.5	280-460	360-540	1,020-1,200
M40	280-460	360-540	990-1,170	P40	280-460	360-540	1,020-1,200
M50	280-460	360-540	1,020-1,200	P50	280-460	360-540	1,020-1,200

\* chamber with 1 to 8 line exchanger

\*\* chamber with 1 to 8 line exchanger, including capillary frame

\*\*\* chamber with 1 to 8 line exchanger, including a free chamber

### Implementation

- Chambers contain an exchanger fitted with finned heat transfer surface in the version of Cu/Al (Cu tubes and Al lamellas)
- Inlet and outlet necks are threaded (they are fitted with a plastic cover plug intended for transport purposes)
- There is a vent valve in the upper neck of the exchanger. There is a drain valve installed in the lower neck.
- Neck outfall into the service side of the unit or to the lateral sides of the unit
- If necessary (servicing, cleaning), the exchanger may be removed to the service side, together with the front panel
- Operational temperature of water is 150 °C, operational pressure is 0.8 MPa (exchangers are tested at the pressure of 2 MPa)

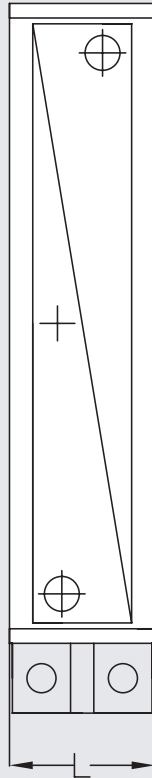
### Design recommendation

- To make installation and check of features of the freezing protection easier, we recommend placing a frame for capillary just behind the heater.

## 4.7 HEATING CHAMBERS – STEAM

They are used for heating the air (pre-heating and post-heating).

*View from the side of servicing person*



size	length of the chamber L [mm]*	length of the chamber L [mm]**	size	length of the chamber L [mm]*	length of the chamber L [mm]**
			P1	250	330
M2	250	330	P2	250	330
M2.5	250	330	P2,5	250	330
M3.15	250	330	P3,15	250	330
M4	250	330	P4	250	330
M5	250	330	P5	250	330
M6.3	250	330	P6.3	250	330
M8	250	330	P8	250	330
M10	250	330	P10	250	330
M12.5	250	330	P12.5	250	330
M16	250	330	P16	250	330
M20	250	330	P20	250	330
M25	250	330	P25	250	330
M31.5	310	390	P31.5	310	390
M40	310	390	P40	310	390
M50	310	390	P50	310	390

\* chamber with 2 line exchanger

\*\* chamber with 2 line exchanger, including capillary frame

### Implementation

- Chambers contain an exchanger fitted with finned heat transfer surface in the version of Cu/Al (Cu tubes and Al lamellas)
- Inlet and outlet necks are threaded (they are fitted with a plastic cover plug intended for transport purposes)
- There is a vent valve in the upper neck of the exchanger. There is a drain valve installed in the lower neck.
- Neck outfall into the service side of the unit or to the lateral sides of the unit
- If necessary (servicing, cleaning), the exchanger may be removed to the service side, together with the front panel
- Operational temperature of steam 150 °C, operational pressure 1,5 MPa (exchangers are tested at the pressure of 3 MPa)

### Non-standard equipment (according to customer's requirements)

- Threaded flanges on inlet and outlet necks of the exchanger – according to ČSN EN 1092-1.

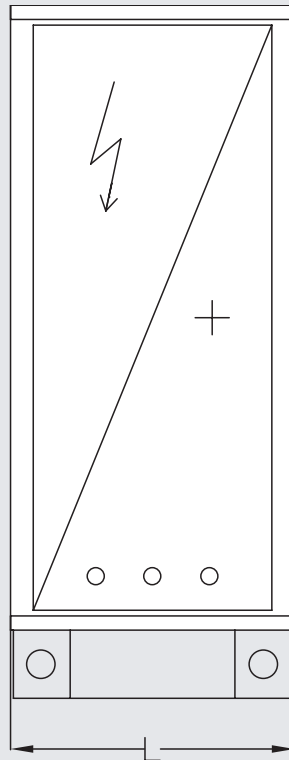
### Design recommendation

- To make installation and check of features of the freezing protection easier, we recommend selecting a frame for capillary directly behind the heater
- Regarding the outdoor design, the steam pipes must be protected against freezing by using suitable insulation or heating cable

## 4.8 HEATING CHAMBERS – ELECTRIC

They are used for heating the air (pre-heating and post-heating).

*View from the side of servicing person*



### Implementation

- Length of the chamber, according to performance required
- Heating bars are interconnected to several sections inside the chamber. Heating power of the heater is controlled by switching individual sections, respectively by thyristor continuous feature of power control.
- Access to the terminal after removing the cover on the operating side of the chamber
- Possibility to set up any power of the heater (230 V or 400 V)

### Design recommendation

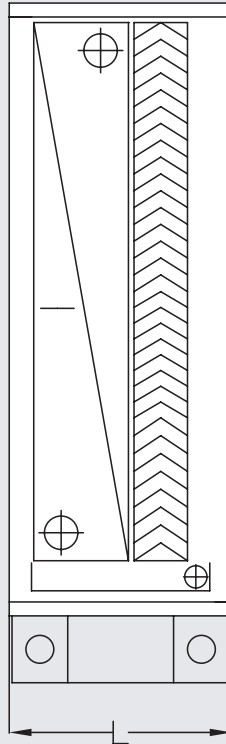
- The minimum air flow rate 1 m/s, through the heater.
- Regulation feature must ensure blocking of electrical heater operation if the air flow through the unit and run-out of the fan do not last at least 3 minutes after turning the electric heater off.
- We recommend placing the electric heating feature to the end of the unit due to thermal resistance of the fan motor (up to 40 °C) and other components of the unit
- If there is a component containing flammable material mounted in the close vicinity to the heater, the minimum distance of 150 mm from any heating appliances must be maintained



## 4.9 COOLING CHAMBERS – WATER

They are used for cooling and moistening the air.

*View from the side of servicing person*



size	length of the chamber L [mm]*	size	length of the chamber L [mm]*
		P1	400-580
M2	400-580	P2	400-580
M2.5	400-580	P2,5	400-580
M3.15	400-580	P3,15	400-580
M4	400-580	P4	400-580
M5	400-580	P5	400-580
M6.3	400-580	P6.3	400-580
M8	400-580	P8	400-580
M10	400-580	P10	400-580
M12.5	400-580	P12.5	400-580
M16	400-580	P16	400-580
M20	400-580	P20	400-580
M25	400-580	P25	400-580
M31.5	460-640	P31.5	460-640
M40	460-640	P40	460-640
M50	460-640	P50	460-640

\* chamber with 1 to 8 line exchanger

## Design

- Chambers contain an exchanger fitted with finned heat transfer surface in the version of Cu/Al (Cu tubes and Al lamellas)
- Water is used as cooling liquid (the minimum operational temperature of the water must be chosen in such the ways that the water does not freeze). It is possible to use antifreeze blend with ethylene glycol or propylene glycol at the concentration of 10–60 %.
- Inlet and outlet necks are threaded (they are fitted with a plastic cover plug intended for transport purposes)
- There is a vent valve in the upper neck of the exchanger. There is a drain valve installed in the lower collector.
- The outlet of the necks towards the service side of the unit
- If necessary (servicing, cleaning), the exchanger may be removed to the service side, together with the front panel
- Operational temperature corresponds to a medium used, operational pressure is 1.5 MPa (exchangers are tested at the pressure of 2 MPa)
- There is a stainless steel bath fitted with the outlet for discharging a condensate (DN32), installed in the chamber
- The delivery includes a trap for discharging a condensate – it is enclosed with the assembly kit
- A chamber is equipped with a plastic flap eliminator

## Non-standard equipment (according to customer's requirements)

- Other antifreeze blends must be consulted with the manufacturer
- Threaded flanges for inlet and outlet necks of the exchanger – according to ČSN EN 1092-1
- A heat exchanger for higher operating pressures must be consulted with the manufacturer
- Service visor

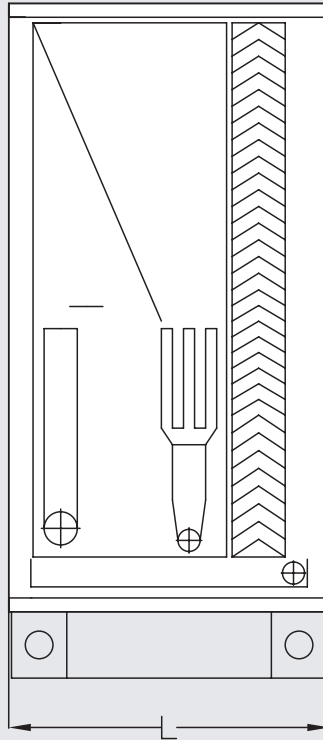
## Design recommendation

- **WARNING:** During installation, you must connect a condensate outlet leading through the trap

## 4.10 COOLING CHAMBERS WITH DIRECT EVAPORATOR

They are used for cooling and moistening the air.

*View from the side of servicing person*



size	length of the chamber L [mm]*	size	length of the chamber L [mm]*
		P1	580
M2	580	P2	580
M2.5	580	P2,5	580
M3.15	580	P3,15	580
M4	580	P4	580
M5	580	P5	580
M6.3	580	P6.3	580
M8	580	P8	580
M10	580	P10	580
M12.5	580	P12.5	580
M16	580	P16	580
M20	580	P20	580
M25	580	P25	580
M31.5	640	P31.5	640
M40	640	P40	640
M50	640	P50	640

\* chamber with 1 to 8 line exchanger

## Implementation

- Chambers contain an exchanger fitted with finned heat transfer surface in the version of Cu/Al (Cu tubes and Al lamellas). The used types of coolants: R407c, R410a.
- Both inlet and outlet necks are made of copper, they are ready for soldering
- The outlet of the necks towards the service side of the unit
- Distributor is located inside the chamber
- If necessary (servicing, cleaning), the exchanger may be removed to the service side, together with the front panel
- Operational pressure according to medium used (exchangers are tested at the pressure of 3.1 MPa)
- There is a stainless steel bath fitted with the outlet for discharging a condensate (DN32), installed in the chamber
- The delivery includes a trap for discharging a condensate – it is enclosed with the assembly kit
- A chamber is equipped with a plastic flap eliminator

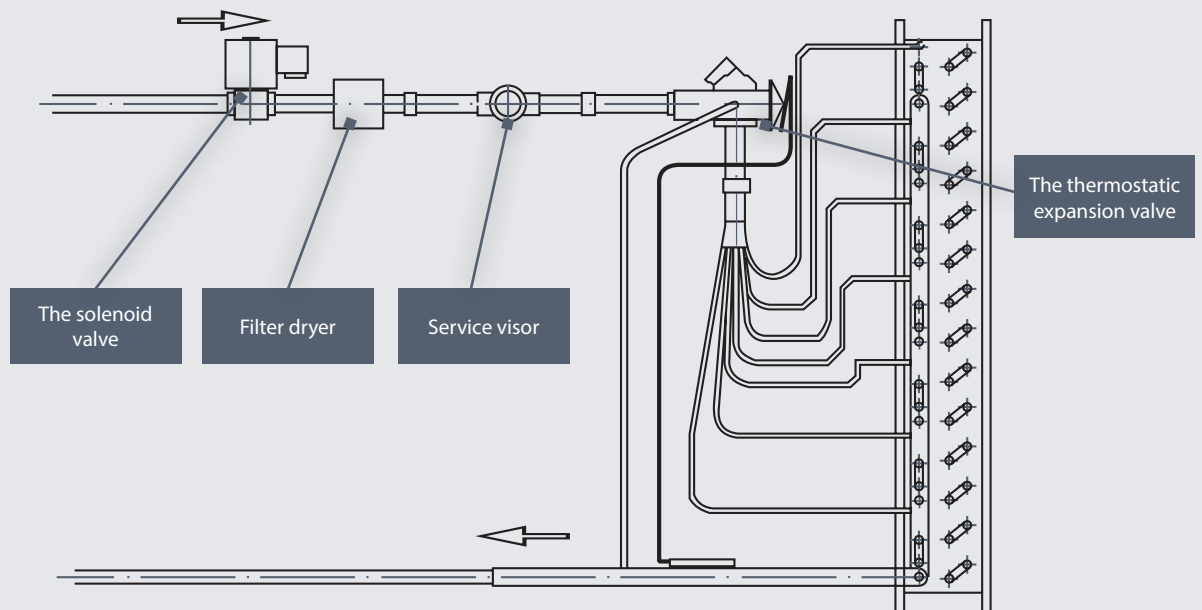


Fig. 4.10.1: Components of fluid section related to the cooling circuit before the evaporator.  
The cooling circuit is not included in the delivery of Mandík, a. s.!!!

## Non-standard equipment (according to customer's requirements)

- Coolants R134a, R404a, R507 and others must be consulted with the manufacturer
- Service visor

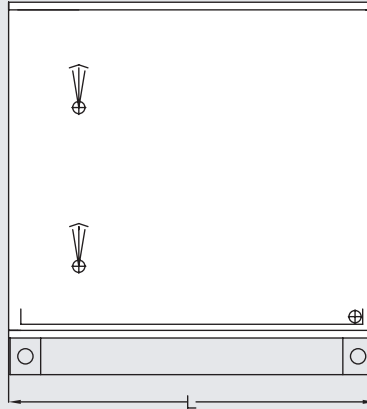
## Design recommendation

- **WARNING:** During installation, you must connect a condensate outlet leading through the trap

## 4.11 STEAM MOISTENING OF CHAMBERS

The chamber is used for moistening the air by using water steam.

*View from the side of servicing person*



size	length of the chamber L [mm]	size	length of the chamber L [mm]
		P1	1200
M2	1,200	P2	1200
M2.5	1,200	P2,5	1200
M3.15	1,200	P3,15	1200
M4	1,200	P4	1,200
M5	1,200	P5	1,200
M6.3	1,200	P6.3	1,200
M8	1,200	P8	1,200
M10	1,200	P10	1,200
M12.5	1,200	P12.5	1,200
M16	1,200	P16	1,200
M20	1,200	P20	1,200
M25	1,200	P25	1,200
M31.5	1,260	P31.5	1,260
M40	1,260	P40	1,260
M50	1,260	P50	1,260

### Implementation

- There is a stainless steel bath fitted with the outlet for discharging a condensate (DN32), installed in the chamber
- A chamber located on the servicing side is fitted with a removable panel

### Non-standard equipment (according to customer's requirements)

- Service visor

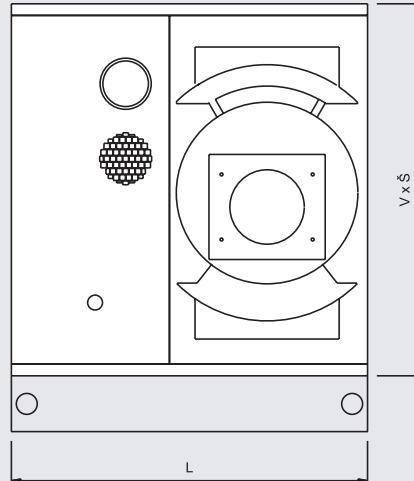
### Design recommendation

- We do not recommend locating the steam moistener chamber outdoors. We always recommend locating the chamber at the end of the unit and in indoor environment.

## 4.12 HEATING GAS CHAMBERS – MONZUN

Chambers are used for indirect heating the air by using an exchanger of the type gas-air.  
Heating performance 15-93 kW

View from the side of servicing person



Size	Length of chamber L (mm)	Width of chamber S (mm)	Height of chamber V (mm)	Size	Length of chamber L (mm)	Width of chamber S (mm)	Height of chamber V (mm)
				P1			
M2	850-900	1030-1110	820-870	P2	1050-1100	1030-1100	820-870
M2,5	850-900	1030-1110	820-870	P2,5	1000-1050	1030-1100	820-870
M3,15	800-1000	1030-1275	820-960	P3,15	1000-1100	1030-1275	820-960
M4	720-1000	1030-1275	820-960	P4	950-1050	1030-1275	820-960
M5	720-1000	1030-1665	820-960	P5	900-1000	1030-1665	820-960
M6,3	720-1000	1030-1665	900-960	P6,3	850-950	1100-1665	820-960
M8	720-1000	1030-1665	1000	P8	720-900	1200-1665	820-960
M10	720-950	1100-1665	1100	P10	720-850	1350-1665	900-960
M12,5	770-850	1200-1665	1200	P12,5	770-850	1500-1665	1000
M16	770-850	1350-1665	1350	P16	770-850	1700	1100
M20	810-890	1500-1665	1500	P20	810-890	1900	1200
M25	810-890	1700	1700	P25	810-890	2100	1350
M31,5	830-910	1900	1900	P31,5	830-910	2300	1500
M40	830-910	2100	2100	P40	830-910	2600	1700
M50	910	2300	2300	P50	910	2600	2100

## Implementation

- Fuel natural gas ZP (G20), Propane-butane – PB (G30/G31), Propane – P (G31).
- Heating sections are equipped with atmospheric burner and a complete control system to ensure safe operation.
- Continuous power control from min. to max. values – modulating.
- Double blast boiler in stainless steel.
- On the side of servicing person is fed out the extension line to the media and venting, including the service door.
- On the side of servicing person are located the alarm functions – feed, start/power block, operation, over-heating.
- Product is equipped with operational and emergency thermostats.
- Compulsory combustion gases exhaust
- The possibility of indoor and outdoor designs
- Design with by-pass or without by-pass.
- In cases, where the cross section has different size comparing the cross section of the heating chamber, the transition is solved by appropriated construction solution

## Non-standard equipment (according to customer's requirements)

- Product could include exhaust system

## Design recommendation

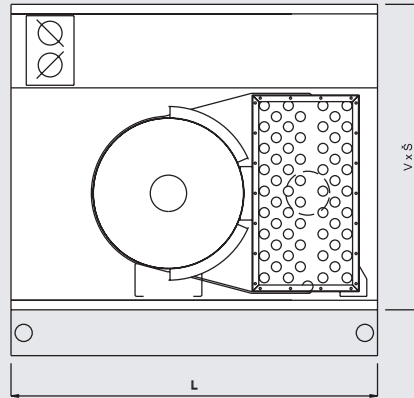
- We recommend placing the chamber behind the fan at the end of the unit.

Performance overview and operational parameters can be found in AHU designing software Mandik

## 4.13 HEATING GAS CHAMBERS – PECÍN

Chambers are used for indirect heating the air by using an exchanger of the type gas-air.  
Heating performance 50-610 kW

View from the side of servicing person



Size	Length of chamber L (mm)	Width of chamber S (mm)	Height of chamber V (mm)	Size	Length of chamber L (mm)	Width of chamber S (mm)	Height of chamber V (mm)
				P1			
M2				P2			
M2,5				P2,5			
M3,15				P3,15			
M4				P4			
M5				P5			
M6,3				P6,3	1300	1200	730
M8				P8	1300	1200	800
M10	1300-1600	1100	1100	P10	1300	1350	900
M12,5	1300-1600	1200	1200	P12,5	1300-1600	1500	1000
M16	1300-1600	1350	1350	P16	1300-1600	1700	1100
M20	1300-1600	1500	1500	P20	1300-1600	1900	1200
M25	1300-1600	1700	1700	P25	1300-2200	2100	1350
M31,5	1300-1600	1900	1900	P31,5	1300-2200	2300	1500
M40	1300-2200	2100	2100	P40	1300-2200	2600	1700
M50	1300-2200	2300	2300	P50	1300-2200	2600	2100



## Implementation

- Fuel natural gas ZP (G20), Propane-butane – PB (G30/G31), Propane – P (G31) and other fuels, according to the burner design.
- Chambers are supplied together with gas overpressure burner powered by natural gas burners from Elco or Weishaupt, including
- Power control depending on the burner design.
- Pipe doubleblast heat exchanger in stainless steel with efficiency in the range of 91-93 %.
- On the side view from servicing person is access for connection line to the media; exhaust is connected on the opposite side.
- Product contains operational and emergency thermostat.
- The possibility of indoor and outdoor design, at the outdoor design is burner equipped with its own burner cover.
- Design with by-pass or without by-pass.
- In cases, where the cross section has different size comparing the cross section of the heating chamber, the transition is solved by appropriated construction solution
- The removable panel (access door) on the side allows inspection and cleaning of the heat exchanger.

## Non-standard equipment (according to customer's requirements)

- Product could include exhaust system.

## Design recommendation

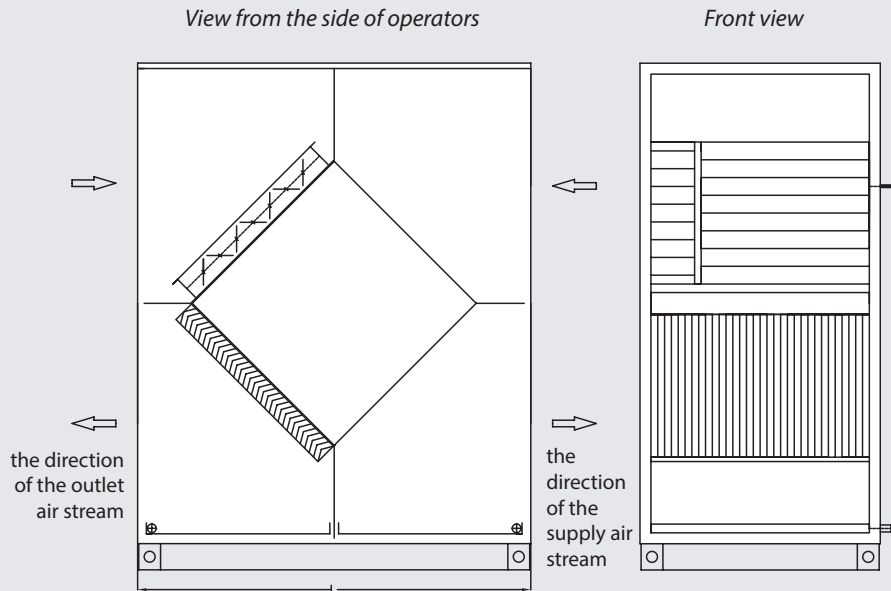
- We recommend placing the chamber behind the fan at the end of the unit.
- It is necessary to ensure the condensate exhaust pipe falling throughout the route away from the boiler.

Performance overview and operational parameters can be found in AHU designing software Mandik

## 4.14 CHAMBERS WITH TABULAR EXCHANGER FOR RETROACTIVE ACQUISITION OF HEAT

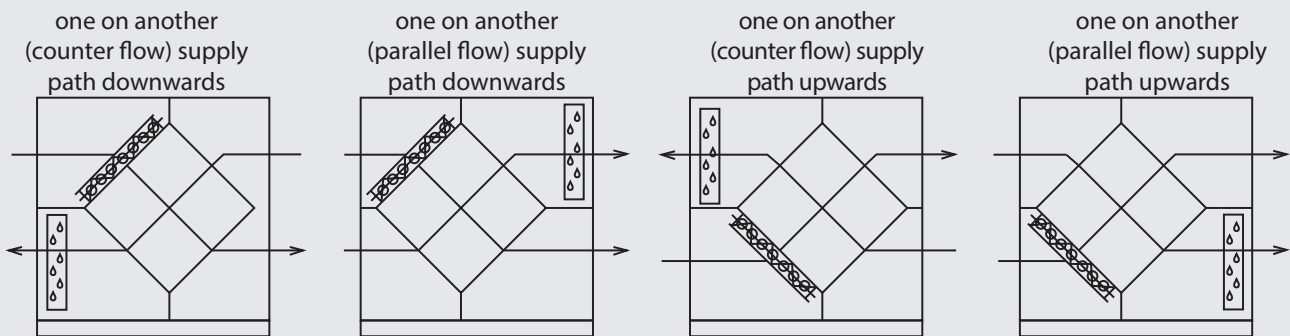
It is used for heat recovery from the exhaust air. Fresh air being supplied and the exhaust air are separated from each other.

*Vertical chambers ("ONE ON ANOTHER")*



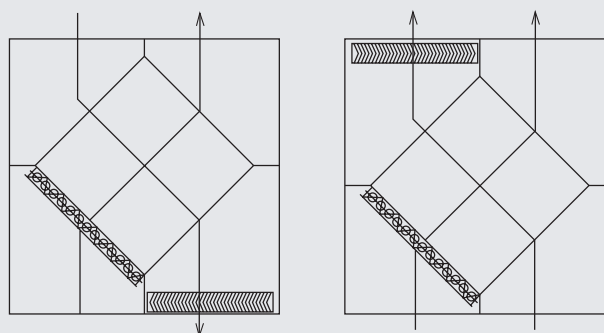
*Horizontal chambers ("ONE NEXT TO THE OTHER")*

*GROUND PLAN*



*Options for arrangement of tabular heat exchangers – vertical design*

*One next to the other (counter flow)    One next to the other (parallel flow)*



*Options for arrangement of tabular heat exchangers – horizontal design*

size	length of the chamber L [mm]* inlet/outlet = over each other	length of the chamber L [mm]* inlet/outlet = next to each other	size	length of the chamber L [mm]* inlet/outlet = over each other	length of the chamber L [mm]* inlet/outlet = next to each other	length of the chamber L [mm]*
			P1	-	890	
M2	1,000	1,100	P2	-	890-1775	
M2.5	1,240	1,240	P2,5	830	890-1775	
M3.15	1,240	1,240	P3,15	830	890-2055	
M4	1,240-1,450	1,240-1,450	P4	830-1100	1810-2090	
M5	1,450-1,590	1,450-1,590	P5	1100-1240	1810-2090	
M6.3	1,450-1,800	1,450-1,810	P6,3	1240-1450	1810-2090	
M8	1,590-2,090	1,590-2,090	P8	1240-1590	2090-2510	
M10	1,800-2,090	1,810-2,090	P10	1450-1810	2090-2800	
M12.5	1,800-2,510	1,810-2,510	P12,5	1450-2090	2090-2800	
M16	2,090-2,790	2,090-2,800	P16	1590-2090	2510-3220	
M20	2,130-2,830	2,090-2,800	P20	1810-2510	2800-3790	
M25	2,550-3,260	2,510-3,220	P25	2090-2510	2800-3790	
M31,5	2,510-3,220	2,510-3,220	P31,5	2510-2800	3220-4630	
M40	2,800-3,790	2,800-3,790	P40	2510-3220	3790-4630	
M50	3,300-4,630	3,220-4,630	P50	2800-3790	3790-4630	

\* chamber length according to a recuperator used

## Design

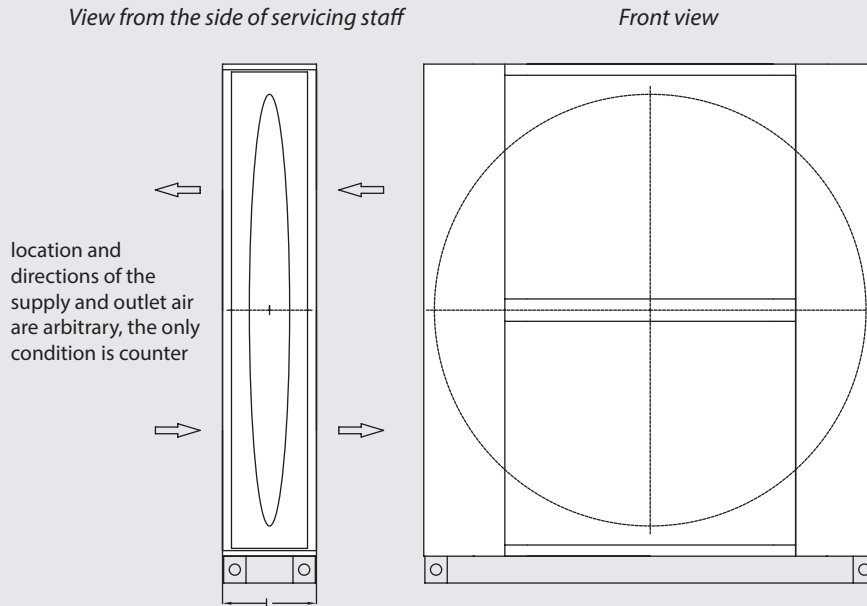
- Different recuperations efficiency choice
- Aluminium tabular recuperator
- There are stainless steel baths fitted with the outlet for discharging a condensate (DN32), installed in the chamber
- Removable panels located on the operating side for the purpose of easy cleaning
- Bypass flap on the side of air inlet
- The delivery includes a trap for discharging a condensate – it is enclosed with the assembly kit
- 3 types of recuperators with various efficiencies

## Non-standard equipment (according to customer's requirements)

- Mixing damper
- Design fitted with flap eliminator
- Chamber lighting system
- Aluminium tabular recuperator with epoxy paint, intended for the aggressive environment
- Differential manometer

## 4.15 CHAMBERS WITH ROTATIONAL EXCHANGER FOR RETROACTIVE ACQUISITION OF HEAT

It is used for leading heat (or moisture) from the air discharged to the transferred air



size	length of the chamber L [mm]	size	length of the chamber L [mm]
M2	420	P1	420
M2.5	420	P2	420
M3.15	420	P2,5	420
M4	420	P3,15	420
M5	420	P4	420
M6.3	420	P5	420
M8	420	P6,3	420
M10	420	P8	420
M12.5	420	P10	420
M16	480	P12,5	420
M20	430	P16	420
M25	430	P20	430
M31.5	430	P25	430
M40	460	P31,5	430
M50	505	P40	460
		P50	505

### Design

- Different recuperators efficiency choice
- Exchanger's rotor is made of aluminum foil
- Rotors up to the size of M16/P16 are located in a cabinet. You can slide them sideways
- Regarding the sizes from M20/P20 up, the box frame is made of steel profiles
- Rotor powered by electric motor 3× 400 V, with gear and belt transmission
- Rotor of the exchanger in the version of "TEMPERATURE" (for heat transfer only) or "ENTHALPIC" (for transferring heat and humidity)
- There is a frequency converter in protection IP20 of regulation 0 – 10 V or 4 – 20 mA
- 0 – 10 V or 4 – 20 mA

### **Non-standard equipment (according to customer's requirements)**

- Separated recuperator

### **Design recommendation**

- Inlet and outlet air must flow through the chamber in opposite directions
- Chambers allowing free access to the exchanger's rotor itself should be located on all sides. They shall be used for revision and cleaning (revision chamber may be formed by any chamber, e.g. free continuous chamber, filtration chamber, etc.).
- Temperature of the flow of the air-volume transported must not exceed 55 °C
- The maximum permitted rotation speed of the rotor is 13 RPM
- Before entering the recuperator, it is necessary to filter the air by using the filter of the class at least EU3

## 4.16 CHAMBERS FOR HEAT RECOVERY – GLYCOLIC CIRCUIT

The glycolic circuit is used for heat recovery from the exhaust air by using two separate heat exchangers, heater located in the feed line and the cooler located in the outlet line. There are usual heating and cooling chambers used in the circuit. There is a pump-circulated heat transfer fluid between these exchangers. The advantage of the glycolic circuit is a complete separation of supply air from exhaust air. Delivery is carried out by a heater chamber and cooler without elements of the circuit.

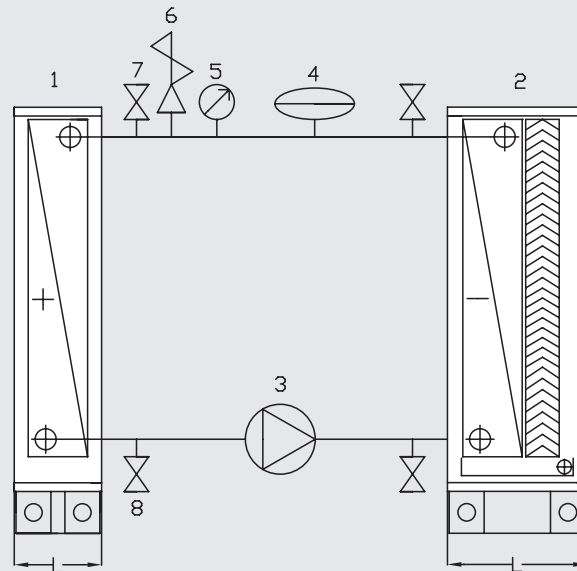


Fig. 4.16.1: Glycolic circuit diagram

### Glycolic circuit description:

- 1 – heating exchanger in inlet branch
- 2 – cooling exchanger in outlet branch fitted with eliminator
- 3 – circulation pump
- 4 – expansion vessel
- 5 – pressure gauge
- 6 – safety valve
- 7 – vent valves
- 8 – drain valves

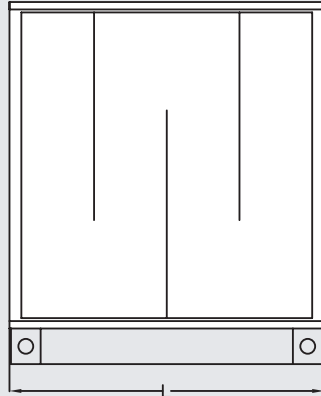
### Heat-carrying medium:

- water/ antifreeze liquid

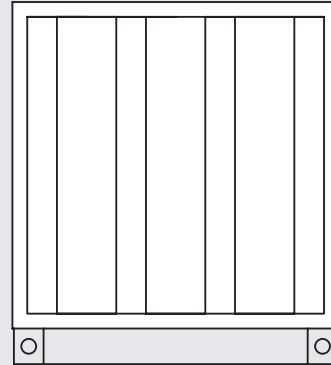
## 4.17 BUFFER CHAMBERS

They are used for inhibition of noise emitted into the suction or discharge part of the unit.

*View from the side of servicing staff*



*Front view*



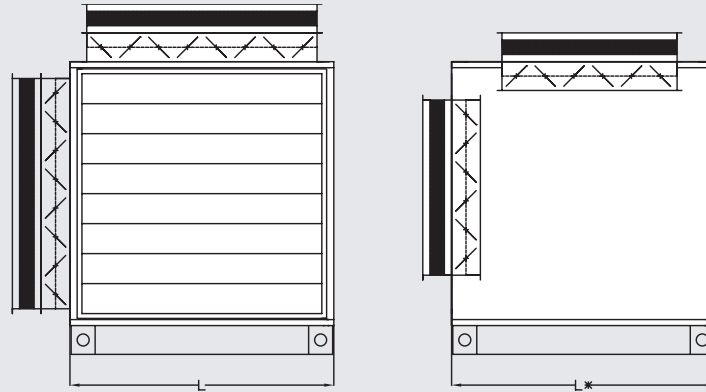
### Design

- Background walls of noise silencers made of galvanized sheet and filled with sound-absorbing material
- A chamber is fitted with removable panel on the operating side, enabling easy access to the chamber during cleaning. The background walls are removable to the operator's side.
- Length of the buffer chamber (up to the size of unit P and M25): 660 mm; 1,060 mm; 1,260 mm; 1,560 mm
- Length of the buffer chamber (from the size of unit P and M31.5): 720 mm; 1,120 mm; 1,320 mm; 1,620 mm

## 4.18 FLAP CHAMBERS

They are used to regulate air flow or blend two or more air streams.

View from the side of servicing person



size	length of chamber L [mm] with upper flap	length of chamber L [mm] with lower flap	length of chamber L [mm] with front/back flap	size	length of chamber L [mm] with upper flap	length of chamber L [mm] with lower flap	length of chamber L [mm] with front/back flap
				P1	580	590	790
M2	580	590	640	P2	680	690	740
M2.5	580	590	740	P2,5	680	690	740
M3.15	580	590	690	P3,15	680	690	890
M4	580	590	790	P4	580	590	790
M5	580	590	740	P5	680	690	740
M6.3	580	590	740	P6.3	680	690	740
M8	680	690	790	P8	680	690	890
M10	680	690	840	P10	680	690	890
M12.5	780	790	890	P12.5	680	690	940
M16	780	790	890	P16	780	790	1,040
M20	880	890	990	P20	780	790	1,140
M25	880	890	1,040	P25	780	790	1,140
M31.5	1,040	1,050	1,150	P31.5	940	950	1,350
M40	1,140	1,150	1,250	P40	1,040	1,050	1,450
M50	1,240	1,250	1,350	P50	1,240	1,250	1,400

\* length of the chamber may vary depending on number and mutual position of the flaps

### Design

- Chambers fitted with regulation flaps located inside and outside the chamber. The maximum temperature resistance of regulation flaps is 60 °C.
- There is a flexible buffer element mounted outside the chamber for connection to pipeline
- On the operating side of the chamber, the chamber is fitted with a removable panel for easy access in case of maintenance of flaps and servo-drives

### Non-standard equipment (according to customer's requirements)

- Buffering inserts with temperature resistance up to 200 °C
- Manual control of the flaps
- The regulation flaps are fitted with servo drive units
- Chamber lighting system
- Stainless steel batch fitted with the outlet for discharging a condensate (DN32)



## 4.19 FREE CHAMBERS

They allow revisions, service, maintenance and installation.

*View from the side of servicing person*



### Design

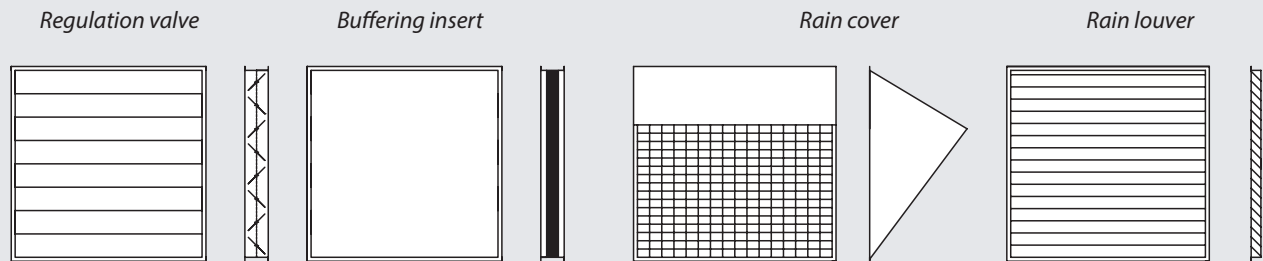
- A free chamber is most often a part of compact block together with another chamber
- Any length of a chamber is possible
- Free chambers can be fitted with service panel or door on the operating side
- Possibility of stainless steel batch fitted with the outlet for discharging a condensate (DN32)

### Design recommendation

- Free chambers are used for the following items:
  - padding the upper floors of the unit,
  - extension of length of selected chambers, as required,
  - change in the air stream axis by 90°,
  - location of various elements,
  - service access, for instance the access to exchangers.

## 4.20 END WALLS

They are used for connecting the unit to the pipeline or to protect the unit from the weather impacts. They are mounted either in the beginning or at the end of the unit.



### Design

- Length of buffering insert: 160 mm
- Length of regulation valve: 125 mm
- Buffering insert with temperature resistance 80 °C
- The maximum temperature resistance of regulation flaps is 60 °C
- Regarding the outdoor use, the regulation flap is installed inside the chamber or the servo-drive is protected by a cover
- Rain cover is made of galvanized sheets
- Rain louver is made of galvanized sheets

### Non-standard equipment (according to customer's requirements)

- Buffering insert with temperature resistance 200 °C
- Rain cover made of lacquered metal (RAL scale) or stainless steel
- Rain louver made of lacquered metal (RAL scale) or stainless steel

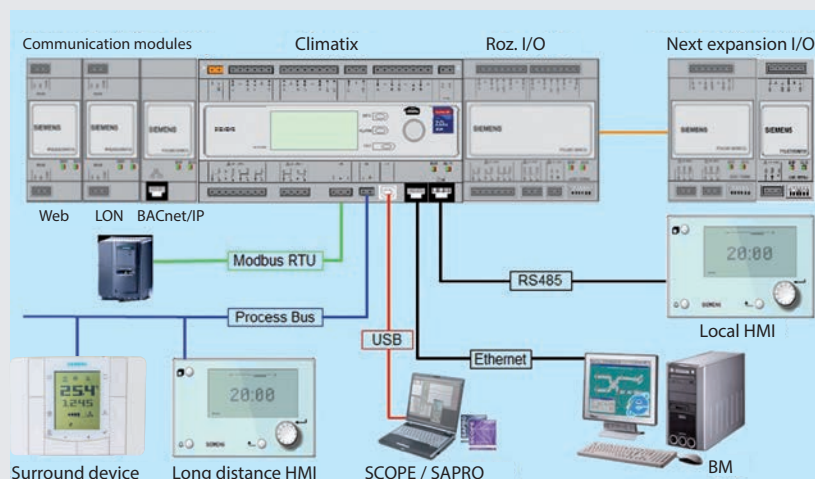
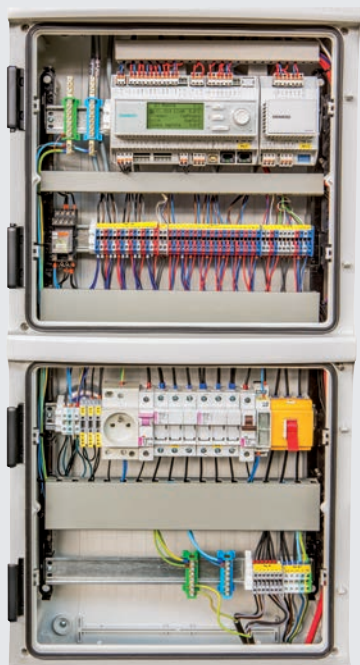
## 5. System of Measurement and Regulation

It is possible to add a system of measuring and regulation to each variant of the assembly design of the air ventilation unit of MANDÍK. Due to high variability of different versions and possible methods of regulation there is the MaR project prepared for specific custom version of MANDÍK unit. The project includes technological diagram of system MaR connection, including indication of types of wires used as well as the wiring diagram (included in documentation supplied on specific order). Deliveries include all components of the MaR system needed for a particular order (description of all possible components is listed below), except of connecting cables.

To control the air handling unit is used freely programmable PLC controller Climatix from Siemens, which meets the new requirements arising from the economic, ecological

and social needs. This regulator is among best rated regulators intended to control the air handling units. Providing a comfortable, safe, and energy control operation of the air conditioning equipment and perfect adaptability to the final solution to the customer's requirements. The indispensable quality of the communication options is wide allowing possibilities for easy control and cooperation with most of the patent systems and systems integration to buildings technology.

Power switchboards with implemented Climatix regulator including short circuit protection are manufactured in various sizes in metal and plastic, depending on the configuration of the air conditioning unit, operating environment and overall power.

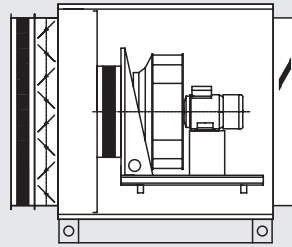


### Control system (Measurement and Regulation) with Climatix regulator offers:

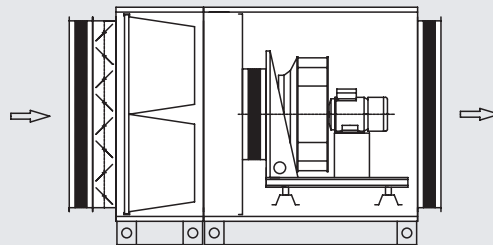
- Excellent ratio price/performance.
- Easy installation.
- Easy to operate in several variants.
- Local and remote control.
- Annual and weekly timer program.
- Text display with a clear data view.
- Screen choice in any European language (default Czech).
- Choice of multiple operating modes.
- Temperature regulation and humidity in the supply line or space. Automatic detection of the needs of heating or cooling.
- Comprehensive, accurate management of air conditioning.
- Comprehensive listing of alarm information including history.
- Important changes to parameters after entering the password (more levels).
- Connect all ventilation components into a single regulatory system.
- It controls all the standard components of the heating and cooling.
- Uniformed marking of terminal connectors.
- Control from PC using an Internet browser (standard delivery) and subsequently from anywhere on the internet.
- Possibility of visualization interfaces.

## 6. Examples of Mandík units assemblies

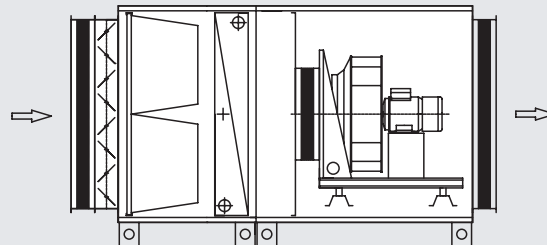
1) Unit for inlet or outlet of the air fitted with the fan with free impeller



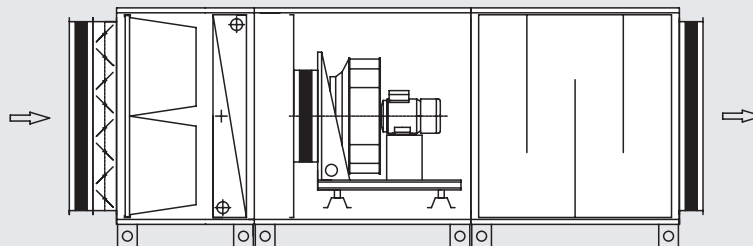
2) Unit for inlet or outlet of the air with filtration system and the fan with free impeller



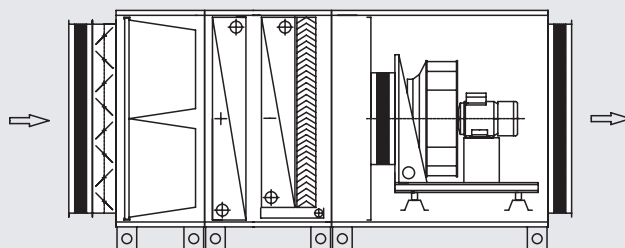
3) Unit for inlet of the air with filtration system, water heating system and the fan with free impeller



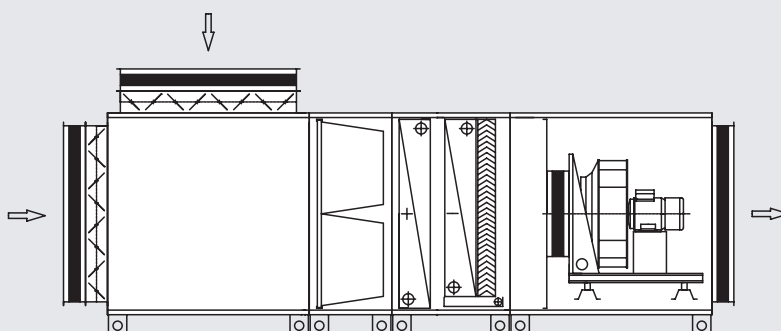
4) Unit for inlet of the air with filtration system, water heating system, fan with free impeller and noise buffer on discharge



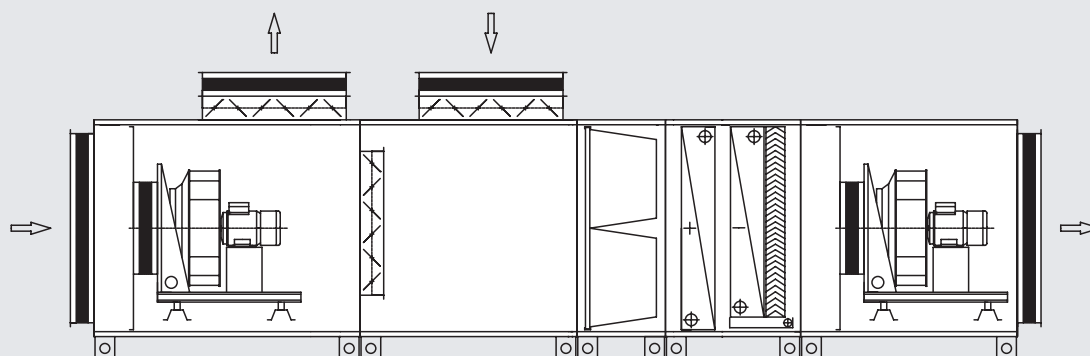
5) Unit for inlet or outlet of the air with filtration system, water heating system, cooling system and the fan with free impeller



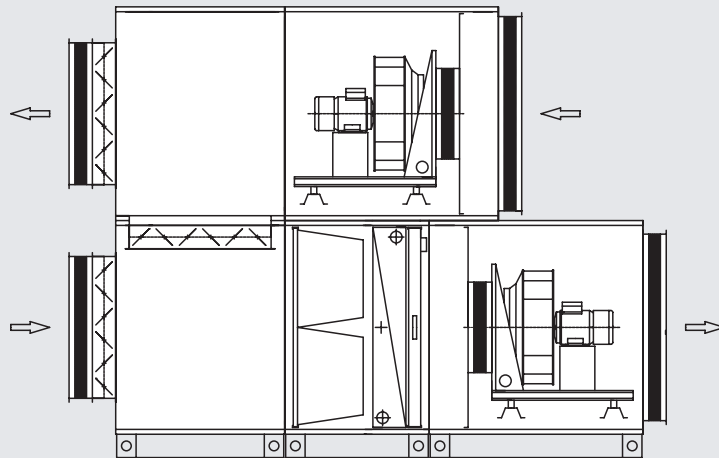
6) Unit for inlet of the air with blending, filtration system, water heating system and cooling



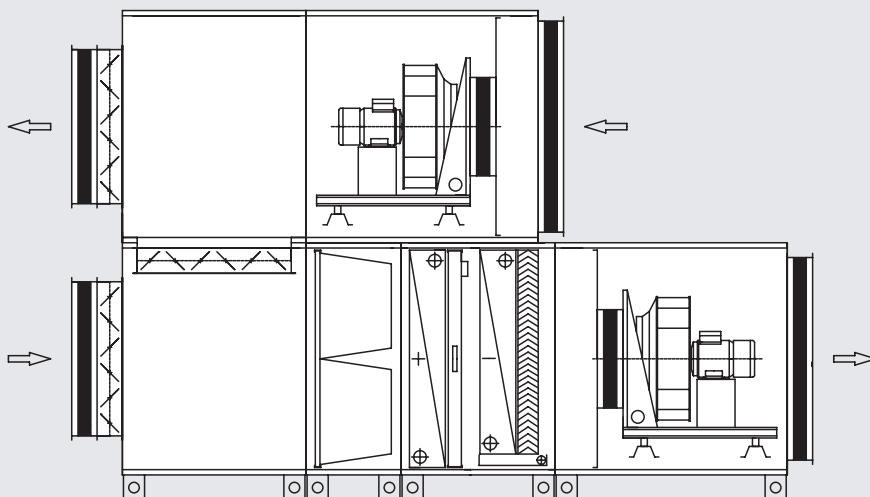
7) Unit for both inlet and outlet of the air with filtration system, water heating system, cooling system, blending (consecutive) and fans with free impellers



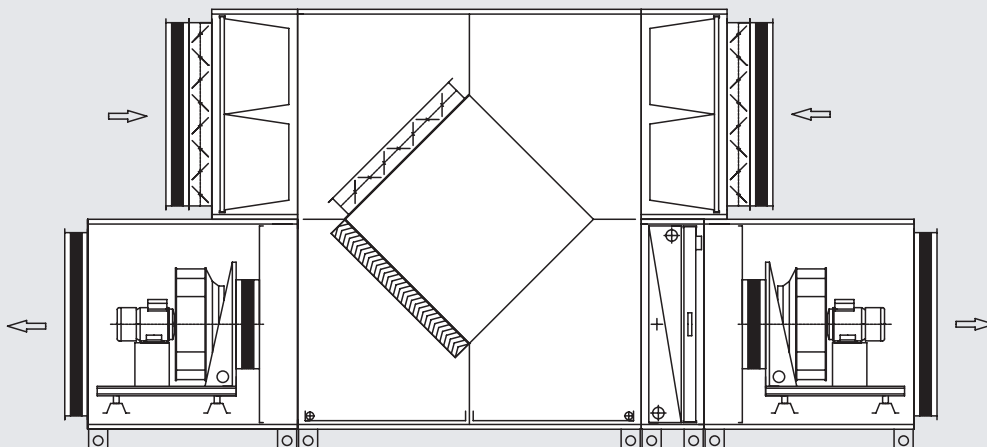
8) Unit for both inlet and outlet of the air with filtration system, water heating system, antifreeze protection, blending (one above another) and fans with free impeller



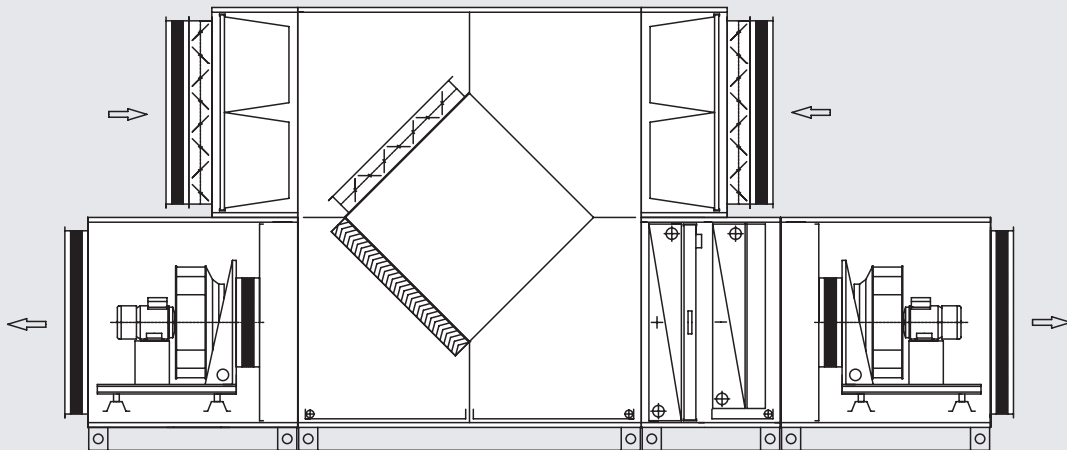
9) Unit for both inlet and outlet of the air with filtration system, water heating system, cooling system and blending (one above another)



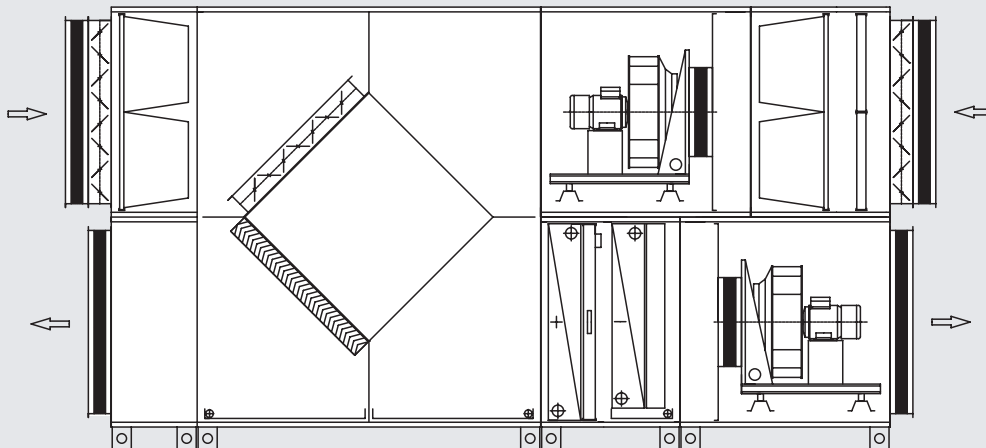
10) Unit for inlet and outlet of the air with tabular recuperator, water heating system, and the fan with free impeller



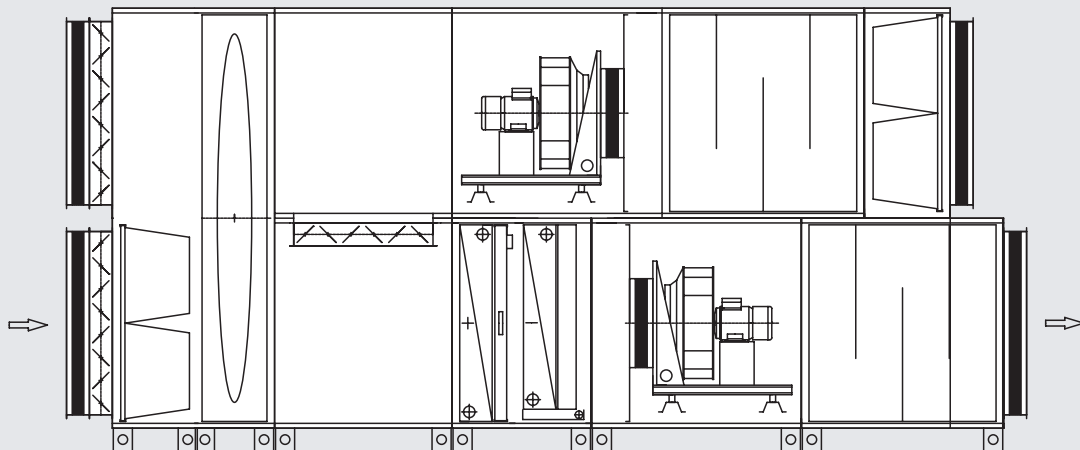
11) Unit for inlet and outlet of the air with tabular recuperator, water heating system, cooling system and the fans with free impeller



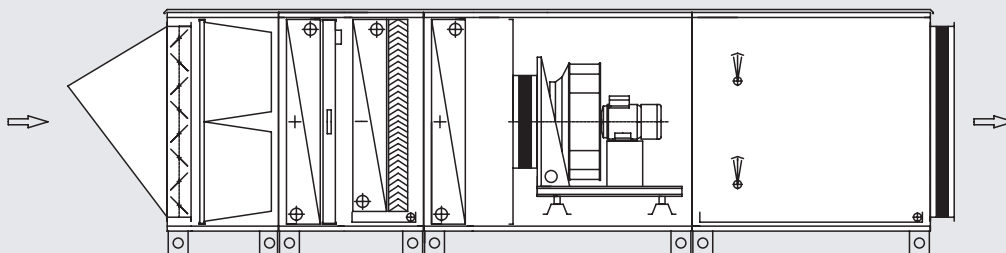
12) Unit for inlet and outlet of the air with tabular recuperator, fat filter at the outlet, water heating system, cooling system and the fans with free impeller



13) Unit for inlet and outlet of the air with rotational recuperator, mixing system, water heating system, cooling system and the fans with free impeller as well as the air buffers



14) Outside unit for inlet of the air fitted with pre-heater, cooler and post-heater, fan with free impeller and chamber for steam moistener



The assemblies are used only as an example of variability of MANDÍK units. They are not considered as binding. Due to high variability of the units, it is not possible to mention all possible assemblies.



# INSTALLATION AND OPERATION REGULATIONS

## intended for the air conditioning units of MANDÍK, series M and P

### 1. GENERAL INFORMATION

- These installation and operation regulations are considered as integral part of Technical Conditions TPM 088/12.
- Before attempting to begin any of these activities, it is necessary to study these regulations and comply with them. Compliance with these regulations is considered as a prerequisite for correct operation, function and fulfilment of warranty conditions.

### 2. SAFETY

- When making any installation, electrical installation, commissioning and maintenance of the units, you should comply with applicable standards, safety regulations and generally accepted technical rules.
- Installation of the units, including connection of the electrical installation, the process of commissioning the unit, repairs, maintenance and servicing, all these activities may only be performed by a natural or a legal person who is properly authorized.
- When working on cleaning, checking or repairs, the unit must be disconnected from the mains. Inlet of active fluid into the exchanger and inlet of fuel must be closed. You may begin to work on the heaters only after cooling them down to the temperature of +40 °C.
- The exchangers may be used only for conditions they were intended for.
- The fans are positioned on flexible insulators of vibrations. Conductors of electrical extensions and earthing system must not interfere with free movement of fans. Conductors must be fitted with loops, for example.
- **WARNING** – Service works on the fans may be started only after making proper protection against spontaneous start-up of the motor!!! We recommend installation of safety switches on the fan chambers. If a chamber is fitted with RM control cabinet which is located at the fan chamber, then it is not necessary to use a safety switch (the switch is included in the control cabinet).
- Units may not be used for other operating conditions than those for which they were shipped. The manufacturer is not liable for any damage caused by improper use. The user bears all the risk thereof.
- When transporting and moving, all the transport units must only be transported by using forklifts (in working position) or by using conveyor belts. It is strictly necessary to comply with relevant safety regulations.
- Changes, additions and modifications on the units, those which could affect safety, must not be carried out without previous consent of the manufacturer.
- When using the units, you must be comply with the guidelines of these installation and operating instructions.
- A fan chamber must be fitted with a safety label which is shown in Figure 1.1.



Fig. 1.1: Safety sign made on the door of the fan chamber (design according to ČSN ISO 3864)

- If you want to stop the fan operation, you shall also ensure closing of the active fluid supply to the heaters.
- When you discharge the active fluids out of the exchangers, you must keep their temperature lower than +40 °C.

### 3. TRANSPORT, HANDLING AND STORAGE

- The units are transported as individual chambers or compact blocks. Roofs for the outdoor units are supplied as pre-assembled together with the unit.
- Units are supplied as packed ones in plastic foil; larger chambers and units intended for export are placed and wrapped on pallets. Ways of packaging may be consulted individually.
- **WARNING:** Plastic foil is a transport packaging material intended for protecting the chambers during transport. They must not be used for long term storage of the chambers. Any changing temperature during transport can result in condensation of water vapours inside the package and consequently there may occur conditions suitable for corrosion of materials used on the chambers (e.g. white rust on the galvanized elements). Therefore it is necessary to remove this transport wrap immediately after finishing the transport in order to allow air coming to the chambers and in order to allow drying the surface of the chambers.
- During the transport and movement, the individual chambers must only be transported by using forklifts or conveyor belts. It is necessary to comply with the relevant safety regulations (ČSN ISO 8792). Chambers

### 4. ASSEMBLY AND INSTALLATION

- Installation of units may only be performed by a person authorized according to ČSN EN 45004, Act No. 174/68 Coll.
- The equipment is checked and preset in the factory. Operation is dependent on proper installation. Burner of the gas heater must be adjusted only after being installed on the chamber.
- The unit and its accessories must be installed according to installation instructions of Mandík, No. TPM 088/12.
- Connection and earthing of the electrical equipment related to the electric motor and also all the wiring systems must comply with the following standards, in particular ČSN 33 2190, ČSN 33 2000-4-41, ČSN 33 2000-5-51, ČSN 33 2000-5-54; they must also comply with applicable regulations and the local environment, with regard to keeping safe operation.
- Units and their accessories must only be commissioned by an authorized and trained technician who is familiar with the equipment and the hazards associated therewith.
- Prior to commissioning, it is necessary to provide a copy of electric systems revision (in accordance with ČSN EN 33 1500) and also the revision of gas installations!

- Connecting, disconnecting, checking or performing any manipulation related to direct cooling circuit may only be carried out by an appropriate mechanic who has the permission for installation and service of these condensing units!!!

may only be lifted up from the bottom side. When lifting them by a crane, you must use belts which are put under the unit. Regarding larger items, you should strut their belts at the top side to prevent the chambers from deformation. When using a forklift, chambers should be supported across the width to prevent the chamber bottom side from getting damaged.

- When taking the product over, it is necessary to check whether the product has been delivered in design and scope agreed and whether it has not been damaged during transport. If it was damaged during transport, then the transferee must record the extent of the damage while using a delivery note of the carrier. Failure to do so may result in risk of rejection of any reclamation claim for damage caused by the transport.
- Units should be stored in dry, dust-free areas which are protected against rain and snow and whose ambient temperature never drops below +5 °C. They must be protected against mechanical damage, contamination and corrosion caused by continuous condensation of water vapour on the surface.

- Units and their accessories must only be connected to the mains under voltage of 230 V/400 V, 50 Hz.
- There must be an access available to the switchboard to which the assemblies are connected. Power elements in the cabinet must be clearly marked (circuit breakers, contactors, switches, etc.) by using numbers of the equipment, according to the project of air ventilation system!
- We recommend that a person of assembly company and a person of a customer are present for the operation staff training.
- Units must not be used for installation of bridges and distribution systems of electric wiring, electric switchboards, etc.; any exceptions must be consulted with Mandík, a. s.
- It is recommended to use protective gloves for working on installation and handling related to the units.
- When handling and lifting, the chambers must only be transported by using forklifts or conveyor belts. It is necessary to comply with the relevant safety regulations. Units must not be transported over the people's heads!!!

- Recommended minimum distances of gaps:
  - Minimum space for basic maintenance and service: 600 mm on the side of operating staff.
  - Minimum space for repair and replacement of the equipment: width of the unit + 200 mm.
  - Minimum gap between the unit and flammable items: 200 mm.

- It is advised to attach a socket for 24 V voltage and a portable fluorescent lamp of 24 V to the inner metal sheet of the panel with a sleeve related to the fan chamber.
- Before installation, it is necessary to remove all supports and braces supplied with the unit for the purpose of transport.
- Lifting lug on the electric motor should only be used for lifting the electric motor during assembly and disassembly.

#### Procedure of assembly:

- Image – composition of the unit is included in the assembly drawing; it is included in every supply of air conditioning units. You shall pay attention to the position of doors and service side!!!
- Each chamber of the unit is fitted with the product label containing important information for operation and maintenance.
- Before beginning to connect the chambers into one compact unit, it is necessary to trace the documentation?: "mounting kit" for particular device in the delivery.
- Chambers should be placed on the roof in the order specified by numbers. They should be placed onto the previously prepared supporting frame or supporting base (see Preparation of the Building). Chambers should be peripherally underlaid with grooved rubber (not included in the supply).
- Chambers must be installed to each other and connected by using coupling eccentrics – see Figure 1.2 and the details attached in Figures 1.3, 1.4.
- Prior to installation, it is required to stick a seal on the seating surfaces of chambers, dimension of the seal is 50 × 3 (it is included in the installation kit).

#### CHAMBER CONNECTION BY USING THE CONNECTING ECCENTRICS – INTERNAL AND EXTERNAL (VERTICAL JOINT)

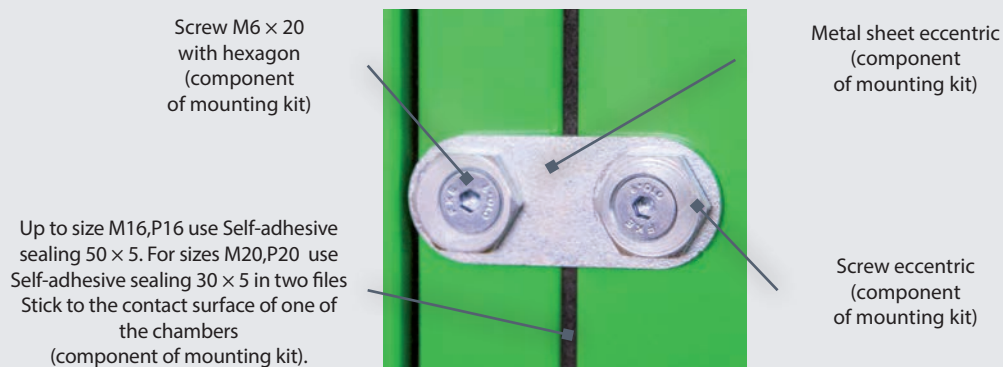


Fig. 1.2: Connection made by using connection eccentrics

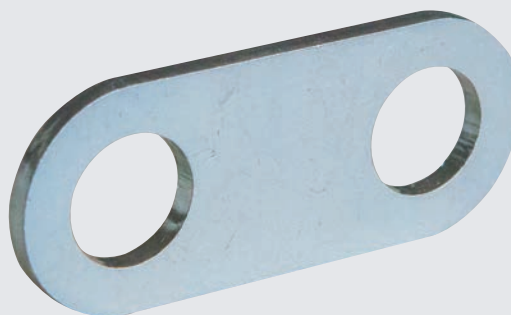


Fig. 1.3: Connection of chambers



Fig. 1.4: Coupling used for connecting the chambers having different sizes

- Material needed to assemble the unit is supplied within the mounting kit.
- The units are mounted by the service department of the manufacturer or a mounting company belonging to the customer, Or mounting partner from the supplier
- There shall be checks of construction readiness carried out before installation.
- Parameters of voltage supply systems, temperature and pressure of cooling and heating systems, completeness and condition of all parts related to the unit.
- Any defects must be solved before installation.
- As for fan chambers, it is necessary to check whether any foreign item is present in the fan impeller. Then it is also important to check out free operation of the electric motor bearings (hand rotating), condition of vibration isolators, conductive bonding of the fan with chamber's skeleton.
- There shall be a manual check related to rotation of the rotor belonging to rotary exchanger and tension of the drive belt.
- When commissioning the fans, it is important to regulate transported amount of air leading into the fan (setting the frequency converter) to the level of projected limit.

Air flow rate shall be determined by using the formula:

$$\dot{V} = k \cdot \sqrt{\Delta p_w} \text{ (m}^3\text{/h)}$$

$k$  = the constant dependent on fan size (see table 1.1)

$\Delta p_w$  = pressure difference measured between the suction mouth of the fan and suction side of the fan chamber (Figure 1.5)

RH22C	47	RH45C	197	RH90C	789	RH35Cpro	121
RH25C	60	RH50C	252	RH10C	999	RH40Cpro	154
RH28C	75	RH56C	308	RH11C	1,233	RH45Cpro	197
RH31C	95	RH63C	381	RH25Cpro	60	RH50Cpro	252
RH35C	121	RH71C	490	RH28Cpro	75	RH56Cpro	308
RH40C	154	RH80C	620	RH31Cpro	95	RH63Cpro	381

Table 4 1.1:  $k$  – constant of the fans used; it is applicable for air density of 1.2 kg/m<sup>3</sup>

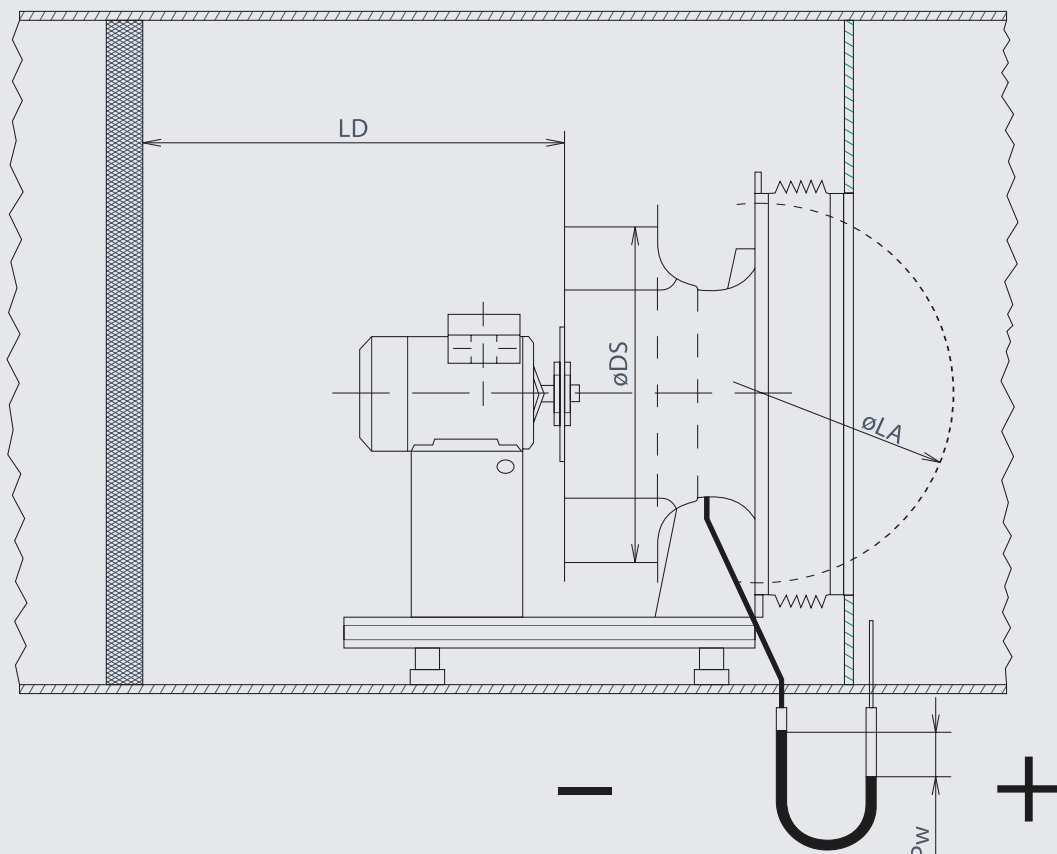


Fig. 1.5: Diagram of pressure difference measured on the fan

### Minimum times of starting the individual composite fans

Type of the impeller (compound):	Motor – number of poles	The minimum value of start-up [s]
RH25C.CR	2	4
RH28C.CR	2	6
RH31C.CR	2	7
RH35C.CR	2	7
	4	4
RH40C.CR	2	6
	4	5
RH45C.CR	2	5
	4	8
RH50C.CR	4	12
	6	8
RH56C.CR	4	13
	6	8
RH63C.CR	4	15
	6	16

## Minimum times of starting the individual steel fans

Type of the impeller (steel):	Motor – number of poles	The minimum value of start-up [s]
RH22C.1R	2	3
RH25C.1R	2	4
RH28C.1R	2	6
RH31C.1R	2	7
RH35C.1R	2	7
	4	2
RH40C.1R	2	6
	4	5
RH45C.1R	2	5
		8
RH50C.1R	4	12
RH56C.1R	4	13
	6	8
RH63C.1R	4	15
	6	16
RH71C.1R	4	13
	6	18
RH80C.1R	4	13
	6	21
RH90.1R	4	11
	6	19
	8	25
	6	18
RH10.1R	8	27
	6	21
RH11.1R	8	24

- Motor of the fan must be controlled by a frequency converter.
- It is necessary to measure stator currents of motors throughout the time of regulation.
- Before the first start, you shall check out correct direction of rotation of the servo drive unit flaps. Then you should also compare correct setting of the peripheral positions of the flaps with the data provided by the MaR system.
- The foundation on which the unit shall be built must be sufficiently strong to withstand operating weight of the unit. The foundation must have strict horizontal and even surface.
- The way of horizontal and even placement of the unit is considered as one of the conditions related to proper function of the unit!!!
- The units do not have to be anchored; we recommend underlay the unit with a band of grooved rubber (not included in the supply).
- Units with water exchangers or those fitted with condensate drain system must be placed in such the way that their possible accident cannot cause any damage (waterproof flooring, etc.)!!!
- The unit must be handled carefully. It is important to avoid any case of crossing the structure over.
- The condensate drain system nozzle related to the gas exchanger (fitted with thread G ½") must be equipped with suitable hose to drain condensate from the flue gases. Warning! It is contaminated fluid!!! Furthermore, it is also necessary to drain the condensate from the bottom side of the chimney.
- If the units are lacquered, you shall make conductive bonding of the chambers (Figure 1.6).
- The connecting parts which are electrically non-conductive, such as elastic damping elements, must be electrically bypassed in order to balance the potential.
- After installing the unit into one compact body, it is necessary to make the unit earthed at one point of the supporting frame and connect the unit to the grounding system of the building.

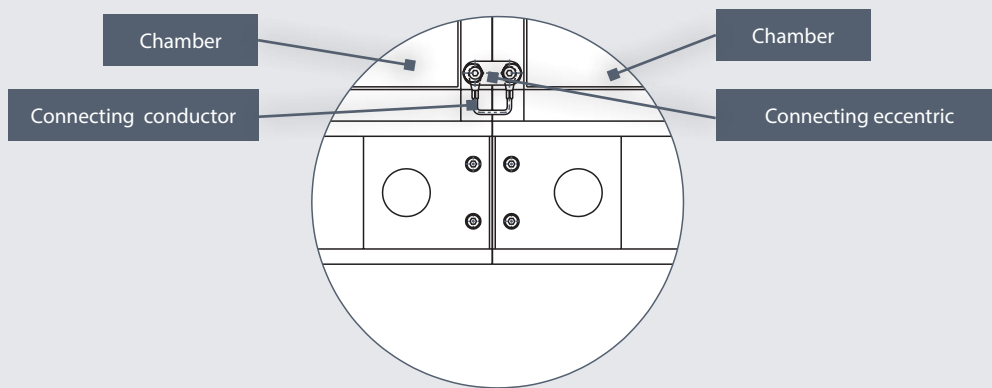


Fig. 1.6.: Conductive connecting of the chambers (in case of lacquered unit)

- All connections, including electrical power circuits and also including the interconnections of automatic control system components, shall not interfere with operation and maintenance of the unit. Connections of electricity are brought to the fan conversions (to the terminal box of electric motor) by using a flexible cable, through plugging bushings. Connections of the gas burner pass through the bushings in the bottom side of the burner's metal cover.
- Connecting the control circuit, including the works related to positioning of sensors, are included in the MaR project which is included in the equipment supply (if it is included in the delivery of Mandík, a. s.).
- Regarding the heating and cooling chambers, it is necessary to keep the methods of connecting the exchanger in back-flow in order to ensure the designed heat exchanger output (Figure 1.7).

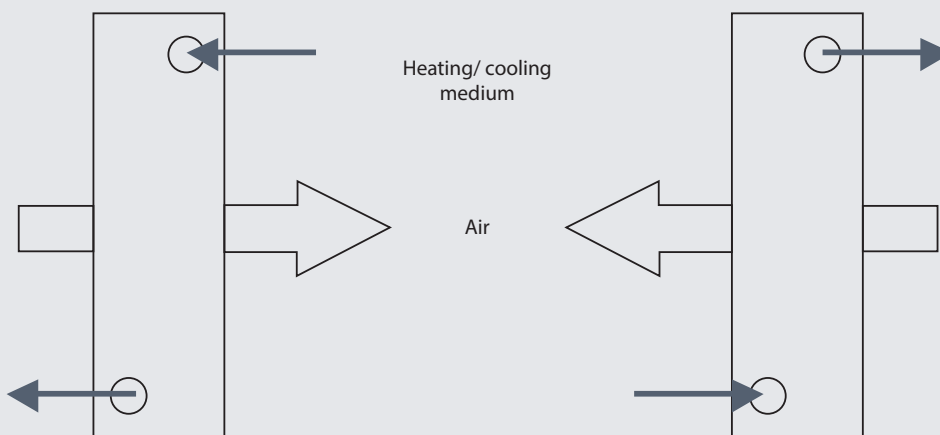


Fig. 1.7: Connecting the exchanger in back-flow

- Before the first start, it is necessary to vent the exchangers.
- Pipelines of the operating fluids must not affect necks of the exchanger with their weight and expansion forces.
- While regarding the steam heaters, it is necessary to use compensators.
- The air ventilation pipeline which is connected to the unit must be individually hung not to affect the buffer elements of the chambers with its weight. You shall check out tightness of all wiring connections before the first start.
- Installation of pressure sensors and temperature sensors is recommended to be done on the unit panels (service side). Each opening in the panel must be properly sealed.
- Installation of the MaR system, including the process of start-up and regulation, must be carried out by a professional company. Before mounting the servo drives, it is necessary to remove the original power cord from the terminal of the actuator (servo drive). Then it is necessary to directly connect the cable of the MaR control box to the terminal, or use the connection of cable related to the servo drive or control box through the box.
- Traps – all drains of the condensate (water) into the sewer system (related to cooling and ZZT modules) must be connected through the traps to allow proper function. The chambers are equipped with condensate drain pipes with dimension of DN 32.

The height of the siphon (trap) shall be adjusted according to the total transport pressure of the fan in particular branch:

1. When the total transport pressure of the fan is  $< 1,000$  Pa, the effective height of the siphon is  $H = 100$  mm.
2. When the total transport pressure of the fan is  $> 1,000$  Pa, the height of the siphon shall be adjusted according to the formula:

$$H = \frac{\Delta p_{cv}}{10} \text{ (mm)}$$

$\Delta p_{cv}$  ... total transport pressure of the fan (Pa)

If the total transport pressure of the fan is higher than 1000 Pa, it is necessary to use a supporting frame under the chambers having the height greater than 150 mm, or the adjustable supporting legs. Also, the unit shall be

placed on a raised plinth when using location in the engine room. The plinth will increase the distance of the condensate draining throat from the floor.

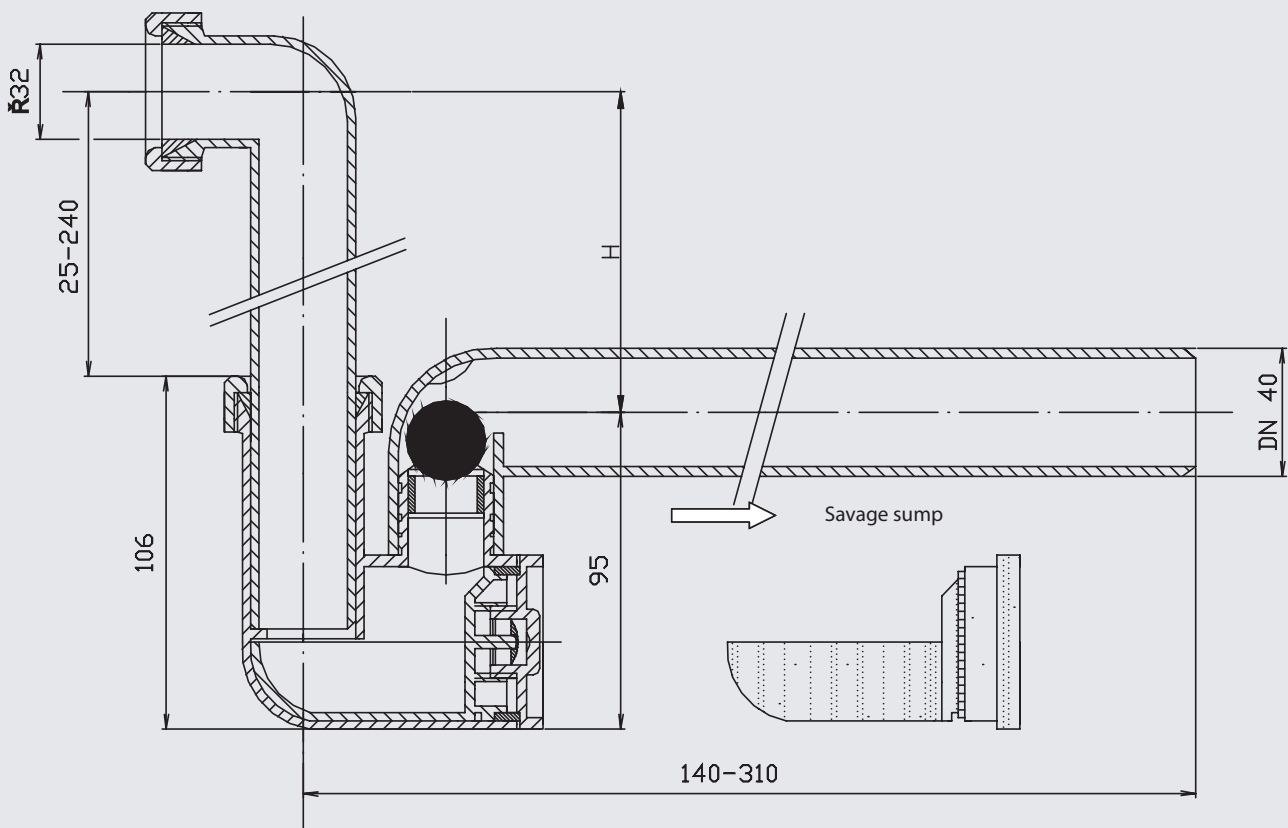


Fig. 1.8: *Ball trap*

- In the winter time, you shall ensure tempering of condensate route (including the traps) by using heating cables for instance.



## 5. COMMISSIONING

- Units may only be commissioned and maintained by properly educated and trained persons while complying with all relevant safety regulations and standards.
- There may occur a case of loosening certain components during transport; therefore it is recommended that you should verify tightness before first starting the unit, especially in the moving parts.
- When the outdoor air temperature falls down below +5 °C, you should open the inlet of active fluid leading to the water heater, before starting the fan. The temperature of the air heated before the fan must not exceed +40 °C.
- Units which are shut down or the units fitted with a cooling chamber for summer cooling only must be protected from freezing. It shall be done by draining the water or condensate from all parts of the unit. In order to ensure draining the water, the pipeline system (in the immediate vicinity of connecting necks) must include drain and vent valves positioned in such the way that there are no more fittings between the exchangers and valves. Any residual water must be removed by blowing out with the compressed air. Protection against freezing must be installed even in units that are not in continuous operation, such as backup units. Anti-freezing protection installed just behind the heater exchanger is the recommended method of protecting the heaters against getting frozen while in operation.

### Fans

- Diagram of the electric motors wiring is specified on the lids of terminals or in Annex 1 at the end of this document.
- Before the first start of the fan, it is necessary to measure the insulation resistance of the electric motor to prevent it from possible damage. During the test operation, door of the chamber must be closed. It is necessary to check out the correct direction of rotation of the fan impeller, according to the arrow located on the fan impeller.
- You shall check out the fan operation, balance – running without vibrations.
- Before starting, you shall tighten the mounting and check out the mounting and condition of the inlet cable (abrasion).
- Fans may only be started after connecting the unit to an appropriate pipeline system. There must be all panels installed on the chambers.
- Electric motors to be used for driving the fan impellers shall be fitted with the feature of smooth start-up operated by the frequency converter (included in the supply), otherwise the aggregate unit may get damaged.
- Manostat intended for controlling the fan operation shall be set up to the level of 80 % of the differential pressure value measured at the sampling points upstream and downstream of the fan.

### Filters

- Before the first start-up of the unit, the complete air-handling equipment must be thoroughly cleaned to prevent filters from excessive clogging.
- Interval of inspection and filter replacement shall be determined during the trial mode, by using a differential pressure gauge (increasing pressure drop). If the pressure drop gets doubled while compared to the pressure drop with clean filters, then the filter elements need to be replaced.
- Replacement of pocket filters must be carried out at least once a year (according to VDI 6022).
- Regeneration (cleaning) of the elements is not performed. Used filters must be disposed of in environmental ways.
- A self-adhesive seal must be stuck on each new filter element.
- WARNING – the filters in use are flammable – RISK OF FIRE!!!
- The process of cleaning the metal filters shall be carried out by beating down the coarse granules seated and subsequent rinsing by the solution of detergent and warm water. Then the filters shall be rinses with sufficient amount of clean water.

## Gas heater – Pecín, Monzun

- WARNING – gas heater – the burner must not be turned on without the fan unit running (switching and overrun of the fan – after cooling the heater down).
- There must be no combustibles stored in place of air heaters – RISK OF FIRE!!!
- Only fuel whose parameters match the requirements of the burner manufacturer is allowed to be used.
- Assembly and operating instructions to the type of burner are included therein.
- To enhance security, we recommend the operator should have the exchanger component checked out at least once a year by a service person.
- When maintaining the heater component, you shall perform inspection of tightening the burner flange and the burner (after the first month of operation and always before the start of heating season). At least once a year, you shall turn the swirling components in the pipes of the heat exchanger to release the deposits; the swirling components shall be removed and the tube shall be swept if necessary. The swirling components are accessible on the gas heater chamber operator side, after removing the panel on the right side of the burner and the metal sheet cover between the first and second draught of the heater. After cleaning, you shall always properly tighten the bolts of the metal sheet cover or replace gaskets on the contact surface. If the exchanger chamber includes the condensate container, you shall empty the container regularly.

### Formula for calculating the input power of the gas burner, respectively the thermal performance of the gas heater:

The formula is suitable for checking calculation of input power (or also the thermal performance of the heater) of the gas burner during being adjusted:

$$P_p = V \cdot \left( \frac{p_b + \Delta p}{101,325} \right) \cdot \left( \frac{273.15}{273.15 + t_p} \right) \cdot H_u \text{ (W)}$$

$$Q = P_p \cdot \frac{\eta}{100} \text{ (W)}$$

whereas

$P_p$  is the input power of the gas burner (W)

$Q$  is the heat capacity of the gas heater (W)

$\eta$  is the value of efficiency of the gas heater (%). This value consists of efficiency of the heater specified by a flue gas analyzer to which the value of heat loss of the heater's isolated cabinet of 1.5 % shall be added.

$V$  means consumption of natural gas from a gas burner ( $\text{m}^3/\text{s}$ ) (respectively the consumption of propane in  $\text{kg}/\text{s}$ )

$P_b$  is the barometric pressure at the time of measuring the current flow of gas (Pa)

$\Delta p$  is the gas over-pressure measured before the valve (Pa)

$T_p$  is the gas temperature before the gas valve ( $^{\circ}\text{C}$ )

$H_u$  is the calorific value of the gas ( $\text{J}/\text{m}^3$ )

$H_u = 36.4 \cdot 106 \text{ J}/\text{m}^3$  for natural gas G20

$H_u = 46.4 \cdot 106 \text{ J}/\text{kg}$  for propane G31

## Description of the function of chambers with gas air heater PEČÍN

Gas heating chambers - the required heating of the air is achieved by modulating the current burner power based on a command given on the control box.

Bypass function: Bypass part of the flap is controlled by servo drive with continuous driving function. The servo drives shall be controlled according to the flue gas temperature in the TS chimney (type PTS51). Flue gas temperature sensor is recommended to be placed in the chimney flue immediately behind the point of flue gas outlet from

the exchanger's component (see Figure 1.10). Servo-drives and the flaps are attached there to keep the flue gases temperature in the chimney at the level of 160 °C. It means that if the flue gases temperature (TS) increases above the level of 160 °C, then the bypass flap closes (and the exchanger section of the flap opens).

**WARNING: There shall be sufficient air flow through the exchanger!**

Safety function of the burner:

1. The emergency thermostat built in the burner senses the state of overheating the exchanger.
2. The MaR system must be fitted with the feature of limitation of the maximum temperature at the point behind the heat exchanger. The value shall be limited to 45 °C (temperature sensor in the supply air in the inlet pipeline). The MaR decreases performance of the burner after achieving this temperature.

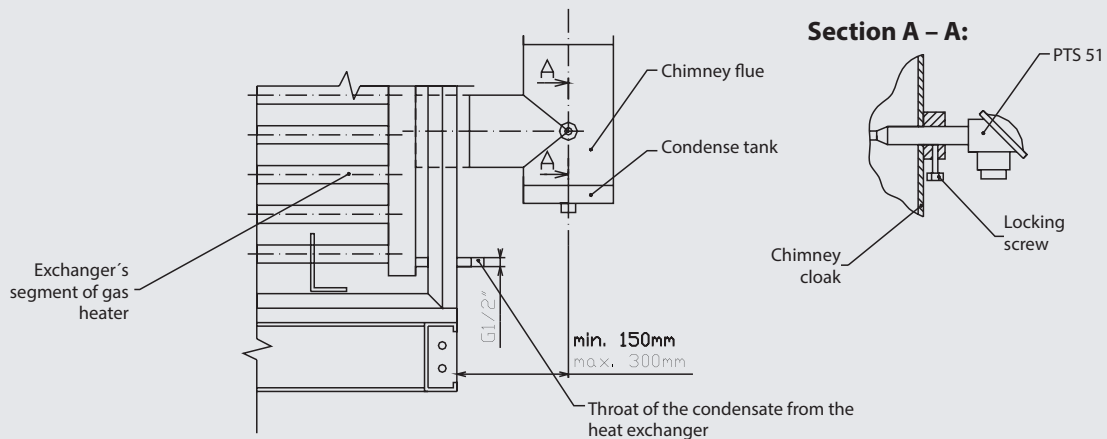


Fig. 1.10: Location of the flue gas temperature sensor

Safety function of the burner:

1. The cabinet with an emergency thermostat RTH must be connected to the burner chamber, according to Figure 1.11. Location of the emergency thermostat and its capillary is obvious in Figure 1.12.
2. The MaR system must be fitted with the feature of limitation of the maximum temperature at the point behind the heat exchanger. The value shall be limited to 45 °C (temperature sensor in the supply air in the inlet pipeline). When reaching this temperature, the system of MaR reduces burner performance regardless of the current need for heating.
3. The MaR system must be fitted with the feature of limitation of maximum flue gas temperature in the chimney at the level of 220 °C (sensor PTS51). When reaching this temperature, the system of MaR turns off the burner and reports the fault of the heater.

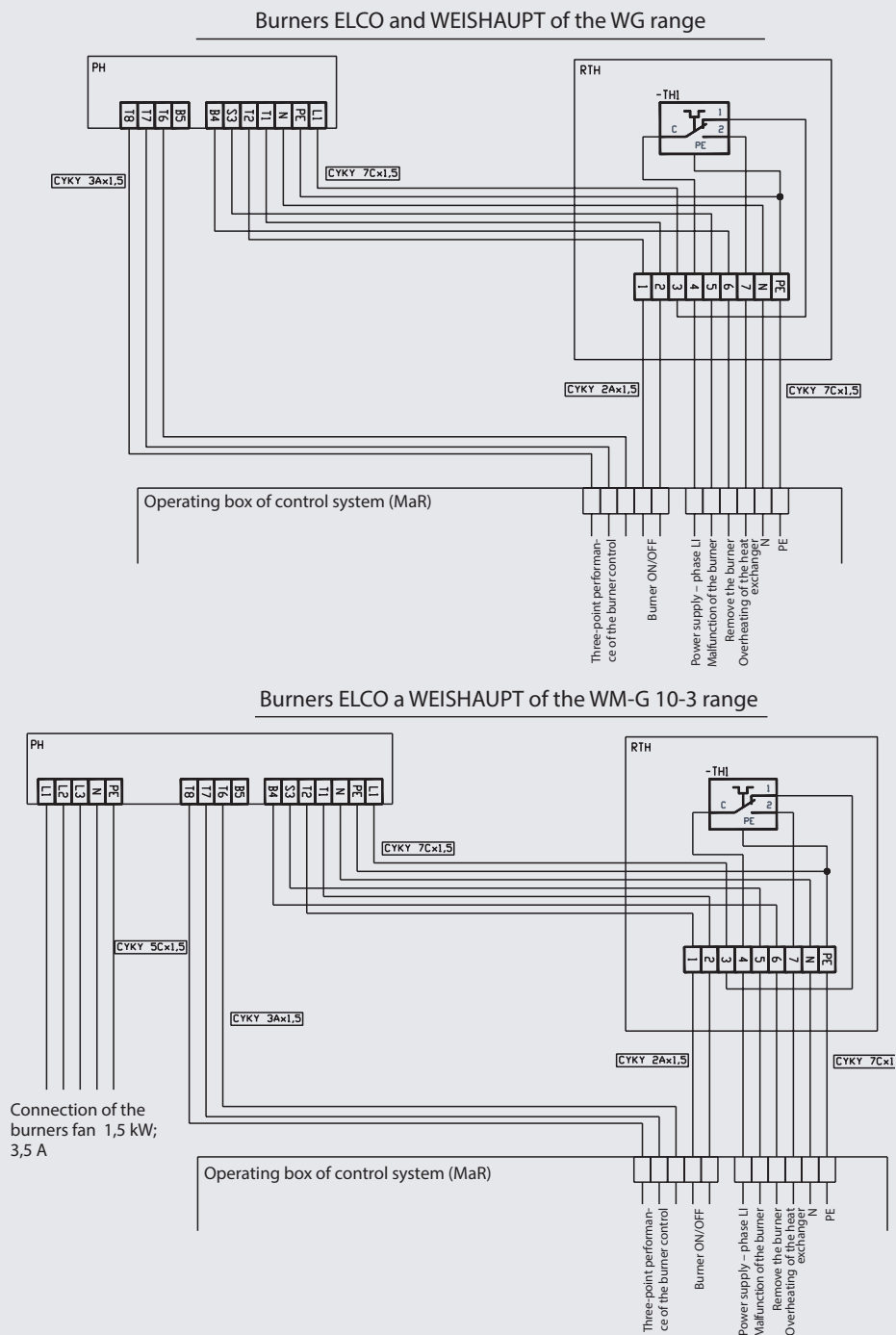


Fig. 1.11: Installation of RTH cabinet with a PH gas burner

### View from the side of servicing person for the chamber of gas burner

Size KJM-PECÍN 6/90; 10/140; 16/240; 25/370; 31/400; 40/610

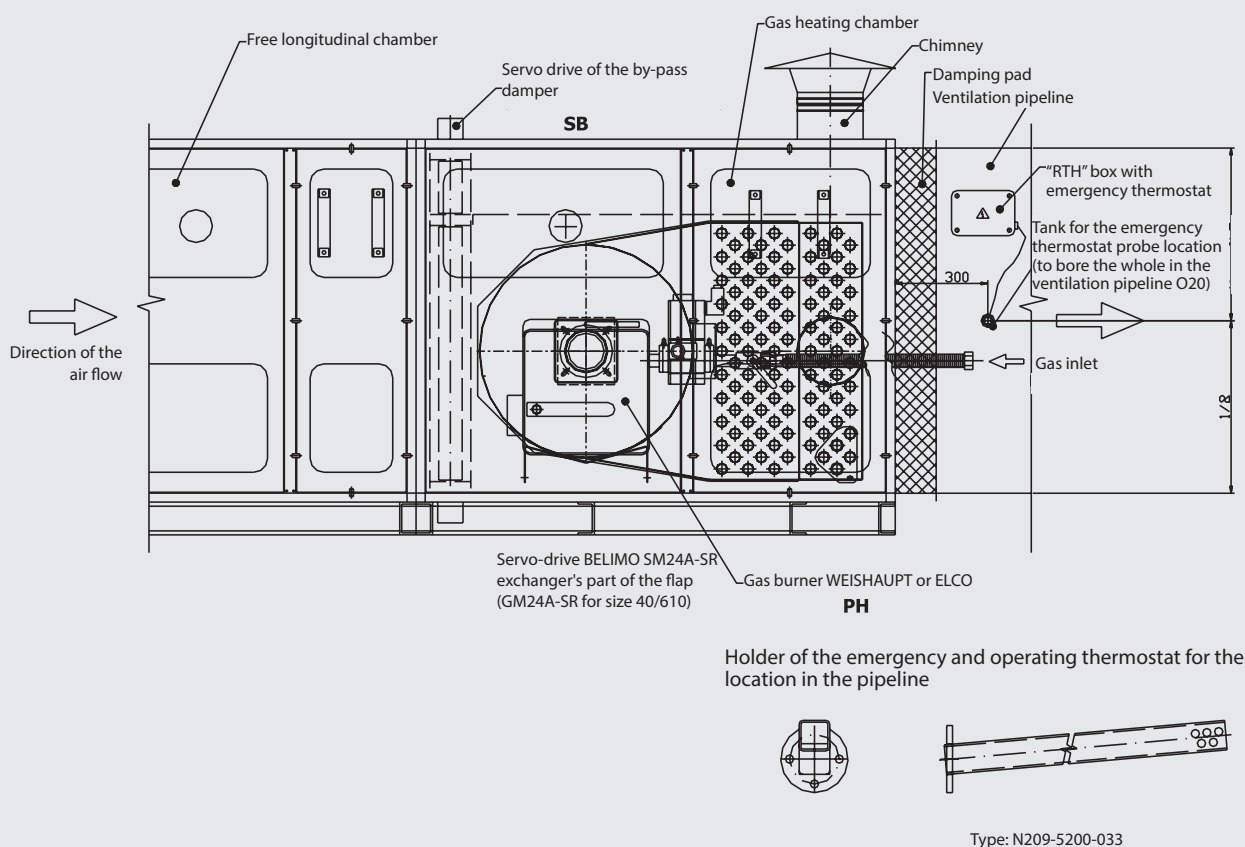


Fig. 1.12: Location of controlling system elements with the gas heater PECIN

- SB – servo-drive of the bypass,
- SV – servo-drive of the exchanger,
- PH – gas burner,
- RTH – cabinet with emergency thermostat.

Gas heating chambers – when heating is needed, burner PH1 turns on and heats up to the temperature level specified in position T2. If performance power of burner PH1 is not sufficient enough and if the desired temperature which is calculated by the regulator in the pipeline cannot be reached, then burner PH2 turn on and modulates to the required power, whereas the burner PH1 runs at the maximum power. The power required is controlled during operation of both the burners PH1 and PH2 by the burner PH2 only (burner PH1 runs at the maximum power, burner PH2 modulates) – principle of cascade regulation. In the opposite direction – if it is necessary to reduce burner performance – first the burner PH2 reduces the power (PH1 still runs at the maximum power). The burner PH2 will turn off the power if further power reduction is required. At the time, burner PH1 begins to modulate downward when it receives a request from the regulation section to reduce the power down.

Regulation should provide alternation of the burners on the basis of operating hours. When the equipment is turned on for the first time, then burner No. 1 is PH1 and burner No. 2 is PH2. When the burner PH1 reaches the number 1,300 of operating hours, the controlling system should use PH2 as burner No. 1 and PH1 as the burner No. 2. After other 1,300 hours of operation there shall be new alternation of burner priorities (PH1 will be again the number 1, PH2 will be the number 2). Flue gas temperature sensors TS1 and TS2 (those located in the chimney according to Figure 1.10) will be for information only in this case (there are no bypass and exchanging valves). Flue gas temperature sensor will have an emergency function – the burner turns off when the flue gas temperature reaches 220 °C, while reporting the fault.

Electrical connection of each of the two gas burners is governed by the diagram in Figure 1.11.

Safety function of the burner:

1. The cabinet with an emergency thermostat RTH must be connected to every burner chamber, according to Figure 1.11. Location of the emergency thermostat and its capillary is obvious in Figure 1.13.
2. The MaR system must be fitted with the feature of limitation of the maximum temperature at the point behind the heat exchanger chamber. The value shall be limited to 45 °C (temperature sensor for the inlet air in the air ventilation pipeline). When reaching this temperature, the system of MaR reduces burner performance regardless of the current need for heating.
3. The MaR system must be fitted with the feature of limitation of maximum flue gas temperature in the chimney at the level of 220 °C (sensor PTS51). When reaching this temperature, the system of MaR turns off the burner and reports the fault of the heater.

### View from the side of servicing person for the chamber of gas burner

Size KJM-PECÍN 50/480; 63/750

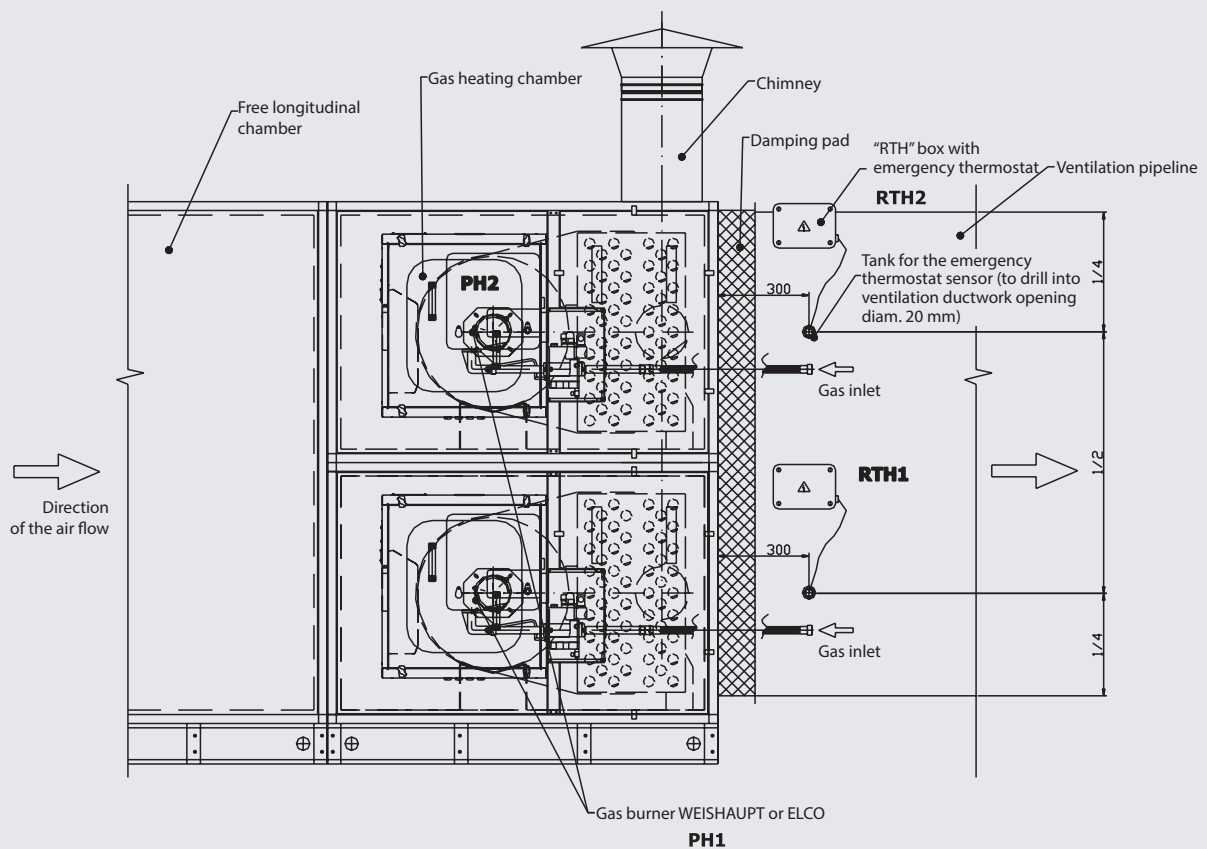


Fig. 1.13: Location of controlling system elements chambers with the gas heater PECIN

PH1 – gas burner No. 1

PH2 – gas burner No. 2

RTH1 – cabinet with emergency thermostat of burner PH1

RTH2 – cabinet with emergency thermostat of burner PH2

### Flaps and flap motors

- Before commissioning the flaps, we recommend testing the operation and direction of rotation of the servo-drive with no load as well as the setting of end positions of the flap. This will help to avoid any possible damage to the servo-drive.
- We recommend regular visual inspection of flaps at the time of rest, smooth operation of the flap, mounting the servo-drive together with cleaning the chambers at least once a quarter.
- You shall check out and lubricate the lever mechanism of the flap at least once a quarter.

### Exchangers with finned heat transfer surface

- Prior to commissioning, you shall check out connection of active fluids to the heat exchanger, filling the traps with water, function of shut-off valves and draining the chambers.
- WARNING – antifreeze liquids are harmful!!! You should not allow a coolant to run away into the environment – you should use a suction device.
- When beginning the operation, the heat exchangers must be vented.
- It is necessary to avoid excessive tightening of connections related to the exchangers, because it may result in damage to the throats of pipe joints (you shall use two wrenches for tightening).
- All the piping must be secured independently of the exchangers.
- Connections must be made in such the way that the expansion of pipes caused by the temperature does not cause excessive load of the connecting necks.
- Water to be used for water heat exchangers shall not contain impurities that cause clogging, especially corrosion products of steel and cast iron parts. To prevent these impurities from appearing, it is necessary to use chemically treated water with the following parameters:
  - hydrogen exponent pH 7–9,
  - water hardness 1.0 mval . l<sup>-1</sup>,
  - content of chlorides, maximum 30 mg . l<sup>-1</sup>,
  - content of phosphates re-calculated to P<sub>2</sub>O<sub>5</sub>, minimum 15 mg . l<sup>-1</sup>.
- Fins of the exchangers shall be purified against the direction of air flow by using the method of blowing the compressed air or a suitable solution.

### WARNING:

In the winter time, when the unit is shut down (e.g. a case of power failure), it is necessary to take into account the potential danger of the heat exchanger freezing – you shall check out the function of anti-freezing protection.

### ZZT chambers (heat recovery chambers) with tabular heat exchanger

- They do not have any special requirements for operation and maintenance apart from occasional blowing the tabular lamellas of the exchanger by using compressed air. Then you shall also verify condition and function of the flap.

### ZZT chambers (heat recovery chambers) with rotary heat exchanger

- Regarding the unit assemblies located above each other, the chambers are supplied as those partially covered with metal sheet in the front sides and fitted with rivet nuts M6 for the purpose of connection to other chambers of the air conditioning unit.
- WARNING – all works may be carried out only when the unit is shut down!
- Power supply of the drive-unit related to rotary exchanger impeller with the constant rotation speed equals 3× 400 V or 1× 230 V. If the rotary exchanger is fitted with the impeller's rotation speed control system by using a frequency converter, then the converter is powered by the voltage of 1× 230 V. The rotation speed control system is allowed by an analogue signal of 0–10 V.
- Before the first start-up, you shall check out the correct direction of rotation of the rotor; then you should also measure current consumption of the motor and free turning of the rotor – it must be friction-free.
- If smooth rotation speed of the exchanger's rotor is required, we supply a frequency converter of the rotation speed. Instructions for installation and operation of the frequency converter are included in the supply of rotary heat exchanger chamber.
- The process of cleaning the lamella surface of the exchanger shall be performed by blowing with the compressed air or steam. Check for tension of the exchanger's wheel belt.

### Electric air heater

- Installation of an electric heater must be done by a person authorized by regulation No. 50 ČÚBP – professional competence in electrical engineering. Electric heater must be connected to the mains according to ČSN 33200-4-41.
- The chamber of electric heater is equipped with a protective expanding thermostat (set up to the level of 70 °C) and the thermal fuse (set up to the level of 95 °C). Thermal fuses must be connected to the control system that switches off the electrical heaters and reports the failure.

- There are checks of heating rods carried out during periodic inspections (their overheating, etc.).
- Heating rods should be replaced when they are broken.
- Thermostat and thermal fuse must always be on the top side when the chamber is fitted.
- The heater must not be operated unless the fan is running.
- The heater must be protected separately.
- Fan run-out should be provided for the minimum time of 1 minute after turning off the power supply to the electric heater.
- The thermostat mounted has safety function. Depending on the conditions of the space, it is also necessary to mount a working thermostat which shall be installed in the air ventilation pipelines.

### Noise buffers

- They do not have any special requirements for operation and maintenance, except for occasional cleaning the buffer pieces by a vacuum cleaner.

### Free chambers

- There are no special requirements for operation and maintenance except for occasional cleaning to be performed with the service panel removed.

### Steam moistener

- When installing and operating the steam moistener, you shall proceed according to guidelines of the manufacturer. When working on the installation, the tubes of the steam moistener shall be plugged through the

- The safety thermostat shall be tested in every case of failure of the heating unit or controlling unit. Then it shall also be tested in preventive manner, e.g. twice a year in peak periods and also before commissioning.
- Amount of the air must correspond to performance of the electric heater to avoid a case of overloading the heating rods.
- In every case of failure, it is necessary to find out and solve the cause of the failure.
- An electric heater must be installed in such the way that the air flow corresponds to the sign on the electric heater.
- The heater must be started after reaching the maximum rotation speed of the fan.

hole in the panel on the unit's lateral side. Required size of opening in the metal cover shall be cut out during installation (if the moistener is not included in the delivery of Mandík, a.s.).

### Inspection during operation

- During operation, you shall monitor function and operation of all chambers of the unit, you shall monitor tightness of connections and mounting the panels,

temperature of transported air, pressure loss of air filters, vibrations.

### Inspection during state of resting

- Cleanliness of internal surfaces of the ventilator, especially the impeller.
- Check for filter clogging.
- Smooth action of flaps.

- Fixing of servo-drives.
- Functionality, throughput, tightness of water pipelines and condition of condensate outlet.
- Feature of anti-freeze protection.



## 6. MAINTENANCE

- Electric motors, servo-drives and burners are maintained according to the manufacturer's instructions.

### Dismantling the fan – impeller (system Taper-Lock®)

- You shall remove screws from the hub, pull them out of the holes. Take one or two of them and screw them fully into the forcing hole with inner thread. Then you shall lightly tap the hub casing. Then you shall tighten the forcing-off screws; the hub shall be released from the motor shaft. You should remove the impeller with hub from the motor shaft.

### Dismantling the electric motor

- This operation shall be done by loosening the screws with which the electric motor is attached to the base of the aggregate unit. Then, the electric motor can be,

### Removal of the gas heater PECÍN

- Removal of the heater exchanger is possible only after removing the cover of the burner, chimney, side panels and partition wall on the operating side of the chamber. The Burner cover is bolted to the side of the chamber by using four pieces of screws M8 (or M6). You shall switch off the gas supply system and dismantle the burner according to the burner manufacturer's instructions (see the installation and operating instructions of the type thereof). You shall dismantle

### Removing water exchangers

- An exchanger may be moved from the chamber along with a panel after disconnecting the supply pipeline of heating and cooling water as well as after dismantling the screws holding the side panels of the chamber.

### Revisions and repairs

- Revision of the air conditioning unit shall be carried out once a quarter. In the revision, you shall mainly perform and check out the following items:
  - a) cleanliness of internal surfaces, mainly the impeller's ones, baths for discharging condensate and filters,
  - b) verification of bearings,
  - c) smooth operation of electric motor and bearings,
  - d) consistency of the sheathing of the exchanger of gas air heater,

- Labels must be kept clean during the lifetime of the unit.

- WARNING – removing the fan impeller from the motor shaft brings the state of unbalancing and subsequent vibration – noise of the aggregate unit, after re-assembly of the impeller!!!
- Therefore we recommend measuring this connected aggregate unit with a vibrometer before or after installation (and weighing), when working on replacing the fan impeller or electric motor.

together with the impeller, moved to the operating side out of the chamber.

the front panel along with the burner flange. The flange shall be attached to the exchanger neck inside the chamber by using a clamp fastener. You shall take out the removable panel and screw out the partition wall between the panels. The exchanger is bolted to the bottom of the chamber by using eight screws M10 (or M8). After their dismantling, the exchanger may be moved sideways out of the chamber.

- e) condition of water exchangers (coolers and heaters) – especially their tightness, condition of lamellas,
- f) condition of sealing of doors and removable panels,
- g) functionality of main components of the unit (fans, motors, flaps, servo-drives, etc.),
- h) condition of paint, if the unit is lacquered.
- Any faults detected and corrected shall be recorded in the "Book of Repairs and Revisions"; user of the unit is obliged to keep such book.
- For any repairs, you can order replacement parts and their subsequent assembly at the company MANDÍK, a.s.

Fault	Possible causes	Solving the case
The unit does not reach the performance prescribed	Closed flap in air ducts or on the unit.	Open the closing elements.
	Blocked or clogged air ducts, impeller, etc.	Clean the air ducts, impeller, etc.
	Air ducts jammed and blocked	Repair and straighten the air ducts.
	Filter blocked.	Replace the filter.
	Improper rotation of the impeller.	Change poles on the electric motor.
	Values of the air ventilation system do not match the assumed values of the air ventilation project.	Compare the values specified by the designer to those of the manufacturer.
Excessive vibration of the fan.	Impeller unbalanced, impurities on the impeller.	Balance and clean the impeller.
Excessive vibration on electric motor bearing	Defective bearing.	Replace the bearing.
	Bearing damaged during installation.	Replace the bearing.
	Higher ambient temperature.	Take measures to lower the ambient temperature.
No operation of the flaps	Insufficient torque value of the servo-drive.	Change type of the servo-drive.
	Faulty servo-drive.	Replace the servo-drive.
	Flap blocked or clogged, foreign items.	Clean the flap.
	Flap crossed – leaves.	Release and straighten the flap or replace the flap.
Gas heater exchanger overheating	Sheathing of the heater's exchanger is burned out. Leaking revision cover on the heat exchanger.	Check out free operation of the lower exchanger section of the bypass flap.
		Check out through-passage of the flaps, in the air ventilation distribution system.
		Capillary of the emergency thermostat is too close to the heat exchanger sheathing.
Flue gases passing into the heated area.	No trap connected to the condensate output.	Change the exchanger.
No water flowing out of the cooling chamber	Není připojen sifon odvodu kondenzátu.	Connect the trap.
	Drain pipe clogged.	Clean and drain the discharge point.
	There are too long pipes, or closing elements, at the outlet of the trap.	Shorten the pipes or remove the closing elements.

- The spare parts are not supplied together with the unit (in the standard mode).
- Spare parts of the filtration chambers – the orders should include dimensions, number of pieces and class of filtration. Serial number of the chamber (specified on the production label).
- Spare parts of ventilation chambers – the orders for motors should include type of the motor, power (kW) and number of poles (rotation speed of the motor). Regarding the fan – impeller –, it is necessary to specify its size, such as RH56C (see the fan label) and the diameter of shaft to the motor. Serial number of the chamber (specified on the production label).
- Spare parts for chambers fitted with water exchanger – no spare parts required. In case of damage to an exchanger, you can order a new one at the manufacturer's.

The order should include: size of the unit, serial number of the chamber, type of heat exchanger – water or direct cooling – water heater, number of lines.

Regarding water exchangers – you shall specify the number of waterways, spacing of lamellas.

While regarding the Freon devices, you shall specify the number of cooling circuits, type of coolant and evaporating temperature.

## 7. DISPOSAL

- After the service life of the product and its subsequent disposal, it is necessary to proceed in accordance with the relevant regulations.
- Ferrous and non-ferrous metals must be scrapped.

- Fabric filters may be disposed of by incineration at higher temperatures, in the pyrolysis incinerators.
- Electric motors, servo drives, burners, moisteners and other accessories are to be disposed of according to the manufacturer's instructions.

## 8. WARRANTY

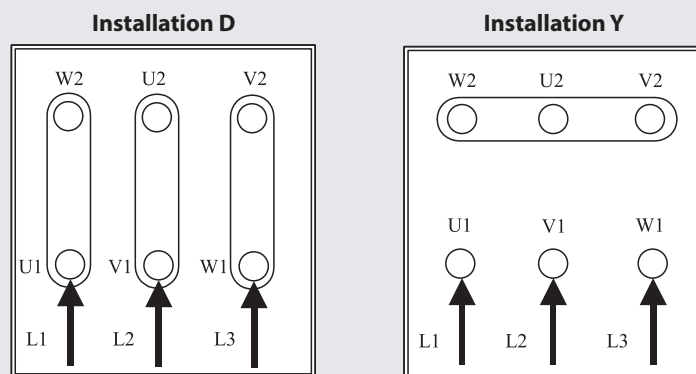
- In the event of a claim accepted and at the same time in the event in which no transport route for spare parts is provided (failure to comply with the recommended gap distances from the unit), we can hold material warranty only, without right for replacement of spare parts.
- Heat exchangers damaged by freeze are not subject to warranty!

- Guarantee under the purchase contract is valid under meeting the conditions described in this manual.
- The standard warranty period is specified for 24 months. Extended warranty of 60 months may be arranged upon an extra fee.

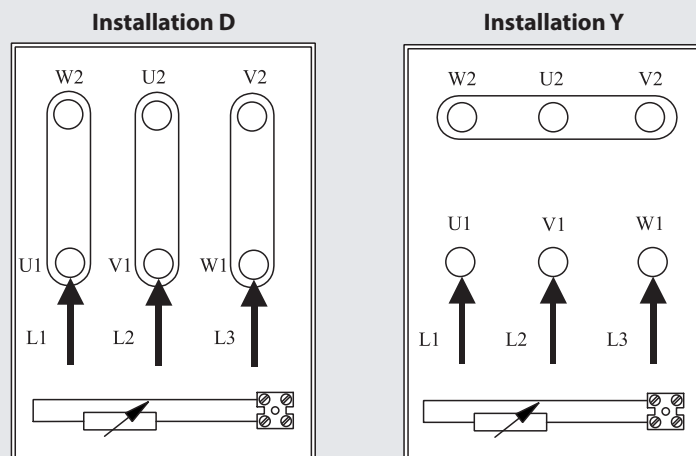
## 9. ANNEXES

### Annex 1: Installation of three-phase single-rotation motors

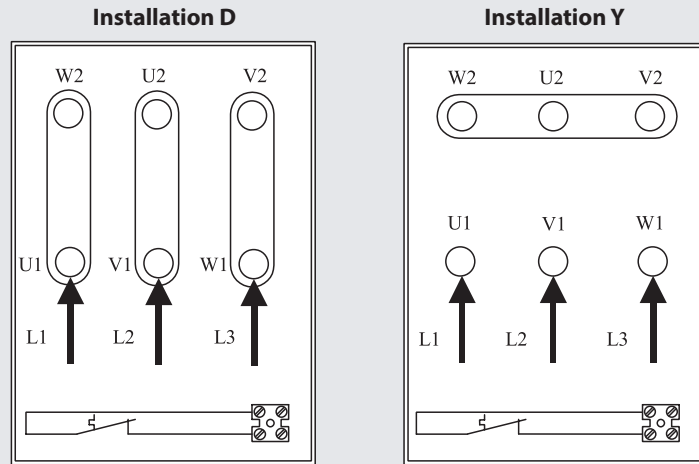
#### Basic installation



#### Installation with PTC thermistors

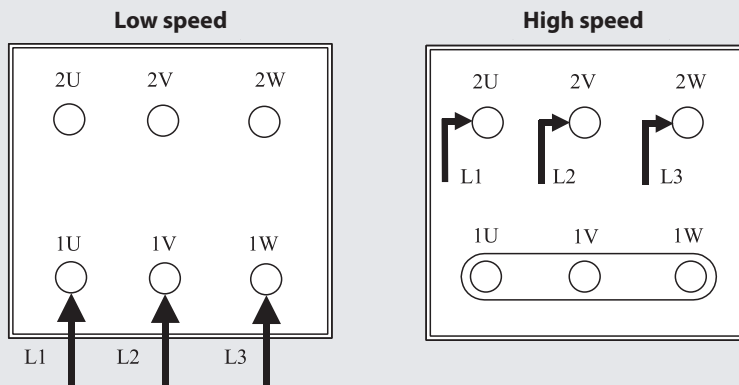


#### Installation with thermo-contacts

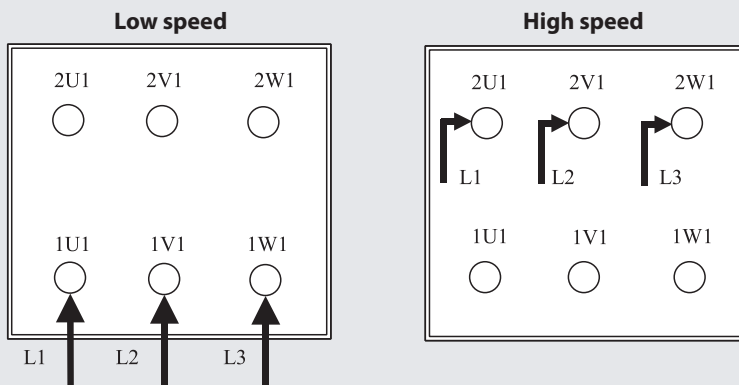


**Annex 2: Installation of three-phase and two-rotation motors**

*Installation of Dahlander 4/2 poles; 8/4 poles*



*Installation for two separated windings of 6/4 poles*









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The Company reserves the right for amendments carried out without any previous notice.