



FKS

Air Handling Units

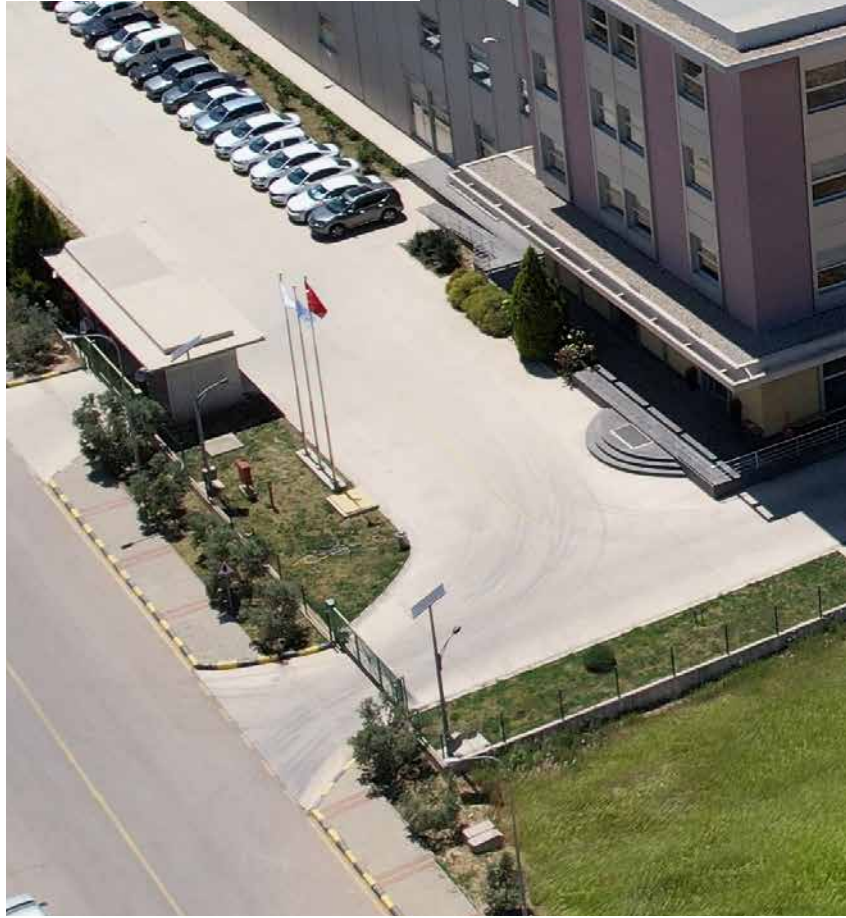




FORM GROUP

Founded in 1965, the main activity of Form Group companies is the Production, Sales & After Sales Services of Commercial and Residential air conditioners, in order to improve the quality of life. The Group is active in the sectors of hotels, hospitals, shopping malls, commercial buildings, schools, factories and homes. The Group consists of 4 companies.

FORM Endüstri Tesisleri A.S. is the manufacturing company of the Group and maintains its activities in 14,000 m2 factory in Izmir. The company has two main activities. The first one is the manufacturing and sales of natural smoke and heat extraction systems, evaporative coolers and natural daylight systems, mostly for the roofs of industrial buildings. The second one is the OEM manufacturing of rooftops, water source heat pumps, air handling units and fancoils for the Group companies. The company also produces air purifiers.



FORM Endüstri Urunleri A.S. specializes in commercial and industrial air conditioning solutions. The products sold and serviced are either manufactured by the sister companies in the Group such as fancoils, air handling units, water source heat pumps, rooftops, or imported from the exclusive representations from world known brands; Lennox, Clivet, Climate Master. The main products are rooftops, chillers, fancoils, heat pump units, air handling units, cooling towers and other commercial air conditioning products. The company is one of the top commercial sales and service providers in the Turkish A/C market.

FORM MHI Klima Sistemleri A.S. is a Joint Venture company with Mitsubishi Heavy Industries. The company provides sales and After Sales Services for commercial and Residential applications, with VRF and Split – Multi Split air conditioners. The company is one of the three biggest suppliers in the Turkish market for VRF equipment.



FORM Yönetim Destek A.Ş. is the management company that provides finance, accounting, logistics, IT, H&R and marketing services to the above three group companies, as they only comprise of manufacturing, sales and service personnel.

The head office of FORM Group is located in Istanbul, Maslak business district. There are regional offices in Ankara, Antalya, Izmir, Adana and Bursa for each sales company separately, with the factory in Izmir.

FORM Group is a founding member of ISKID Turkish HVAC Association and ISKAV Turkish HVAC Foundation. The group believes in professional organization and work ethics, by being a serious, reliable, technical and trustworthy provider, depending on the ethical values.

Air Handling Units are used in order to find solutions to heating, cooling, humidification, dehumidification, filtration, ventilating and similar demands in buildings. In order to reach ideal comfort results air temperature, humidity and quality should be properly controlled before being introduced into the space.

Therefore, air handling units in air conditioning systems must be versatile and reliable to meet those expectations, with proper control of the indoor comfort. This applies in residential buildings as well as in commercial and industrial applications. Furthermore, for critical production processes, such as food and beverage, hospitals and pharmaceutical industry additional hygienic solutions must be provided.



FORM FKS AHU's with Eurovent certification are fully compliant with demanding ErP 2018 Ecodesign European Regulations.

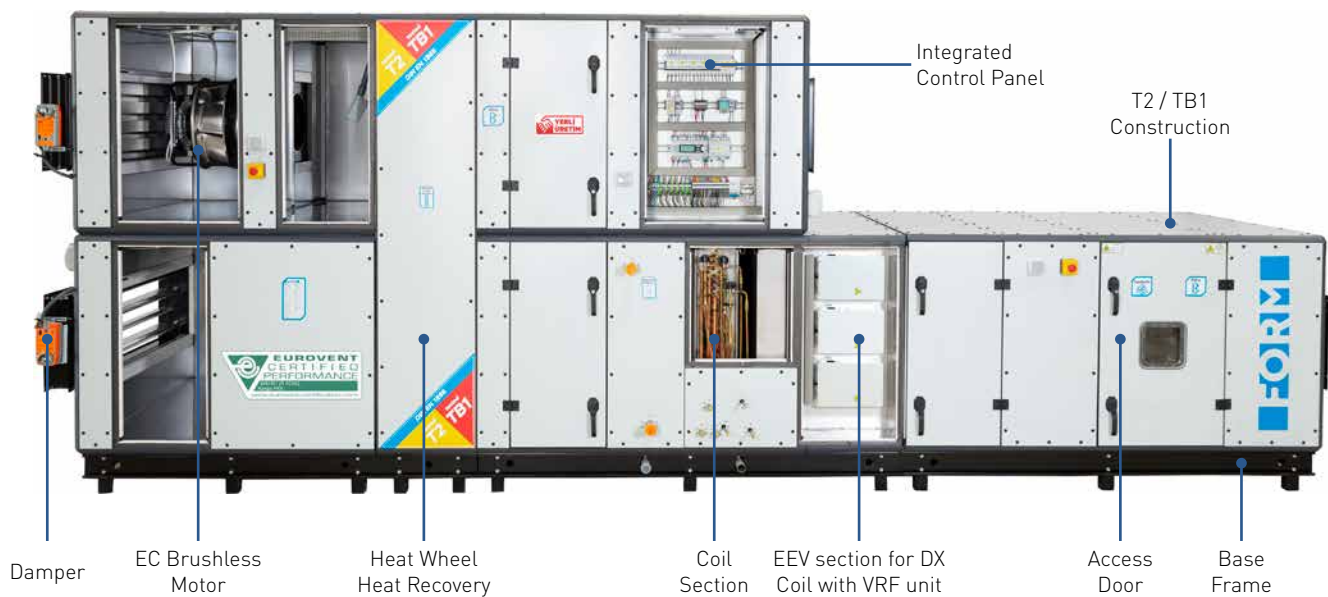
Standards

FORM FKS AHU with its modular design is based on the following ISO, VDI and EN Standards:

EN 1886:2008	Air handling units. Mechanical performance.
EN 13053:2011	Ratings and performance for units and components.
EN 13779:2008	Ventilation for non-residential buildings. Performance requirements.
VDI 3803	Air conditioning systems - Structural and technical principles
VDI 6022	Hygiene in air - conditioning systems
DIN 1946	Ventilation and air conditioning – Ventilation in buildings and rooms of health care
EN 305:1999	Heat exchangers. Definition and test procedures.
EN 308:1998	Heat exchangers. Test procedures.
EN 779:2012	Particulate air filters for general ventilation.
EN 1216:2008	Heat exchangers.
EN 1751:2014	Aerodynamic testing of dampers and valves.
EN ISO 16890:2017	Air filters for general ventilation.
EN 60204-1:2006	Machine safety. Electrical equipment of machines.
EN ISO 3741:2010	Determination of sound power level in reverberation rooms.
EN ISO 5136:2009	Determination of sound power level in a duct.
EN ISO 12100:2010	Safety of machinery.
EN ISO 12944-2:2018	Corrosion protection classification of environments



EN 1886 is related with mechanical performance of unit. VDI 3803 is related with structural and technical principles of air conditioning system. VDI 6022 defines the hygiene criteria in the product. DIN 1946 is about ventilation in buildings and rooms of health care. DIN 1946/4 is about the criteria of hygienic air handling unit and duct systems. EN 13053 is rating and performance for units, components and sections.



Available AHU Dimensions

1.000


Air Flow m³/h


133.000

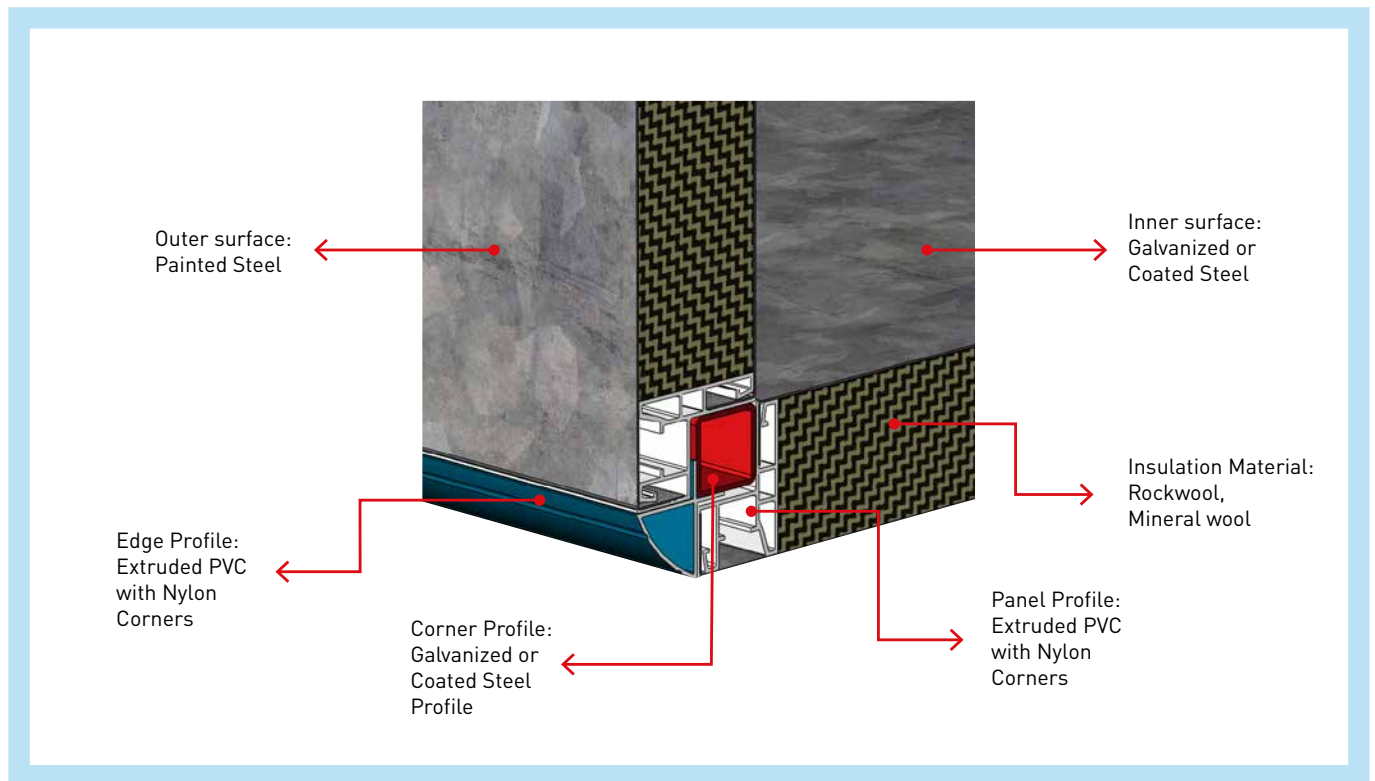
3180									FKS 40×40	FKS 40×44	FKS 40×48						
2874								FKS 36×36	FKS 36×40	FKS 36×44	FKS 36×48	FKS 36×52	FKS 36×56	FKS 36×60	FKS 36×64	FKS 36×68	FKS 36×72
2568							FKS 32×32	FKS 32×36	FKS 32×40	FKS 32×44	FKS 32×48	FKS 32×52	FKS 32×56	FKS 32×60	FKS 32×64		
2262						FKS 28×28	FKS 28×32	FKS 28×36	FKS 28×40	FKS 28×44	FKS 28×48	FKS 28×52	FKS 28×56				
1956					FKS 24×24	FKS 24×28	FKS 24×32	FKS 24×36	FKS 24×40	FKS 24×44	FKS 24×48						
1650				FKS 20×20	FKS 20×24	FKS 20×28	FKS 20×32	FKS 20×36	FKS 20×40								
1344			FKS 16×16	FKS 16×20	FKS 16×24	FKS 16×28	FKS 16×32										
1038		FKS 12×12	FKS 12×16	FKS 12×20	FKS 12×24												
732	FKS 8×8	FKS 8×12	FKS 8×16														
579	FKS 6×8																
	732	1038	1344	1650	1956	2262	2568	2874	3180	3486	3792	4098	4404	4710	5016	5322	5628



Hygienic Considerations

During these days, along with the fight against the pandemic, to be able to select properly configured and produced air handling units used in the ventilation of hygienic rooms is getting more and more important. Ventilation systems in hospitals, pharmaceutical facilities or gene laboratories that play a critical role in combating the epidemic, must meet all the criteria specified in DIN 1946-4 at the highest level.

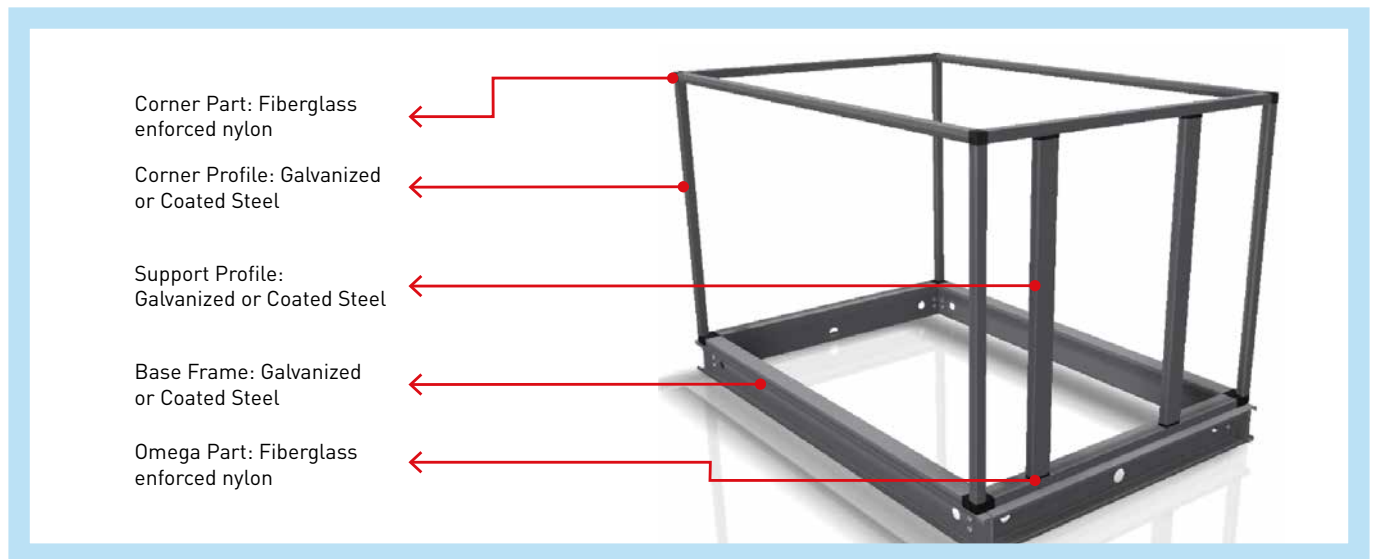
Panel Construction



Thickness	60 mm
Outer Surface	0.8 sheet thickness is available with following coating options: PVC coated galvanized and pre-painted Pre-painted galvanized with nylon film protection Galvanized and Electrostatic powder coated Customer specific requirements also available (all options passed Neutral Salt Spray Test for 500 hours)
Inner Surface	0.8 sheet thickness is available with following coating options: 275 gr/m ² galvanized steel Customer specific requirements also available (all options passed Neutral Salt Spray Test for 500 hours)
Insulation	Rockwool (Thermal Conductivity 0,033 – 0,040 [W/mK] DIN 4108, Fire Class A1, EN 13501-1)
FORM Panel Profile®	Specially designed PVC Panel Profile® along with Nylon Corner Elements® are used for the best thermal performance (Tested according to EN 1886, TB1)

Casing

Construction Details



Steel casing profiles are used in frame construction. Casing profiles can be galvanized or electrostatic powder coated where different colors are available. Casing is constructed by joining glass fiber enforced, UV resistant plastic corner and omega parts with steel profiles.



The complete unit is mounted on base frame made of a galvanized C profile sheet of not less than 2mm thickness. Standard base height is 150 mm with different height options are also available on request. As shown the picture, base frames give an opportunity for easy lifting by forklift.

All components and materials, including seals and sealing materials used in our air handling units, are not harmful to health, does not carry risks such as smell, harmful substance spread and not creating a suitable environment for micro-organisms.

Casing Performance

EN 1886: 2009 expects certain mechanical and thermal performance requirements to be complied by air handling units. FORM FKS air handling units are tested by Eurovent® and met the following specifications:

Thermal transmittance and thermal bridging factor test results are T2/TB1, which represents very low energy loss. Casing strength result is D1 which is best in class. That means the surface of the unit has a strong resistance to pressure from inside and outside. Casing air leakage class is L2. That means the surface of the unit has a very small amount of leakage. Filter by-pass rate is F9, which is also the best value that means the surface of filter case has a very small amount of leakage. So we can say air can not pass without filtering.

Class Description	Class	Value Range	Unit
Casing Strength	D1 (M)	0 < Bending ≤ 4	mm / m
Casing Air Leakage (+700 Pa)	L2 (M)	Leakage ≤ 0,22	lt/sec*m²
Casing Air Leakage (-400 Pa)	L2 (M)	Leakage ≤ 0,15	lt/sec*m²
Filter By-Pass Rate	F9	By-Pass ≤ 0,5	%
Thermal Transmittance	T2	0,5 < U ≤ 1,0	W / m² °C
Thermal Bridging Factor	TB1	0,75 < Kb < 1,0	-


Technical data's according to EN 1886 standards.

All our air handling units are designed to operate extremely efficiently and with very low sound pressure levels.

FORM FKS Model Box Sound Absorption Values

Frequency	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz
Sound Absorption [dB]	21	24	33	32	32	37	46

One of the important adverse effects of thermal bridging is condensation of hot and humid outside air on relatively cooler AHU surface area. These wet surfaces provide suitable environment for micro organisms and resulting corrosion shortens equipment life. FORM FKS AHU's with their TB1 thermal bridging factor eliminates this risk. As seen in below example t_{s_max} can not be smaller than t_{a_dew} except extreme conditions.




Thermal Class	Thermal Bridging Factor k_b
TB1	$0,75 \leq k_b < 1,00$
TB2	$0,60 \leq k_b < 0,75$
TB3	$0,45 \leq k_b < 0,60$
TB4	$0,30 \leq k_b < 0,45$

$$k_b = \frac{\Delta t_{min}}{\Delta t_{air}} = \frac{t_i - t_{s_max}}{t_i - t_a}$$

$$t_{s_max} = t_i - k_b \cdot (t_i - t_a)$$


If $t_{s_max} < t_{a_dew}$ Condensation Starts

k_b thermal bridging factor
 t_i mean internal air temperature [°C]
 t_{s_max} maximum external surface temp. [°C]
 t_a mean external air temperature [°C]
 t_{a_dew} dew point temperature of t_a [°C]



Easy cleaning is an another must for ahu. To catch this target, we have easy accessible components, appropriate base height for quick drainage, smooth inner and outer surfaces and full stainless antibacterial surface in inner side.

Thanks to the drain pan with three-dimensional slope, water is not allowed to accumulate inside the pan.



Easy access, accessible indoor equipment, is a must also for easy cleaning and easy service. The inside of the unit and all the equipments used are easily accessible from all sides.

Joints between the panels are covered with antibacterial hygienic silicon as you see from the pictures.

Selection Software

The fastest and most accurate selection results for FORM FKS air handling units is available with FORM HVAC Calculator. It is very easy to use thanks to its user-friendly interface; you can complete the transition between models or sizes within seconds.

FORM HVAC Calculator® is powerful selection software which offers a fast and complete service for the customer, in order to make the correct technical choices and the economic evaluation of each component. It is a complete tool that can configure any type of product and respond exactly to the most stringent design requirements. The result is a complete economic offer that includes all the technical data and drawings.

FORM HVAC Calculator® is an advanced software developed and designed to quickly convert into an executive order. It is able to produce technical drawings and other technical details to be sent and approved by the customer. It also offers production drawings, bill of materials, ERP code generation for each component used as well as BIM files.

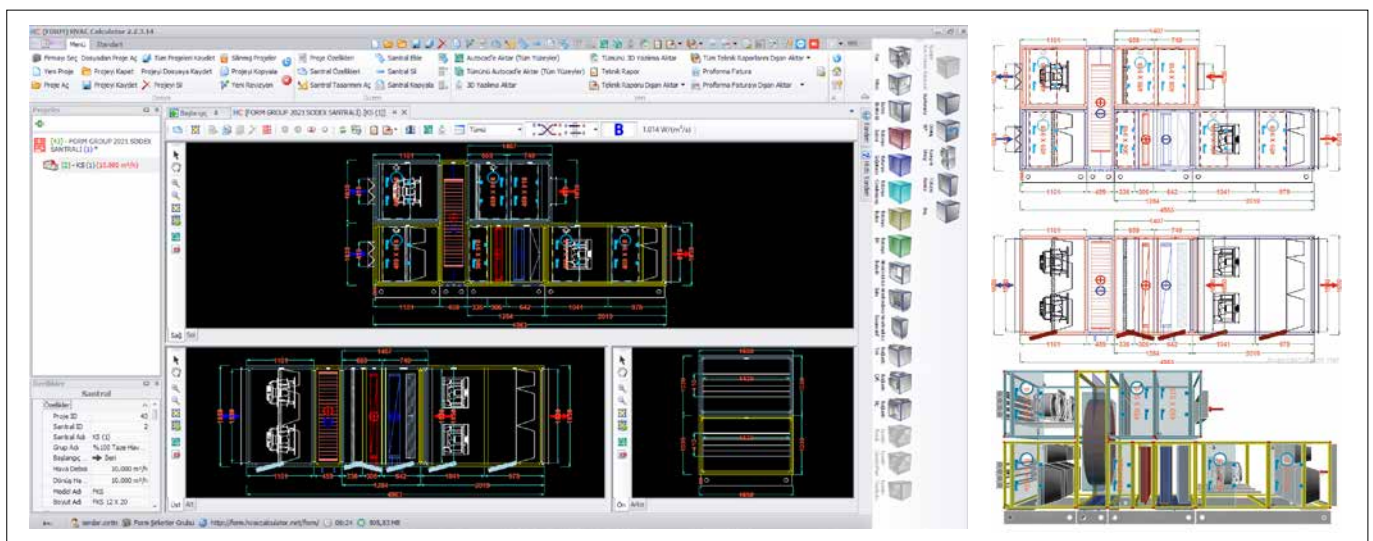
FORM HVAC Calculator® made possible the complete automated management of the process, to reduce the time between the offer and delivery.

Some of the main features of FORM HVAC Calculator® can be seen below:

- EUROVENT approved software.
- Complies with ERP 2018.
- Provides detailed technical drawings in *.dwg and *.dxf formats.
- Access to 3D view.
- Check the selection on the psychometric diagram.
- Access to fan curves.

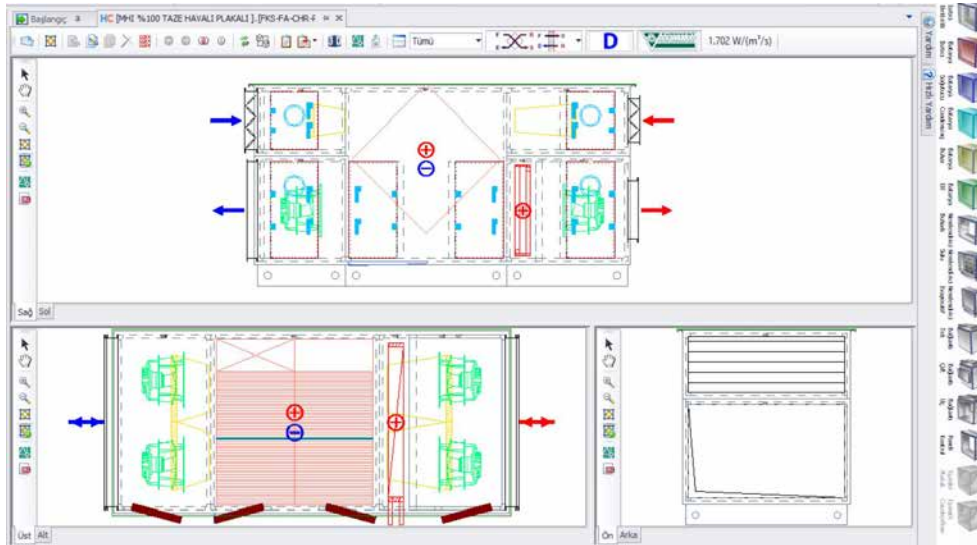
Advantages of FORM HVAC Calculator®

The sustainability of your business is the main driver to all our resources. We do believe our internal quality criteria allow the energy conscious use of our products, resulting in both effective operations cost and protection of the environment. Some of the advantages can be seen in following examples:



Custom Unit Sizing

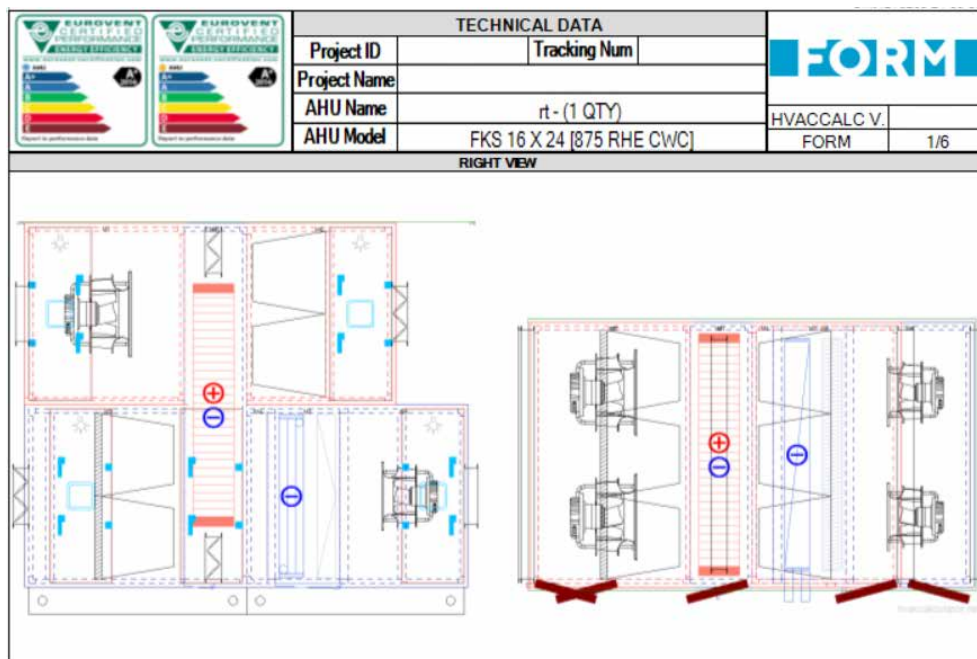
We can optimize the size of the AHUs, especially for your projects where the exhaust air flow is small. This offers added value to your projects.



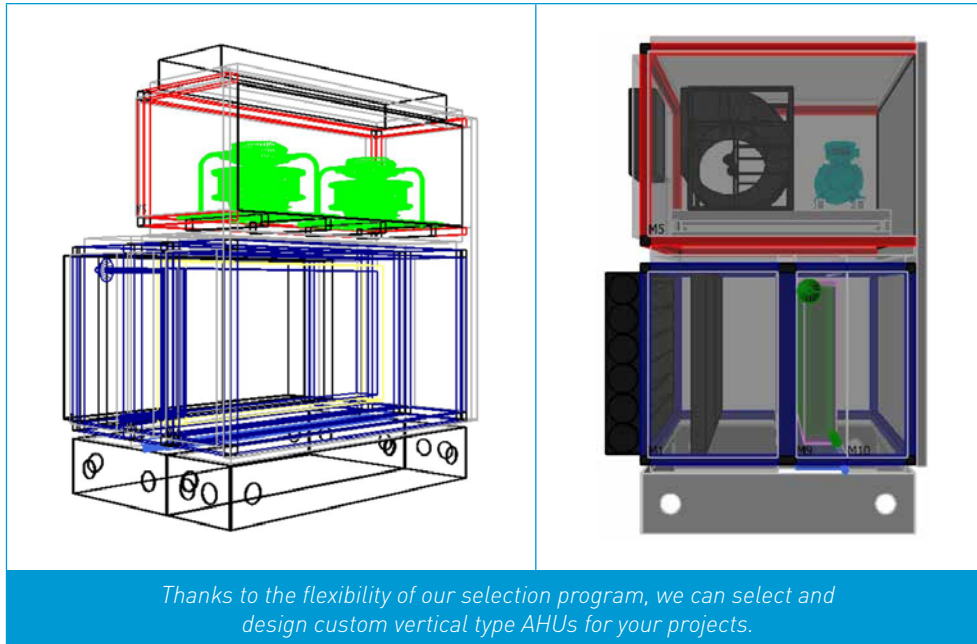
By Pass Damper Option for Heat Recovery and Coils

Using by-pass dampers in heat recovery units with heat wheels provides a great advantage to your operating costs. We can present this in our AHU selection and printouts.

FORM FKS allows configurations suitable for any type of application. Everything through simple structural changes already made available and selectable.

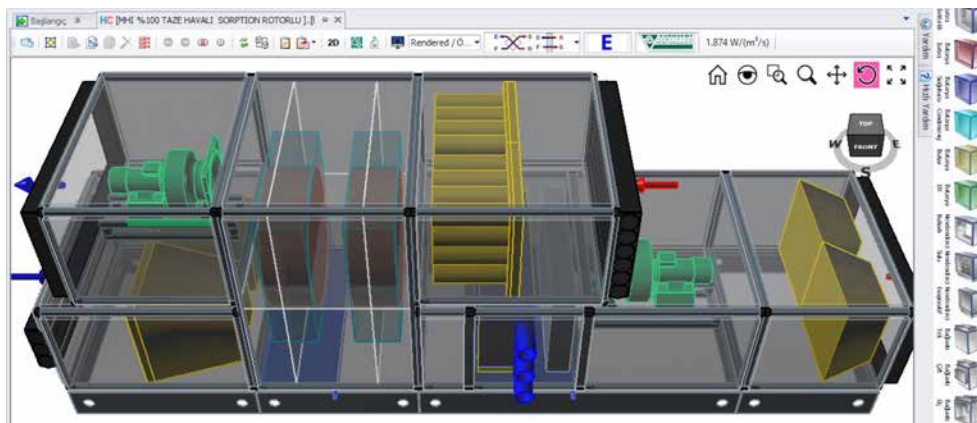


Vertical / Side By Side Configuration

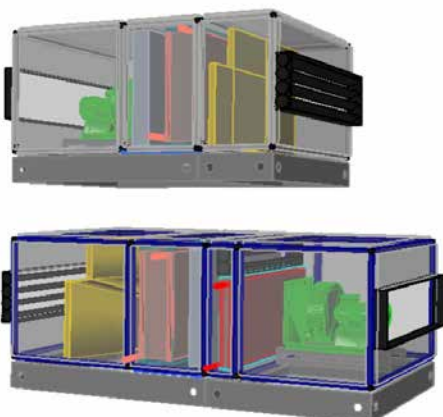


Double Rotary Heat Wheel Configuration

We can choose double heat wheel special ahus for regions with high humidity and temperature.



Separate Units for Run Around Configuration

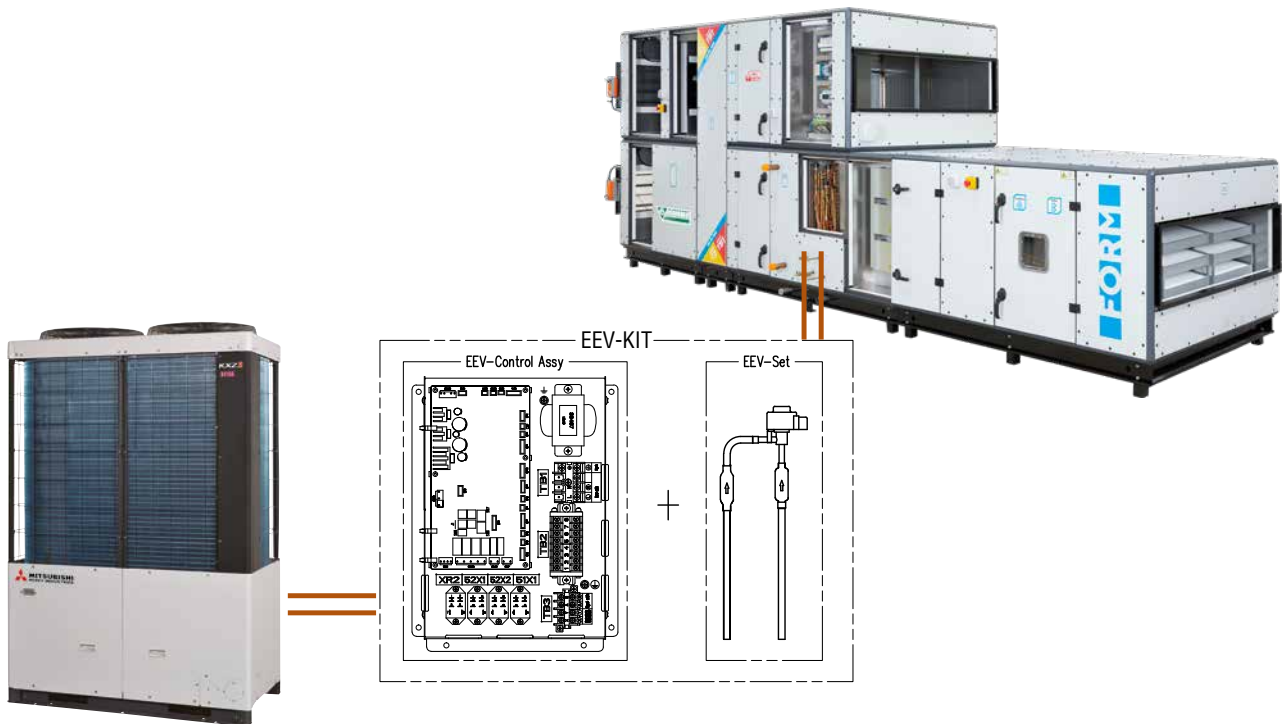


Heat recovery from water to air is especially important for hygienic AHUs. This gives you a perfect solution and eliminates completely the air leakage risk from the exhaust side to the fresh air side.

In your projects, the exhaust unit may be separate from the fresh air unit. In our selection program AHUs with run-around coils can be offered individually in a single selection. In this way, we offer you excellent confidence in our calculations.

You can also request the use of by-pass dampers on the coils.

DX Air Handling Units – Integration with VRF Outdoor Units



- Provides higher EER and COP values thanks to full-inverter technology.
- Occupies less space and provides flexibility in design.
- Both heating and cooling can be done with a single outdoor unit.
- Faster reaction to instant load changes by faster cooling and heating.
- Lower start-up currents reduce energy installation costs.
- More control options thanks to wider range of control equipment and simpler BMS control.

Explosion Proof Option



The explosion proof air handling units type corresponds to the following categories:

Equipment group II, equipment category 2, explosive atmosphere caused by gasses, vapors and mists G, temperature class T3 and/or T4. The fans is ATEX category II 2G IIB T3 or II 3G IIB T4 of this category are designed for areas where an explosive atmosphere as a mix of air, gasses, vapors or mists

Components

Motors

EC / AC motor are in alternatives. Efficiency class is in accordance IE3-IE4 with self-cooled TEFC and IP 55 protection, class F insulation and class B temperature rise fan motors are used. Motors used in FORM FKS AHU's have TS EN 60034-1, CE, ISO 9001: 2015 quality system certificate and all of them certified according to DIN and IEC norms.

Motors are pre-assembled, configured and wired in the factory. 380-415 V / 3 pH / 50 Hz grid voltage motors that are protected internally against overheating.

The motors are mounted on rubber or spring vibration isolators and adjustable rails to reduce vibration to the minimum. Necessary space for easy maintenance and access is automatically included. Stand-by motor option (manual switching mode) is possible.

AC (Alternative Current) Motors



The shaft rotation speed is not constant (asynchronous) motors consist of two basic components, the stator and the rotor.

The stator forms the fixed part of the motor and it contains the stator core and field windings. In the stators of 3-phase asynchronous motors, there is a separate winding for each 3-phase. The rotor is the rotating part of the engine.

$$N = 120 \times F/P$$

N: rotation speed (rpm)

F: supply frequency (Hz)

P: Number of poles of the stator winding (pcs)

According to this calculation; the 2-pole motor is 3.000 rpm; 4-pole motor is 1.500 rpm; The 6 pole motor is called 1.000 rpm.

Speed control is realized with the logic of increasing the slip by regulating the voltage. The lower the voltage for speed control, the greater the losses.

EC Motors

EC motors are DC brushless motors controlled by an external electronic circuit board. This provides more control and higher efficiency.

EC means "Electronically Commutated", that is, DC (direct current) motor with electronic variable. What is meant to be explained here with the variable; Electronically changing the direction of electric current backward or forward. In conventional AC motors this is done mechanically.



EC motors are permanent magnets and electronically adjust the direction of rotation according to the current. Therefore, it does not cause power loss in current changes as in AC (alternating current) motors. Alternating current is a curve that constantly turns from negative to positive and then back to negative. This rotation or change inside the engine creates magnetic repulsion fields that move the engine. This loss in alternating current motors causes inefficiency and heating in the motor. EC motors are more efficient as they have less copper, iron and friction losses.

EC Motor Advantages

- More efficient
- Low operating and maintenance cost
- Low noise level
- Low heat losses, less risk of overheating
- Small dimensions
- Easy control
- Compliance with the desired operating point
- The control unit is on the engine
- Possibility of remote control
- No loss of efficiency and no increase in sound level at variable speeds
- It can be controlled with 0-10V DC.
- EC motor is a brushless DC motor that can be driven with main voltage. The part behind the motor, known as the integrated electronics group, is responsible for converting the alternating current, which is the main voltage, into direct current and providing the necessary commutation for speed control.

The reasons why EC motors are more efficient than AC motors (similar to the advantages of DC motor);

- In AC motors, the magnetic field in the stator windings and the inductive current strength created in the rotor depend on the number of turns. In the EC motor, since such induction is not required on the rotor side, it is designed with less winding and this increases the efficiency.
- The losses of the asynchronous motor are higher and therefore it works more inefficiently. Due to these losses, both energy is used inefficiently and unused energy is reflected to the environment as heat. Since DC motors are synchronous, the losses are less and therefore they have a longer life.
- Current speed monitoring with microprocessor controlled DC motors, alarm outputs, simple speed control and soft start are some additional features that can be provided.

Considering that speed control is made with a 0-10 VDC analog signal coming from PLC or sensor, the noises due to harmonics that occur in motors driven by different speed control methods do not occur in EC technology.

In addition, operating the fan by reducing the speed for the desired capacity will reduce the energy consumption in proportion to the cube of the speed change. In applications with traditional asynchronous motors and no speed control, variable capacity needs are solved by cascade operation of the fans. Thus, if the air flow requirement is reduced by 50%, 50% of the fans are turned off and the energy consumption is reduced to half of the anticipated installed power. On the other hand, in an application with an EC fan, the desired air flow is achieved by keeping all the fans active but reducing their speed to half of the nominal speed.

Fan

Fans can be used with frequency inverters for speed control in order to provide constant or variable airflow in all conditions. Taking into consideration that it can be easily disinfected; a backward fan is preferred.

Depending on demand, plug fan (direct drive) or EC motor driven fan application is also possible.

In the fans which are positioned on the case through the frames on the rubber pads, the electric motors are installed on the same frame.

Double radial suctions are used with a V-belt pulley system and the plug fans are coupled directly to the motor.

Fan Types

The impeller, which is the movable element of the fans, which provides the flow of air by creating a pressure difference, gives static and kinetic energy to the air. Fans are generally classified as centrifugal (radial) or axial (axial) depending on the direction of flow of air on the impeller.

With axial fans, high flow and low pressure are obtained.

With radial fans, high pressure and low flow are achieved. There are forward-curved, backward-curved, straight-wing and aircraft wing-section types.

Forward curved fans are used in low and medium pressure ventilation. Investment costs are lower than other radial fans. Forward curved fans, whose blade inclinations are in the direction of rotation, have small bodies and low revolutions.

Flat bladed radial fans are preferred for conveying small parts and dust.

Backward curved fans are preferred in medium and high-pressure ventilation. The blade angles are opposite to the direction of rotation.

Airfoil section fans are also called airfoil blades. Their cost and efficiency are higher than other fans. They are preferred for medium and high-pressure ventilation. The blade angles are opposite to the direction of rotation and backwards.

Widely used fans in ventilation units;



forward curved fan	backward curved fan
<ul style="list-style-type: none"> ● Efficiency is between 45-65%. ● Minimum pressure is obtained at the point where the flow is minimum at any speed. ● Power consumption is very high at high pressures. ● Fan speeds are lower than backward curved fans. 	<ul style="list-style-type: none"> ● Efficiency is between 65-80%. ● Maximum pressure is achieved at the point where the flow is minimum at any speed. ● The volume is higher. ● The fan speed is about twice as high as with forward curved blades. ● It is easier to clean.

Plug fans (direct drive) characteristically behave like backward curved radial fans. In addition;

- Since the motor and fan connection is directly coupled, there is no power loss. Therefore, they are more efficient with the efficiency up to 80%.
- Direct coupled fans provide air flow by pressurizing the volume. For this reason, a more homogeneous flow is obtained in the section coming after the fan.
- Less vibration than centrifugal fans.
- When used with a frequency inverter, which is recommended, it provides the possibility to control the air flow and pressure.
- It is frequently used in hygienic systems because it is easy to clean and maintain.

Dampers

Damper is the base product for adjusting the air flow. Standard dampers used in FKS AHU's are manufactured in house and have CLASS 2 leakage rating. Blade and frame profiles are made of extruded aluminum and actuated with handle or motor for the modulation of the flow. Those profiles can be coated or painted according to customer specifications. Specially made EPDM gasket is used on the blades for leakage prevention. Dampers can be made in any size and for larger sizes or by-pass needs specially constructed support profile is used for sturdier construction. The nylon gear system is installed inside the shoulder profiles. The blade profiles used in the air dampers operate with the minimum pressure loss when they are open, and with the minimum leak tightness when closed. In the units with mixed air, exhaust and mixture dampers are combined with a joint-mechanism.



Construction Specifications and Options

- Frame Profile: Extruded aluminum (Painted or anodized option available)
- Blade Profile: Extruded aluminum (Painted or anodized option available)
- Gear System: Reinforced Nylon
- Shaft: Galvanized steel shaft (Brass option available)
- Opposed blade construction
- Gasket on the blades
- Horizontal/vertical use
- Vertical / horizontal by-pass option available

Filters



All filter types are available in our selection software. Filters are selected to ensure a high filtration class, taking into account the recommended pressure drops mentioned in EN 13053, and are fitted with a minimum filter bypass ratio.

Replacement is from the front (dirty) side with a clamp.

Filter placements are made according to ISO 16890 standard. Thanks to the design of our filter cases which provide the highest level of filter bypass control, dust does not pass to the fresh air side during filter changes and the mechanism that holds the filters guarantees air leakage without being affected by the air flow.



Panel filter



Bag Filter



Rigid bag filter



Hepa absolute filter

The ISO 16890 standard takes into account the particle size (Particulate Matter = PM) in the range of 0.3 μm to 10 μm , unlike the EN 779 standard for efficiency evaluation. PM can also be called as particulate pollution consisting of very small particles that cannot be seen.

After January 2017, the ISO 16890 test standard replaced the EN 779 standard. It is the only filter standard effective as of July 2018. EN 779 was used extensively in Europe, and ASHRAE 52.2 in the United States.

For the tests of air filters, PM1, PM2.5 and PM10 particle classes used by the World Health Organization and other authorities have been determined as evaluation parameters.

With ISO 16890, filter performances are evaluated at the highest sensitivity level. Classification is made on the basis of 3 different particles, 1 μm , 2.5 μm and 10 μm . ePM1 up to a particle size range of 0.3 – 1 μm (soot particle, viruses); EPM2.5 efficiencies up to 2.5 μm (organic components) particle size range and ePM10 efficiencies up to 10 μm (dust, pollen) particle size range are calculated. The calculated efficiency values are rounded to the nearest lower value according to the efficiency values in the ISO 16890 classification groups. It was taken as 5% between stages.

EN 779:2012	EN ISO 16890 – range of actual measured average efficiencies		
Filter Class	ePM ₁	ePM _{2.5}	ePM ₁₀
M5	5% - 35%	10% - 45%	40% - 70%
M6	10% - 40%	20% - 50%	60% - 80%
F7	40% - 65%	65% - 75%	80% - 90%
F8	65% - 90%	75% - 95%	90% - 100%
F9	80% - 90%	85% - 95%	90% - 100%

HEPA and ULPA filters are not covered by this classification.

EN 1822							
H10	H11	H12	H13	H14	U15	U16	U17
≥ 85	≥ 95	≥ 99,5	≥ 99,95	≥ 99,995	≥ 99,9995	≥ 99,99995	≥ 99,999995

Humidifier

By keeping the specific humidity constant in air conditioning, we can increase or decrease the relative humidity. With sensible cooling, the specific humidity is constant, but the relative humidity increases. While the specific humidity is constant during heating, the relative humidity decreases. The value that is aimed to change in humidification or dehumidification processes in HVAC applications is the specific humidity.

Humidification is the process of adding water to increase the specific moisture content of the air. It can be performed in two different ways; water is sprayed onto the air as liquid or vapor. The air warms or cools according to the temperature difference between the temperature of the air and the water/steam that makes the humidification process.

Adiabatic Humidification

The water used in the humidification process is in liquid form. When sprayed on the air, it evaporates into the air. The water that cannot be evaporated returns to the reservoir to be used again. It is sprayed back into the air with the help of a pump. As the cycle continues in this way, the temperature of the water is equalized to the wet bulb temperature of the air. Therefore, in this process where the water is not heated or cooled by an external source, the humidification line moves along the wet bulb curve of the air.

Since the enthalpy does not change along the wet bulb line, this phenomenon is called adiabatic humidification.

The humidification process continues towards the saturation point of the air. However, it can never reach the 100% curve. Therefore (unless there is an external source) the temperature of the water remains lower than the dry-bulb temperature of the air. Therefore, the temperature of the air decreases. This is why this process is also called evaporative cooling or humidification.

Atomization (Atomized – With Fog Nozzle) Humidification



In these systems, the water is separated into very small droplets with the help of compressed air. Since there is no water-air mixture inside the nozzle, there is no potential for bacterial growth. It can be connected directly to the space or ventilation unit.

Steam Humidification

Sterile steam type humidifiers produce steam at atmospheric pressure with an electrode-operated steam generating reservoir.

Humidifier modules can be produced in the same structure with the unit.

Equipped with drain pan, drop holders and steam distributing nozzles.

Those nozzles are produced with 304 SS pipe.

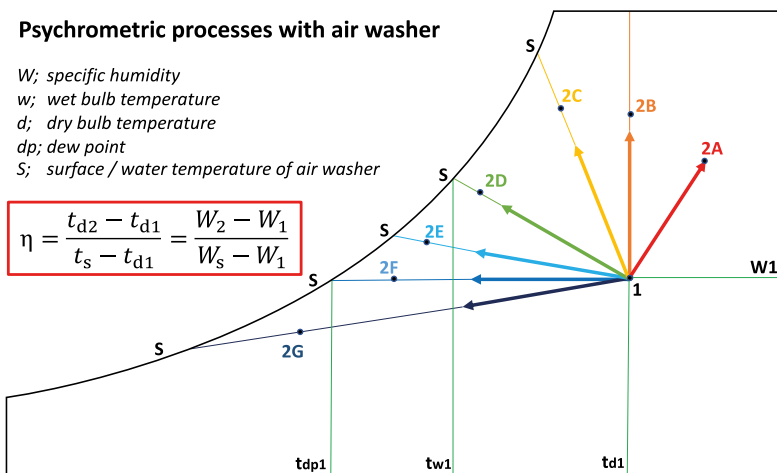
In this humidification process, water is sprayed into the air in the vapor phase. The main purpose of steam humidification is to obtain a hygienic environment. In addition, the amount of moisture is easier to control. Unlike water humidification, steam humidification is not adiabatic, as the steam used is hotter than water and air.

Package products that produce steam through electrolysis by taking advantage of the conductivity of water are called steam humidifiers. With its microprocessor control, it provides the most suitable humidity adjustment for the system needs. It determines the amount of steam proportionally according to the signal coming from the automation system. The steam produced is pure and completely hygienic. Initial investment costs are lower than electric resistance type humidifiers, and the operating cost is higher. They can be adapted to the building automation system.

Psychrometric processes with air washer

W ; specific humidity
 w ; wet bulb temperature
 d ; dry bulb temperature
 dp ; dew point
 S ; surface / water temperature of air washer

$$\eta = \frac{t_{d2} - t_{d1}}{t_s - t_{d1}} = \frac{W_2 - W_1}{W_s - W_1}$$



1-2A: heating and humidification, $t_s > t_d$ enthalpy is increasing therefore water is externally heated.

1-2B: humidification $t_s = t_d$ enthalpy is increasing therefore water is externally heated.

1-2C: cooling and humidification, $t_w < t_s < t_d$ enthalpy is increasing therefore water is externally heated.

1-2D: adiabatic, $t_s = t_w$ pumped recirculation of water without any external heating or cooling.

1-2E: cooling and humidification, $t_{dp} < t_s < t_w$ enthalpy is decreasing therefore water is externally cooled.

1-2F: cooling, $t_s = t_{dp}$ enthalpy is decreasing therefore water is externally cooled.

1-2G: cooling and dehumidification, $t_s < t_{dp}$ enthalpy is decreasing therefore water is externally cooled.

Coils



Coils are main components used to add or remove heat from air stream. Aluminium, epoxy-coated aluminium or copper fins with corrugated surface are used in FORM FKS AHU's.

Standard coil frame is made of galvanized steel sheets. Optionally, it can be produced from stainless steel, aluminium or copper sheet.

Standard collectors are made of steel tube and hygienic applications collectors are made of copper and connections are externally threaded as standard or with flanges on request. Each collector has air vent and drain lines beside blind cap. When the collectors are steel, there is painting made for collectors in order to avoid corrosion.

Test; all water coils are tested in water pool with 20 bar pressure unless otherwise is indicated. Coils are tested in accordance with Pressured Equipment Directive 97/23/EC.

Horseshoe and Heat Pipe

Heat pipe coils take different names according to their application. It can be used for heat recovery as well as for dehumidification. Theoretically, the system technique is the same in all of them.

In the system, a refrigerant circulates in the closed loop by means of heat exchange. The evaporator side, which attracts the heat in the air, evaporates the gas and directs it to the condenser side. On the condenser side, the heat accumulated in the gas is transferred to the air.



Due to both the properties of the refrigerant and the production technique of the product, the heat transfer in these products is always in the same direction. In other words, the evaporator and condenser sides of the product do not change during summer and winter transitions. Therefore, the side that cools it in summer cannot be used as a heater in winter. This is the most important difference that distinguishes this system from run-around heat recovery batteries, plate or rotary heat recovery exchangers.

There is another application area where the evaporator side of the system is used as pre-cooling and the condenser side as post-heater. In such applications, the product is called "horseshoe heat pipe".

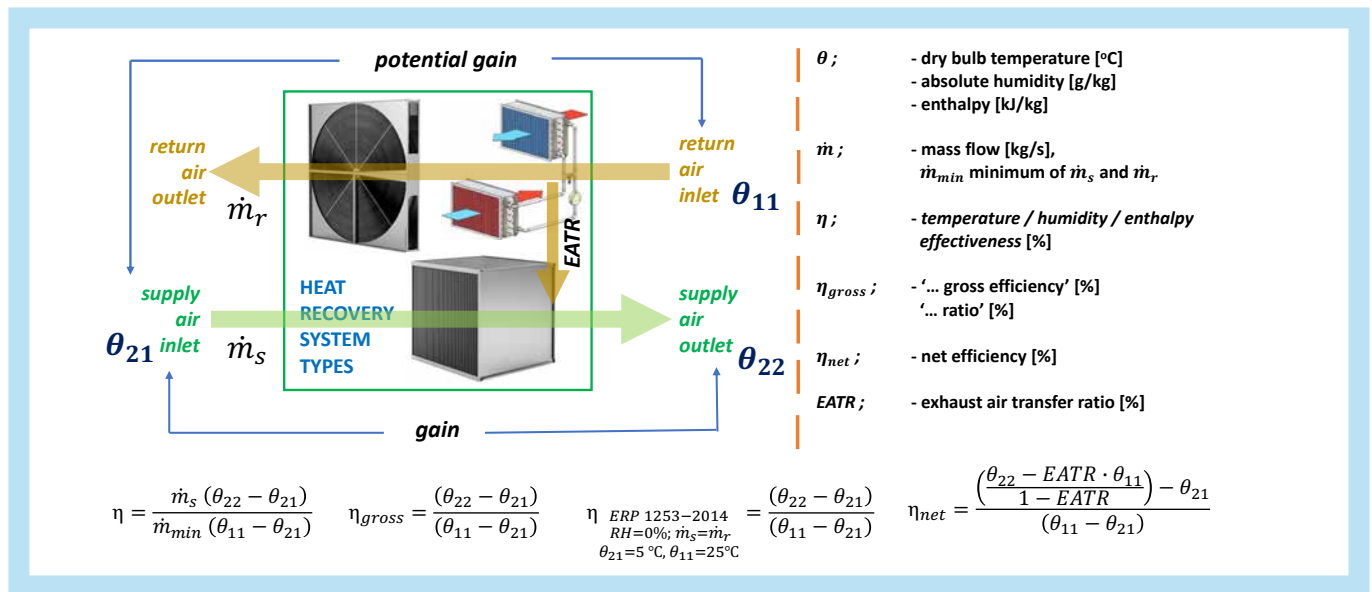
Heat Recovery

Efficiency of Heat Recovery

If condensation has taken place in heat recovery, wet efficiency is mentioned. We can see the answer to the question of what would be the efficiency if there were no condensation in the dry bulb conditions, from the dry efficiency value. In other words, if the relative humidity is assumed to be zero on the supply and return air sides, the resulting efficiency is dry efficiency.

Dry efficiency value is not affected by temperature changes as long as there is no condensation. In other words, it expresses the maximum efficiencies that can be obtained from this heat exchanger in dry conditions.

Dry efficiencies are only affected by changes in air flow rate and heat exchanger geometry.



Air to Air Heat Recovery

Air to air heat recovery is an essential aspect for air-conditioning systems. Heat recovery units have to guarantee pre-cooling and post-heating in addition to reduce energy costs.

Plate Type Heat Recovery



In the plate heat recovery unit aluminium plates are used which are shaped in a way to create separate ways for the exhaust air and fresh air.

Fresh air and exhaust air meet on the unit in a way that they can never mix up and there occurs a heat exchange through the plates.

Cleaning of the plate heat exchanger is very important because, exhaust air can hold some dusts although filter is used before air entering the heat exchanger.

Rotary Type Heat Recovery



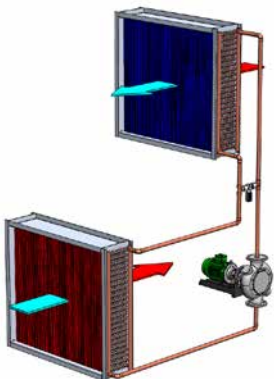
Heat wheel is a good solution for HR when the hygienic criteria isn't considered.

There are many kinds of heat wheels. Some of them can only transfer sensible heat, some of them can also transfer the latent heat.

Compared to plate type, rotary type has some advantages and disadvantages;

Advantages	Disadvantages
<ul style="list-style-type: none"> ● Higher temperature efficiency ● Possibility to transfer moisture ● Smaller volume ● Less risk of freezing 	<ul style="list-style-type: none"> ● More air leakage ● Requires maintenance ● Less hygienic

Water to Air Heat Recovery - Run Around Heat Recovery



This application is more common, especially for hygienic applications since the mixing risk between the fresh air and the exhaust air, does not exist.

Consider in the selection of the run around heat recovery units are the optimum coil face velocity of the air, the air side pressure drops and the freezing risk to be discarded depending on the fluid temperatures.

The drain pan is provided as standard for any kind of condensation risks.

The circulated water regime is determined by the temperature difference between the room air and the outside air.

Lighting and Inspection Glass



According to requirements, all access door sections which has inspection glasses are equipped with lighting lamps.

Inspection glasses and all energy cables of the lighting, in order to see the inside of the unit during its operation, are factory fitted.

All electrical wirings are factory fitted.

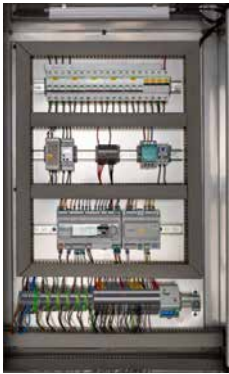
Door switches are standard application for fan access doors.

Control System

Air handling Units supplied with MCC-DDC panel to save site installation costs, delays to your program and the associated risks of having controls fitted on site.

Units are available with pre-installed and fully integrated control system. It is an advanced, easy-to-use system with an external remote control panel for all settings. It is a modern control system with a large number of alarm functions, time setting, operation parameters and operational status. The system is designed for damper actuators, inverters, pipe valves with wiring actuators, standard or customized control and communication to a BMS system. The panel can be positioned freely in the building.

Integrated Control Panel



With our standardized set up, you will get a high and consistent quality of the wiring and controls configuration.

All of FORM FKS AHUs are available with complete control panel that includes the main breaker, switch contactors, overload protection, variable frequency inverter and programmable logic controller as well as control peripherals such as temperature and humidity sensors, pressure switches, dampers, actuators, valves.

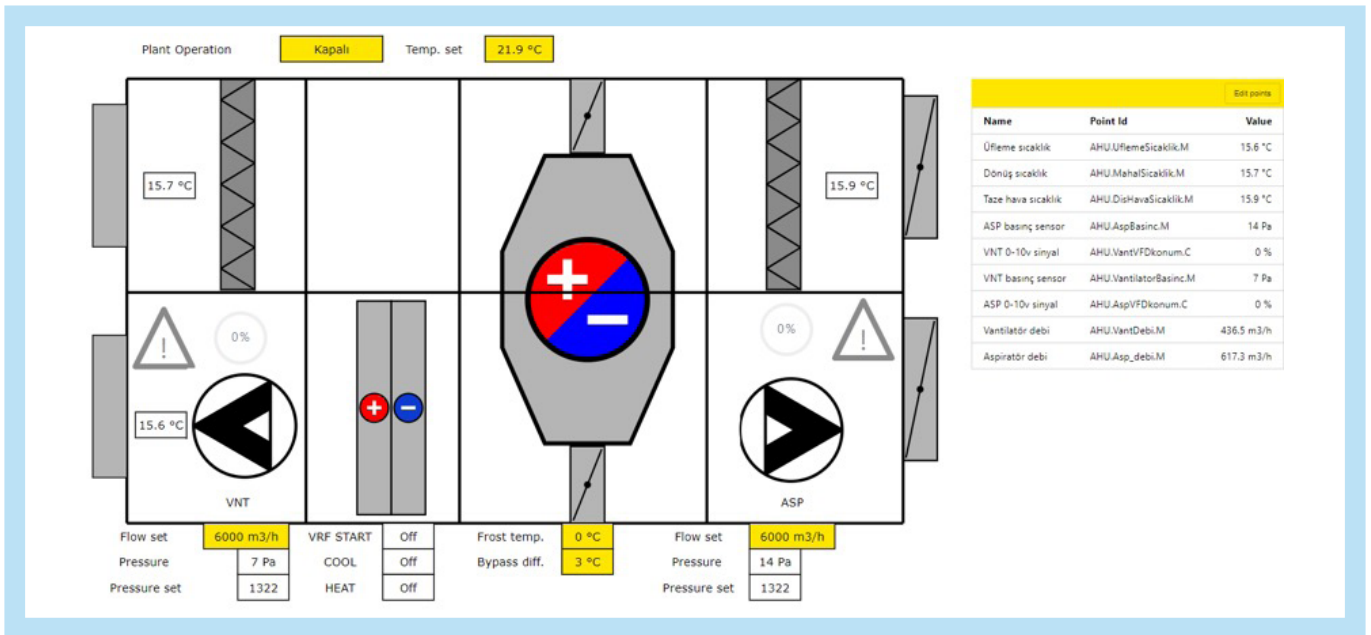
The units are tested and pre-commissioned at the factory. This translates into high reliability, time saving and exclusion of problems in on site commissioning.

Factory mounted controls;

- Lockable electrical panel door
- Main breaker with red yellow handle suitable for emergency
- Electric heater
- Inverter for fan motor
- Safety microswitch on the fan door
- Pressure switch synthetic filter
- Pressure transducer for fan
- Damper actuator ON-OFF
- CO₂ sensor
- Antifreeze thermostat
- Temperature probe air signal NTC
- A customized control can be provided to achieve all needs of a specific application.

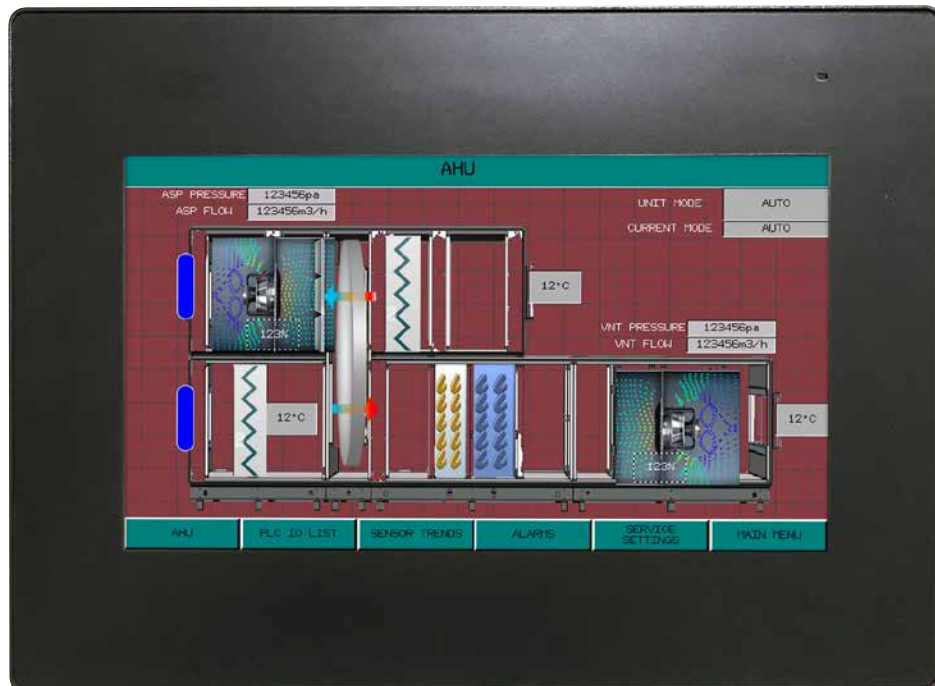
Integrated Control Software

Build in house sophisticated control software is used in FORM FKS AHUs. It has a simple interface where all internal sensors and alarms can be read and commanded on easy to use HMI (human machine interface).



Properties of Control Software

- Embedded screen on PLC
- Reading all sensor and alarm information from HMI
- Heating / cooling, damper, fan flow control
- VRF, humidifier, electric heater and damper control
- Easily configurable and parametric
- Internal MODBUS IP and MODBUS RTU communication
- LONWORKS, BACNET, KNX communication with additional module
- Web access and remote monitoring
- Software revision and online testing over the web
- Ability to change parameters and monitor all software via online testing



Accessories and Options

- PLC microprocessor
- Two- or three-way valves
- Valve servo motors
- Damper servo motors
- UV lamp

- Emergency Stop Button
- Maintenance Switch
- Manometers
- Variable frequency inverter (VFD)

- Smoke detector
- Air quality sensor
- Temperature, humidity, pressure, frost protection etc. sensors

			
Emergency stop button	Temperature sensor	Difference pressure sensor	Humidity and temperature sensor
			
Frost thermostat	Door switch	Maintenance switch	Differential pressure switch
			
Light	Damper motor	Valve	Vale
			
Valve motor	Valve motor	Thermostat for panel	Junction box for power supply

Some of Our References



Academic Hospital (Istanbul - Turkiye)



Anagold Mining (Erzincan-Turkiye)



Seluz Frangrance & Flavor Factory (Kocaeli- Turkiye)



Sultan Mosque & Complex (Kars- Turkiye)



Data Center - Senegal



Gina Restaurant (Istanbul - Turkiye)



Gokceada Courthouse (Canakkale- Turkiye)



WBM Romitex Yarn Factory (Tashkent - Uzbekistan)

FORM ENDUSTRI URUNLERI

Form Endustri Urunleri is a sales and service company for Central Air Conditioning equipment. Form Endustri Urunleri provides equipment and also helps designers and investors in choosing the right system for their building due to long experience. The main desire is creating high efficiency and Green Certified Buildings. The company provides various different kinds of central air conditioning units for any size and type of project. The main equipment provided are Rooftops, Heat Pump units, Chillers, Cooling Towers, Fancoils, Air Handling units and Ventilation systems.

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