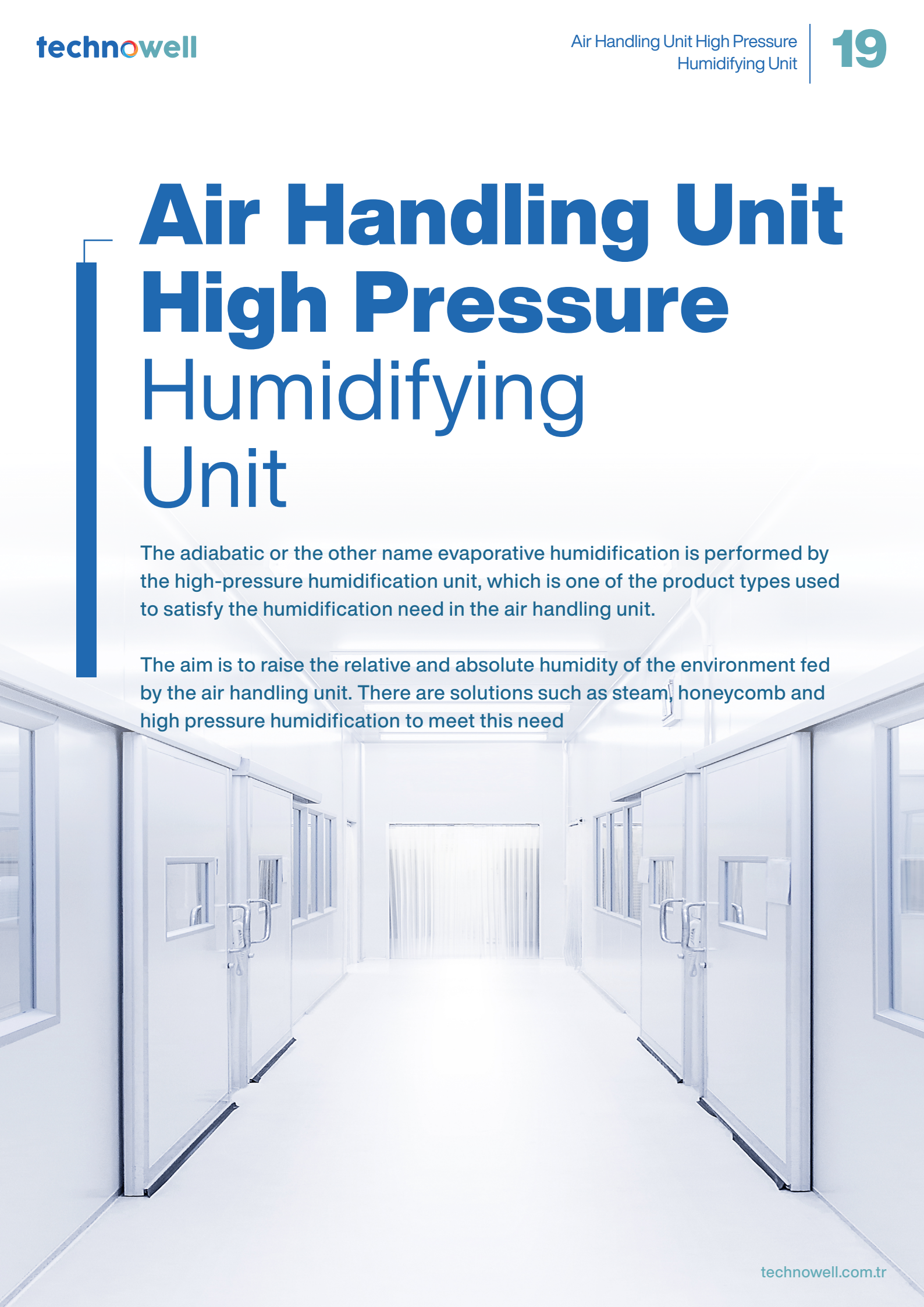
Air Handling Unit High Pressure Humidifying Unit

The adiabatic or the other name evaporative humidification is performed by the high-pressure humidification unit, which is one of the product types used to satisfy the humidification need in the air handling unit.

The aim is to raise the relative and absolute humidity of the environment fed by the air handling unit. There are solutions such as steam, honeycomb and high pressure humidification to meet this need



In several ways, a high-pressure humidifier outperforms other methods of humidification. When efficiency, particle size, electricity consumption, and return on investment are considered, it is the preferred method.

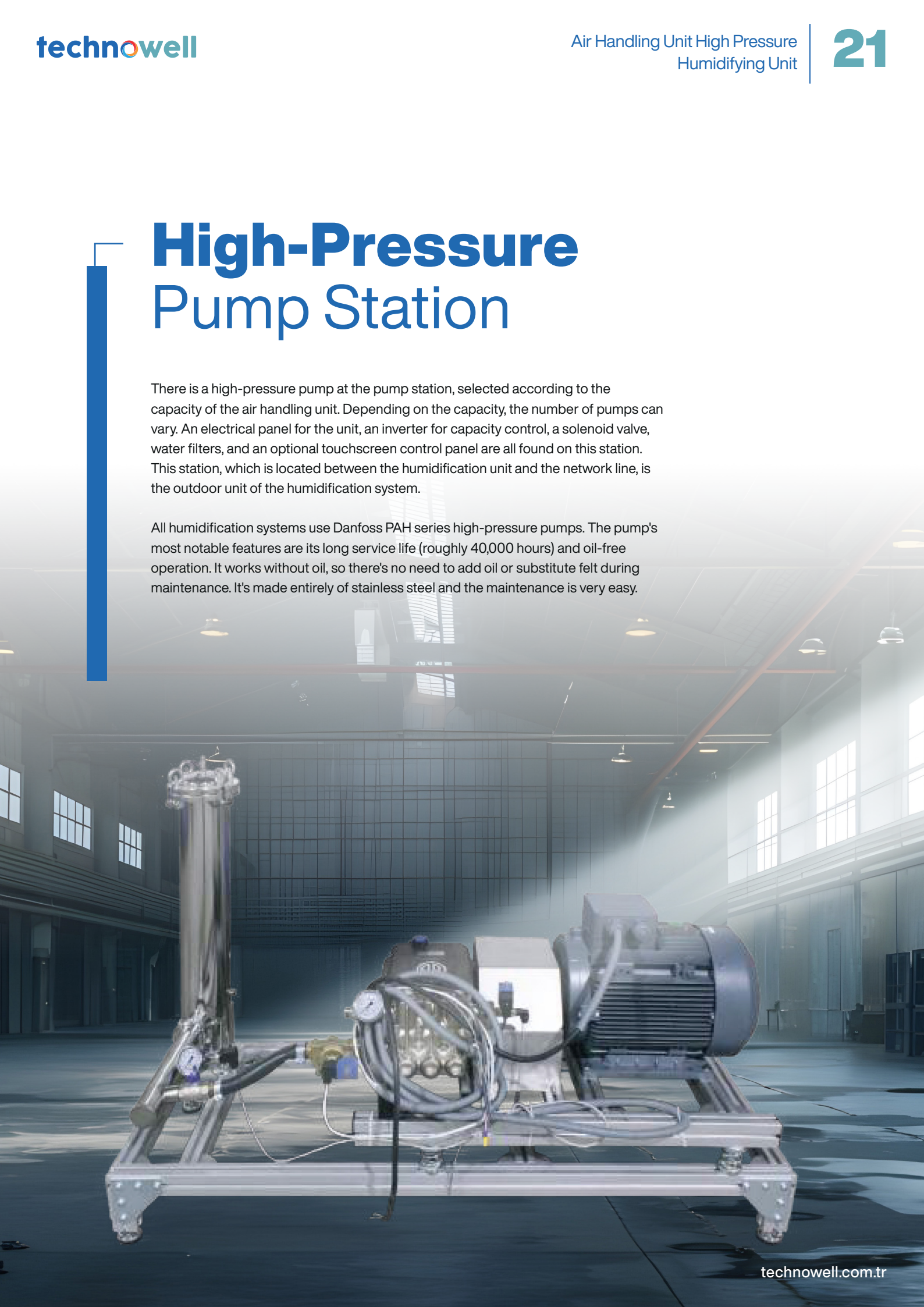
Two main units make up the air handling unit's high-pressure humidification unit;

- **High-Pressure Pump Station**
- **Humidification Unit**

High-Pressure Pump Station

There is a high-pressure pump at the pump station, selected according to the capacity of the air handling unit. Depending on the capacity, the number of pumps can vary. An electrical panel for the unit, an inverter for capacity control, a solenoid valve, water filters, and an optional touchscreen control panel are all found on this station. This station, which is located between the humidification unit and the network line, is the outdoor unit of the humidification system.

All humidification systems use Danfoss PAH series high-pressure pumps. The pump's most notable features are its long service life (roughly 40,000 hours) and oil-free operation. It works without oil, so there's no need to add oil or substitute felt during maintenance. It's made entirely of stainless steel and the maintenance is very easy.



High-Pressure Pump Station

MODEL	PAH 2.0	PAH 4.0	PAH 6.3	PAH 10	PAH 12.5
BODY MATERIAL	AISI 304	AISI 304	AISI 304	AISI 304	AISI 304
GEOMETRIC DISPLACEMENT	2 cm^3/dev	4 cm^3/dev	6,3 cm^3/dev	10 cm^3/dev	12,5 cm^3/dev
MIN. OUTLET PRESSURE	30 bar	30 bar	30 bar	30 bar	30 bar
MAX. OUTLET PRESSURE	140 bar	140 bar	140 bar	160 bar	160 bar
MAINS PRESSURE	0 -4 bar	0 -4 bar	0 -4 bar	0 -4 bar	0 -4 bar
MIN. REVOLUTIONS PER MİNUTE	700 d/d	700 d/d	700 d/d	700 d/d	700 d/d
MAX. REVOLUTIONS PER MİNUTE	1800 d/d	1800 d/d	1800 d/d	1800 d/d	1800 d/d
CAPACITY	2 lt/min	5,2 lt/min	8,7 lt/min	13,4 lt/min	17,2 lt/min
ELECTRIC ENGINE	0,90kW	1,70 kW	2,60 kW	4,50 kW	5,60 kW
SOUND LEVEL	76 dB(A)	76 dB(A)	76 dB(A)	75 dB(A)	75 dB(A)
WEIGHT	4,40 kg	4,40 kg	4,40 kg	7,70 kg	7,70 kg
NOTE	The values given for the capacity and electric motor are specified for 1500 rpm. Request information for higher capacity models.				

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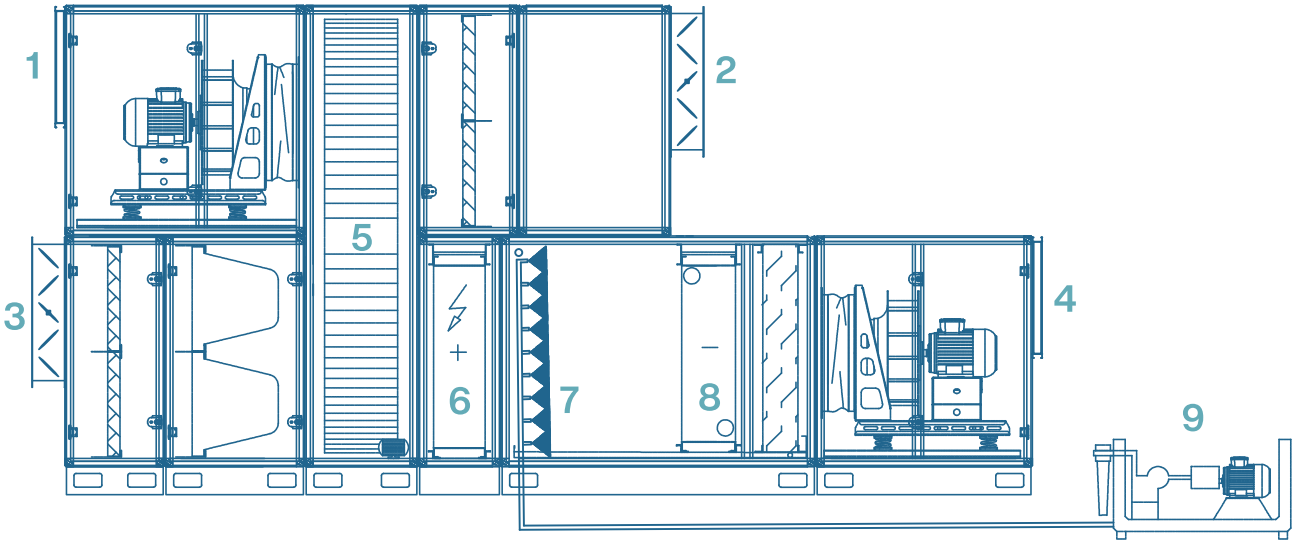
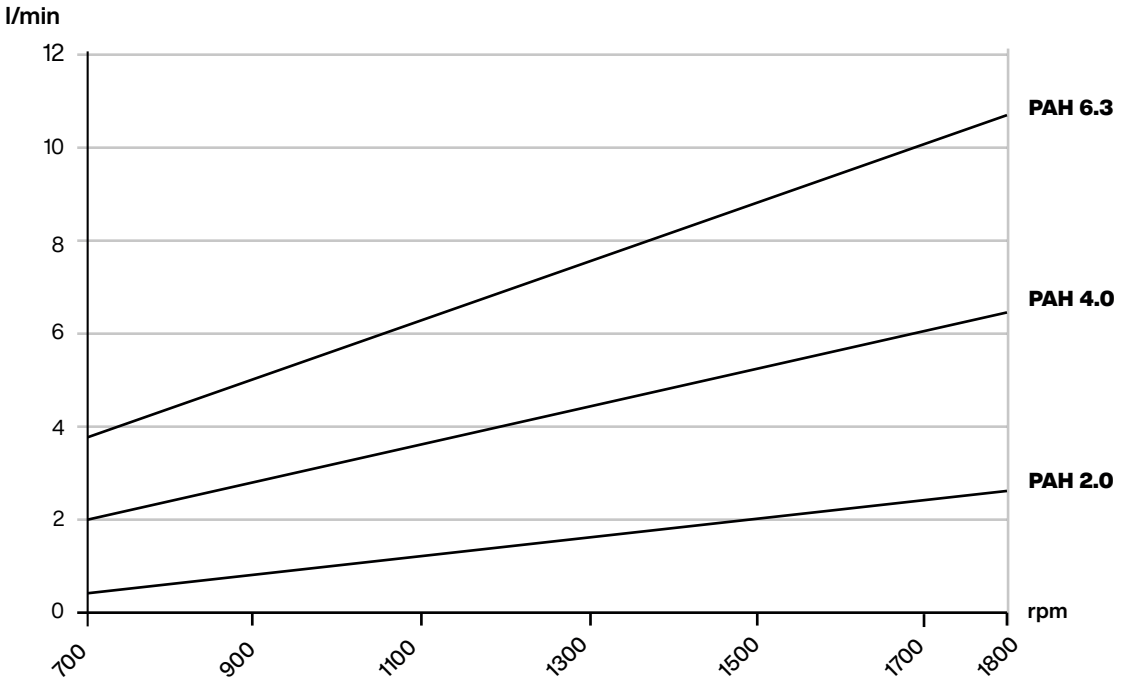
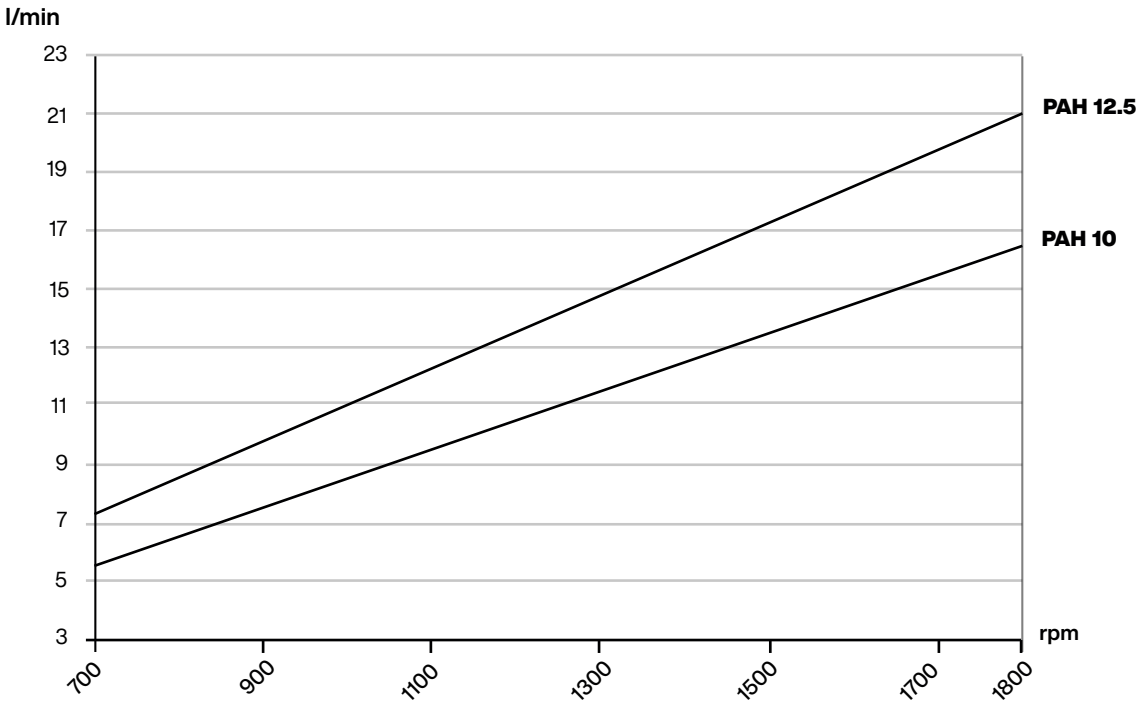


1. Inside Air Exhaust
2. Inside Air Suction
3. Fresh Air Inlate
4. Inside Air Outlet
5. Rotary Type Heat Recovery Unit
6. Heating Coil
7. High-Pressure Nozzle System
8. Cooling Coil *Drop eliminator according to air velocity at empty cross-section*
9. High-Pressure Pump Unit

PERFORMANCE

CURVES OF PUMPS





Humidification Unit

There are stainless steel nozzles and pipes on the humidification unit, which are determined according to the capacity. To ensure homogeneous humidification, the distances between the nozzle and the pipe are computed specifically based on the cross-sectional areas provided by the plant manufacturer. Total capacity varies depending on the air handling unit's air-flow rate and the desired humidity conditions. To determine the pump model and calculate capacity, the following information is needed:

- **Air Handling Unit Air Volume (m^3/h)**
- **Inlet Air Dry Bulb Temperature (°C)**
- **Inlet Air Relative Humidity (%RH)**
- **Desired Outlet Air Dry Bulb Temperature (°C)**
- **Desired Outlet Air Relative Humidity (%RH)**

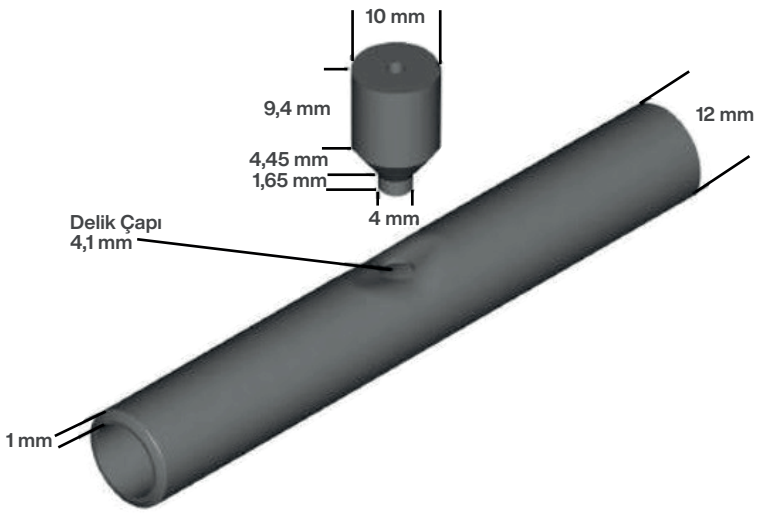
The nozzle, frame and pipes used are all stainless steel. Although there are nozzle options with appropriate diameters for various capacities, their numbers are determined for a uniform distribution based on the air handling unit's flow rate and cross-sectional area. To increase the nozzle capacity of a cell with a very high flow rate and a small cross-section, a nozzle with a large hole diameter is used.

Capacity Selection and Automation

To make it easier to choose, air handling unit manufacturers use precise cross-sectional dimensions for specific air-flow speeds. The table below shows the units and capacities chosen as averages based on these air-flow rates and air handling unit cross-sectional dimensions.

NOZZLE CAPACITIES

NOZZLE DIAMETER	0,15 mm	0,20 mm	0,30 mm	0,50 mm
70 BAR CAPACITY	2,90 lt/h	4,30 lt/h	6,90 lt/h	13,00 lt/h
80 BAR CAPACITY	3,10 lt/h	4,70 lt/h	7,40 lt/h	14,00 lt/h
100 BAR CAPACITY	3,50 lt/h	5,30 lt/h	8,30 lt/h	15,60 lt/h



EXAMPLE
CAPACITY SELECTION

MODEL	POWER PLANT CELL INTERNAL SECTION	AIR VOLUME	PUMP MODEL	HUMIDIFICATION MODEL CAPACITY
ACHP-2	1220 x 1530 mm	15000 m^3/h	PAH 2.0	72 kg/h
ACHP-2	1220 x 2140 mm	22000 m^3/h	PAH 2.0	106 kg/h
ACHP-4	1530 x 2140 mm	28000 m^3/h	PAH 4.0	135 kg/h
ACHP-4	1530 x 3060 mm	40000 m^3/h	PAH 4.0	192 kg/h
ACHP-4	1830 x 3060 mm	50000 m^3/h	PAH 4.0	240 kg/h
ACHP-4	2140 x 3360 mm	60000 m^3/h	PAH 4.0	288 kg/h
ACHP-6.3	2140 x 4280 mm	70000 m^3/h	PAH 6.3	336 kg/h
ACHP-6.3	2440 x 3670 mm	80000 m^3/h	PAH 6.3	384 kg/h
ACHP-6.3	2440 x 3670 mm	80000 m^3/h	PAH 6.3	384 kg/h
ACHP-6.3	2440 x 4590 mm	100000 m^3/h	PAH 6.3	480 kg/h
CAPACITY SELECTION CONDİTION	**Entry Requirement**	35 °C - %20 RH		
	Exit Condition	25 °C - %60 RH		

NOTE

The capacities have been chosen based on the flow rate and cross-section dimensions of the air handling unit. The values in the table are not exact and reflect the average values of the above-mentioned climatic conditions.

Different scenarios can be used if automation is requested. The humidification unit can be monitored and controlled remotely. The pump can be driven with an inverter or used as On-Off. In the humidification unit, precise control can be achieved. Using solenoid valves, the humidification unit is divided into compartments for gradual control application, and each compartment can be controlled independently.

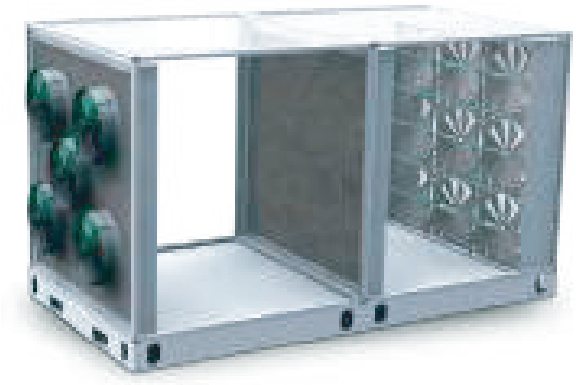
Automation Scenarios

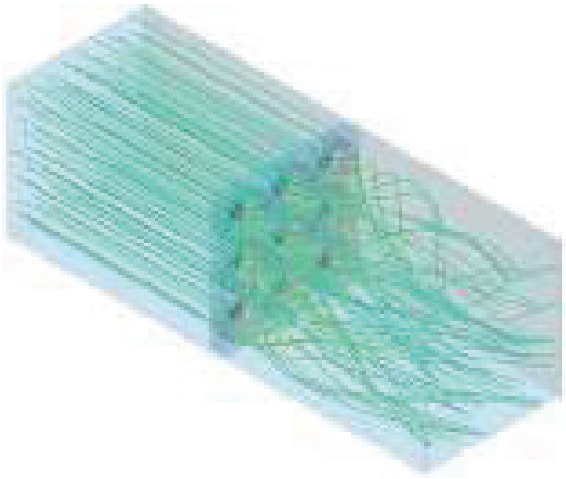
On-Off: At a constant pressure of 80 bar, all nozzles in the humidification unit open at the same time and deliver moisture to the air handling unit cell. When the necessary humidity is present in the indoor climate, the system shuts down automatically.

Gradual Control: The humidification unit's nozzles are divided into four main zones, with the 1st mainline providing a continuous capacity of at least 25%. The required moisture requirement is met with gradual control by opening the 2.-3.-4. mainline, in case of need.

Air Turbulator

In order for the air to be sufficiently saturated with moisture when a high-pressure humidification unit is used in a standard air handling unit, a minimum cell with a length of approximately 1.80 - 2.00 m is needed. As a result, increasing the cell size raises the costs. Productivity starts to decline as the cell size shrinks. Intense water drainage is observed before the drop eliminator as a result of water drift. Even if the power plant manufacturer produces a suitable length power plant for this unit, there would not be enough room to position it in the field. In this case, air diverters are used, which are entirely manufactured and designed by the Technowell Engineering group.





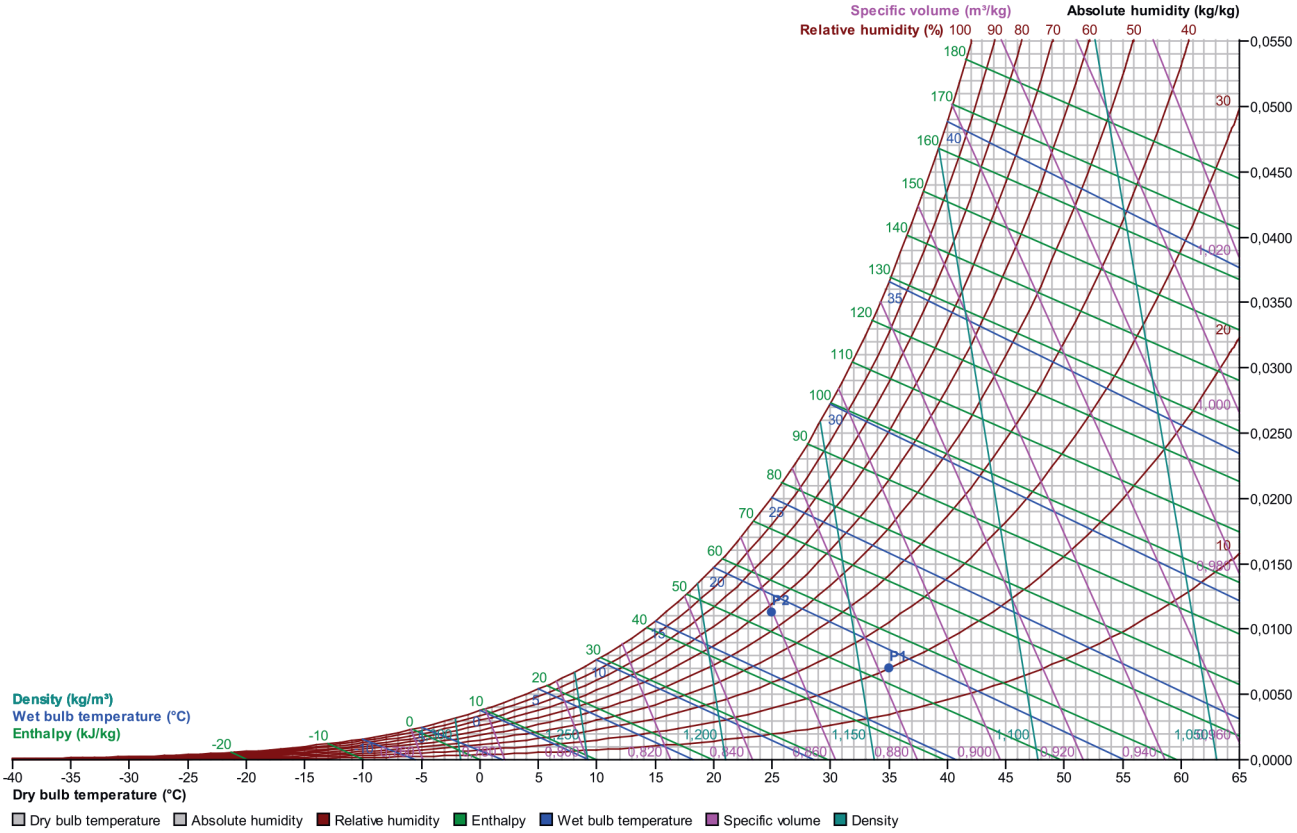
Water Quality

There are two filters on the pump station to filter the water taken from the mains line and sent to the pump. Filters should be closely followed and replaced according to a predetermined procedure to ensure pump health and productive humidification. To control internal leakage and improve component performance, Danfoss PAH series pumps have a very narrow dead space design.

A 10 µm absolute filter with a beta value of ß10 ≥ 5.000 and an efficiency rate of 99.98% is used as the main filter. This filter is efficient enough that it only allows 20 particles out of 100,000 to pass through.

High-Pressure Humidification and Psychrometric Diagram

In high-pressure humidification processes, there is no audible heating or cooling. Since the moisture released into the environment has a small enough particle size to blend with the air, evaporation is facilitated, and the environment naturally cools. The enthalpy remains constant in the process since there is no sensible heating or cooling. After the humidification process, the temperature decreases. As moisture is provided to the atmosphere, absolute humidity rises. Depending on the absolute humidity, the relative humidity also increases.



Electricity Saving and Efficiency

Because of its high efficiency and low energy usage, a high-pressure humidification unit is favored over a steam humidifier. The pump station's electric motors use very little energy because instead of heating the water, it pulverizes it with a 0.2 mm nozzle at high pressure. But the temperature drops after the high-pressure humidification process. Extra preheating can be needed if temperature and humidity are significant in the system. As compared to a steam humidifier, the high-pressure humidifier has a self-compensation duration of about 4 months.

SYSTEM OPERATING CONDITIONS AND GENERAL INFORMATION

MAINS WATER PRICE	1,5768 $/m^3
ELECTRICITY PRICE	0,0939 $/kWh
SYSTEM DAILY WORKING HOURS	18

TECHNICAL DATA BEFORE HIGH-PRESSURE HUMIDIFICATION UNIT

SYSTEM ELECTRICITY CONSUMPTION	67,60 kWh
SYSTEM MONTHLY ELECTRICITY CONSUMPTION	36.504 kWh
SYSTEM MONTHLY ELECTRICITY BILL	3.427,72 $
TOTAL INVOICE PAID MONTHLY	3.427,72 $

TECHNICAL DATA BEFORE HIGH-PRESSURE HUMIDIFICATION UNIT

HUMIDIFICATION UNIT ELECTRICITY CONSUMPTION	2,20 kWh
HUMIDIFICATION UNIT MONTHLY ELECTRICITY CONSUMPTION	1.188 kWh
HUMIDIFICATION UNIT MONTHLY ELECTRICITY BILL	111,55 $
HUMIDIFICATION UNIT WATER CONSUMPTION	660 lt/h
HUMIDIFICATION UNIT MONTHLY WATER CONSUMPTION	356,4 m^3
HUMIDIFICATION UNIT MONTHLY WATER BILL	561,97 $
TOTAL INVOICE PAID MONTHLY	673,52 $

GAIN AMOUNTS AFTER HIGH-PRESSURE HUMIDIFICATION UNIT

MONTHLY EARNINGS AFTER HUMIDIFICATION UNIT	2.754,2 $
HUMIDIFICATION UNIT SELF COST RECOVERY TIME	≤4 Ay

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