FAST
TRATTAMENTO DELL'ARIA

Trattamento dell'aria

AIR HANDLING UNITS
FOR SPECIFIC SECTORS
FM-H Series

0509-6180607

EUROVENT
CERTIFIED PERFORMANCE

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ICIM
ISO 9001 - Cert. n° 0882/0
CISQ IQNet
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SELECTION MANUAL

GB

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1. Generalities

Considering the clear responsibilities connected to the violation of the Law 626/94 on the protection of the workers health, specifically in cases of death due to the incorrect evaluation of biological risks in the aeraulic equipment, FAST proposes the air handling units for specific application of the FM-H series. The FM-H series air handling unit is therefore the ideal choice to minimize the risk of internal development of polluting agents, a totally new unit in the air-conditioning panorama for specific environments (hospitals, chemical-pharmaceutical industry, nursery homes, thermal centres etc.). The air handling units of the FM-H series represent the synthesis of experiences, studies, experimentations in the specific sector of aeraulic equipment.

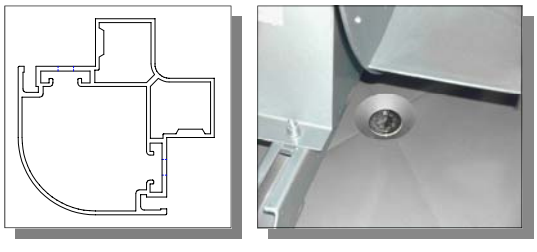
1.1 NORMATIVE-LEGISLATIVE REFERENCES AND MAIN TECHNICAL SOLUTIONS

The air handling units for specific environments of the FM-H have been designed on the base of the indications present in the most recent national and international normative-legislative documents in terms of hygiene and indoor air quality. The normative and legislative references which brought to the specific exclusive technical solutions for the FM-H series air handling units are the following:

- Guidelines for health protection and promotion inside limited and defined environments (G.U. n.276 - 27/11/2001);
- Guidelines for the control and prevention of the Legionellosis disease (G.U.S.G. n. 103 - 05/05/2000);
- Norm project 5/716 of the UNI CTI “Air conditioning installations: hygienical requirements for the maintenance operations on the air-conditioning equipment.“;
- Rules for the application of Liguria regional law n. 24 dated 02/07/2002 “Discipline for the construction, installation, maintenance and cleaning of the aeraulic equipment”;
- ASHRAE 12-2000 guideline - Minimizing the risk of Legionellosis associated with building water system;
- White book on Legionellosis, AICARR 2001;
- NADCA, “General specification for the cleaning of commercial heating, ventilating and air conditioning system”;
- Technical norm EN 1886;

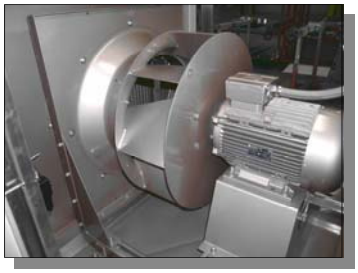
The main features of the FM-H series air handling units, briefly summarised here below, make them a unique product on the market.
For further information please refer to the paragraphs in chapter n. 2..

Inspection and cleaning:



- internal corners have been connected with joints in order to avoid accumulation of dirt and make the cleaning operation easier;
- drain panels for each section, with central discharge with siphon;
- edges, holes, crevices where dirt could accumulate are reduced to the minimum (permanent joints are sealed);
- each section is equipped with access opening and adeguate light to allow for a correct cleaning and maintenance inside the unit.

Components:



- external air inlets sized for air velocity inferior to 2 m/s and equipped with adequate protection devices to avoid the suction of external pollution (the dampers are made from aluminium with aerofoil blades);
- minimum filtrating capacity according to point 7.2.3. of the "Guidelines for the control and prevention of Legionellosis":
  - class F7 for the filters placed before the air handlers;
  - class F8/F9 for the filters placed after the air handler and silencers (if any);
  - class F7 for the filters placed on the external air inlets;
- all types of filters are available: cell pre-filters, bag filters, absolute filters and germicyde lamps (possibility of equipping the unit with filters with germicyde properties);

- coils in copper/copper, stainless steel/copper or stainless steel/stainless steel execution;
- static cross-flow plate recuperators or with double coils;
- "plug fan" direct-driven fans for all sizes with slides and brackets reduced to the minimum to make the cleaning easier;
- direct steam humidifier or with submersed electrodes producer, kept at due distance from the successive components to avoid the formation of condensate;
- horizontal sound attenuators equipped with polyethylene film easy to disassemble.

Panels:

- the materials used are washable, disinfectable and resistant to cracks, splintering, chipping, abrasion; these do not favour the proliferation of biological agents and decrease the microbe charge (anti-bacteria treatment with certified decrease of the microbe charge);

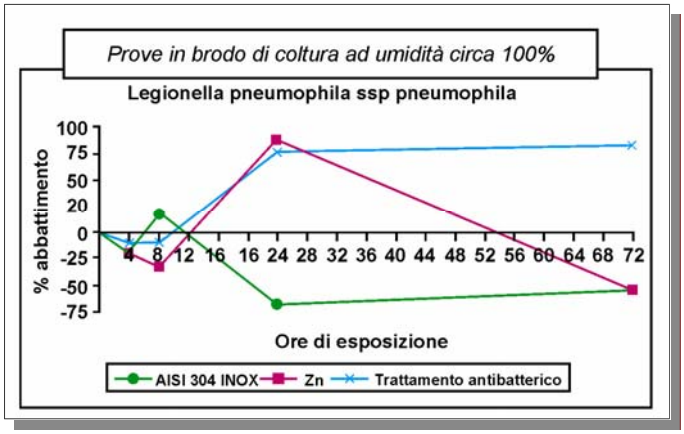
Controls:

- **version equipped with thermoregulation**: the unit may be equipped with complete thermoregulation and therefore ready to use. The unit is therefore complete with the electrical and electronic components needed for its correct operation. In this case the unit is supplied with the CE label which certifies its compliance with the safety requirements and applicable directives;

- **version without thermoregulation**: the unit is however complete with all those components which would require the internal wiring and assembly. In this case, according to previously-agreed requirementes, temperature probes, humidity probes, safety thermostats, pressure switches etc. are provided for. The choice of equipping the unit with components already assembled inside reduces the number of interventions which may create hygienical problmes with possible formation of biological niches. The user will have to see to the completion of the thermoregulation in order to proceed with the CE labelling according to the law in force.

1.2 ANTI-BACTERIA TREATMENT AND RESULTS OF THE RESEARCH

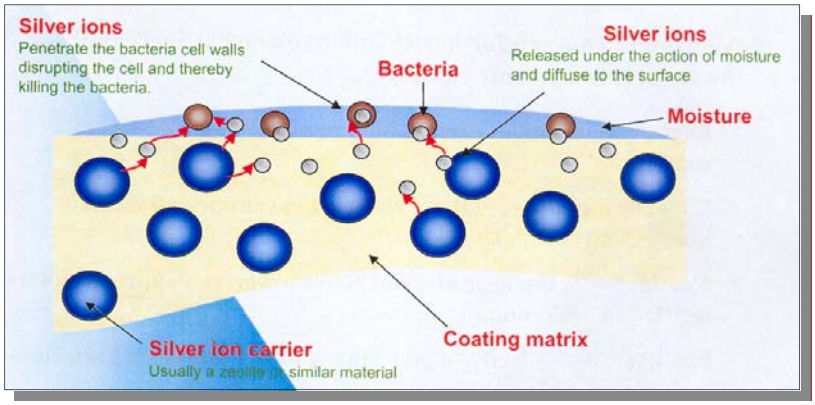
The activity of research made by FAST has permitted to create a special anti-bacteria treatment with certified bactericyde action. The following graph shows how the active action of the treatment is particularly effective if compared with that obtained with materials normally used for the internal panels of the air handling units (specifically on the Legionellosis bacteria, one of the most dangerous and most common inside air-conditioning equipment).



The excellent results obtained, in terms of reduction of the principal biological polluting agents, have been confirmed by tests carried out by Padua University Laboratories. The tests have been performed on several micro-organisms and at different development conditions.

All the results and their certification are available on request.

In the following picture the action of the anti-bacteria treatment is represented.



The microorganisms against which the anti-bacteria treatment grants a reduction by at least 90% (tests carried out according to the standards JIS Z2801:2000) are enlisted in the following chart:

Microorganism
Listeria monocytogenes
Eschericia coli 0157
Salmonella enteritidis
Staphylococcus aureus (Resistant Strain)
Bacillus subtilis
Pseudomas aeruginosa
Salmonell typhimurium
Streptococcus faecalis
Legionella pneumophila
Viibrio parahaemolyticus
Enterobacter aerogenes

Copies of the certificates are available on request.

The anti-bacteria treatment is patented

1.3 EUROVENT CERTIFICATION

The air handling units of the FM-H series are built in full compliance of the EN 1886 norm. This norm classifies the following aspects of the air handling units:

- Mechanical strengh of the casing;
- Air leakage through the casing;
- Air leakage around the filters frame (filter by-pass);
- Casing thermal performance;
- Casing acoustic insulation.

The EN 1886 norm foresees specific ranges of values for all the above-mentioned characteristic, which correspond to different classes.
The FM-H series air handling units have such characteristics as to excel in every classified aspect, as the following table shows:

Classified characteristic	Table	Class	Values EN 1886
Casing mechanical strength	1	**2A**	Casing deflection max.: 4 mm/m
Casing air leakage with pressure test –400 Pa	2	**B**	Max. leakage: 0.44 l/s m^2
Casing air leakage with pressure test + 700 Pa	3	**B**	Max. leakage: 0.63 l/s m^2
Filters by-pass	4	**F9**	Total loss K: 0.5 %
Casing thermal transmittance U	5	**T3**	$1 < U \leq 1.4$ W/K m^2
Thermal bridges (base execution)	6	**TB3**	$0.45 < k_b \leq 0.6$

In the following table, the certified acoustic attenuation data are shown, referring to the panels with injected polyurethane insulation with density 40 kg/m^3:

Centre range frequency	Hz	125	250	500	1000	2000	4000	8000
Acoustic attenuation	dB	11	12	13	13	15	33	38

The performances are confirmed by the Eurovent certification program by the TÜV laboratories.

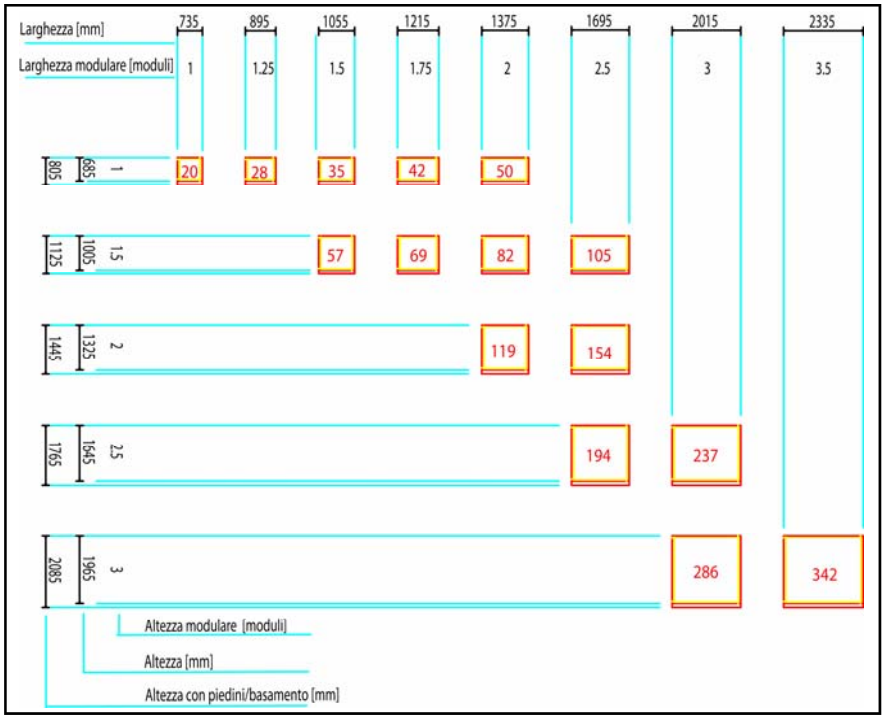
The F9 filter by-pass certification allows, thanks to the really minimum leakage through the filter frame, to adopt filtrating systems in compliance with the relevant norms on the air quality, which foresee the following filtrating efficiences:

- class F7 for the filters placed upstream of the AHU;
- class F8 / F9 for the filters placed downstream of the AHU and of the sound attenuators (if any);
- class F7 for the filters placed on the external air inlets.

2. Technical features

2.1 SIZES

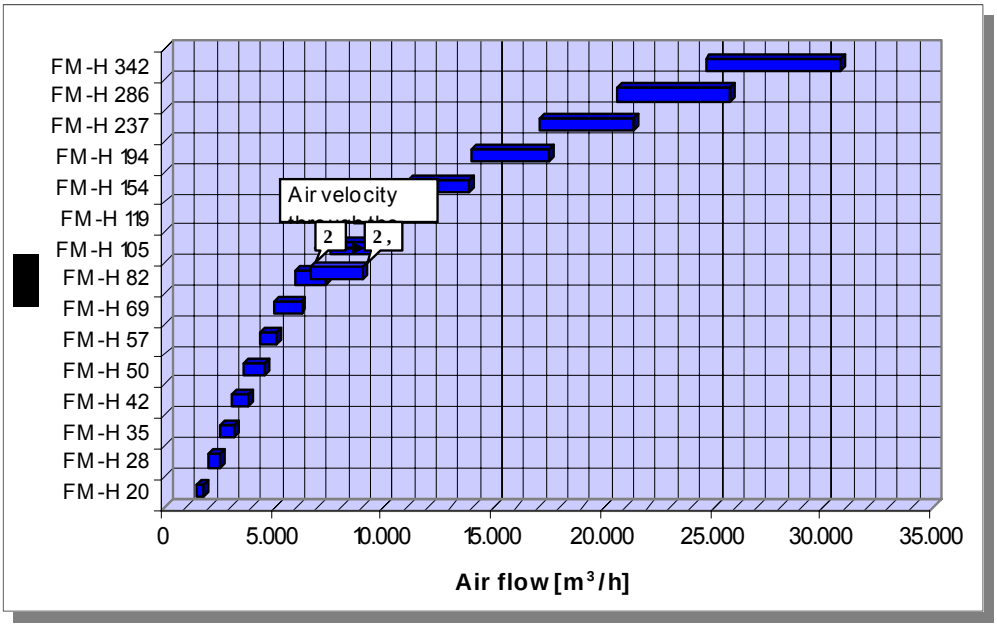
The 15 sizes available for the FM-H series air handling units are shown in a front view in the following diagram.
The air handling units for specific sectors, FM-H series, are designed with a modular approach that allows the maximum standardization of the components while offering a comprehensive coverage of the range of the possible capacities.



* dimensions given for units without control devices installed.

2.2 FLOW RATES AND DIMENSIONS

The air flow range for each of the 15 sizes of the FM-H series air handling units is shown in the following diagram.



In the table reported below the following information are resumed:

- air handling unit size: the number following the "FM-H" label shows the coils front surface [dm^2];
- air handling unit nominal height in modules (h_m);
- air handling unit nominal width in modules (w_m);
- air handling unit overall height including base (h);
- air handling unit overall width (w);
- air handling unit internal height (h_i);
- air handling unit internal width (w_i);
- coils front surface (S);
- air handling units flow rates (m^3/s) calculated with face velocity 1.5, 2, 2.5 m/s;
- air handling units flow rates (m^3/s) calculated with face velocity 1.5, 2, 2.5 m/s.

	Modules		External Dim.		Internal Dim.		Coil surf.	Flow rate [m^3/s]			Flow rate [m^3/h]		
FM-H	h_m	w_m	h	w	h_i	w_i	S	Face velocity [m/s]			Face velocity [m/s]		
	[mod]	*[mod]*	*[mm]*	*[mm]*	*[mm]*	*[mm]*	*[m^2]*	*1,5*	*2*	*2,5*	*1,5*	*2*	*2,5*
20	1	1	805	735	570	620	0,202	0,30	0,4	0,5	1.091	1.440	1.800
28	1	1,25	805	895	570	780	0,278	0,42	0,56	0,7	1.501	2.020	2.520
35	1	1,5	805	1055	570	940	0,348	0,52	0,7	0,87	1.879	2.520	3.130
42	1	1,75	805	1215	570	1100	0,425	0,64	0,85	1,06	2.295	3.060	3.820
50	1	2	805	1375	570	1260	0,502	0,75	1	1,25	2.711	3.600	4.500
57	1,5	1,5	1125	1055	890	940	0,566	0,85	1,13	1,41	3.056	4.070	5.080
69	1,5	1,75	1125	1215	890	1100	0,69	1,04	1,38	1,73	3.726	4.970	6.230
82	1,5	2	1125	1375	890	1260	0,815	1,22	1,63	2,04	4.401	5.870	7.340
105	1,5	2,5	1125	1695	890	1580	1,053	1,58	2,11	2,63	5.686	7.600	9.470
119	2	2	1445	1375	1210	1260	1,191	1,79	2,38	2,98	6.431	8.570	10.730
154	2	2,5	1445	1695	1210	1580	1,539	2,31	3,08	3,85	8.311	11.090	13.860
194	2,5	2,5	1765	1695	1530	1580	1,944	2,92	3,89	4,86	10.498	14.000	17.500
237	2,5	3	1765	2015	1530	1900	2,369	3,55	4,74	5,92	12.793	17.070	21.300
286	3	3	2085	2015	1850	1900	2,862	4,29	5,72	7,16	15.455	20.590	25.780

* dimensions given for units without control devices installed

2.3 CASING

2.3.1 PANELS

The casing is made from a self-bearing frame with aluminium alloy profiles and insulation panels.
The panels are 50 mm thick and are secured to the frame by means of locking profiles and absolutely without screws. This system grants an uniform pressure between the sealing and the frame in order to reduce the air leakages in units both in pression and in de-pression. The result is confirmed by the Eurovent certified class B for the air leakages and by TÜV laboratories tests.
The shape of the panels is designed in order to obtain an internal smooth surface for a lower dust accumulation and an easier cleaning and maintenance of the air handling units.
The dimensions of the panels are chosen to build air handling units with horizontal joints in the possible lowest number, making the casing stronger.

The panels are available in the following possible solutions:

Type	External panel	Insulation	Internal Panel
PTP	Pre-painted galvanized steel	Injected poliurethane	Aluminium alloy with anti-bacteria treatment
	Thickness 0,6 mm	Density 42 kg/m3	Thickness 0,8 mm
XTP	Aisi 304 stainless steel	Injected poliurethane	Aluminium alloy with anti-bacteria treatment
	Thickness 0,6 mm	Density 42 kg/m3	Thickness 0,8 mm
ATP	Aluminium alloy	Injected poliurethane	Aluminium alloy with anti-bacteria treatment
	Thickness 0,8 mm	Density 42 kg/m3	Thickness 0,8 mm

Type	External Panel	Insulation	Internal Panel
PTL	Pre-painted galvanized steel	Rock wool	Aluminium alloy with anti-bacteria treatment
	Thickness 0,6 mm	Density 40 kg/m3	Thickness 0,8 mm
XTL	Aisi 304 stainless steel	Rock wool	Aluminium alloy with anti-bacteria treatment
	Thickness 0,6 mm	Density 40 kg/m3	Thickness 0,8 mm

All the panels, except the base ones, are available also with insulation by means of rock wool with 80 - 100 kg/m^3 density. Please, contact the Technical Dept. for additional data.
The inspection doors are installed on fibreglass reinforced nylon hinges with steel spindles and are provided with safety handles that can be opened both from the outside and the inside of the unit. For an higher safety level, the inspection doors of the fan sections are not provided with handles but with screw plugs.
In order to prevent water stagnation and to allow the condensate and the washing fluids to easily flow away, all the units are provided with base draining panels with a 3% minimum gradient and drain discharge pipes at their centre. I pannelli
The base panels are provided with injected polirethane insulation.

Prepainted sheet steel specifications:

Hot galvanised sheet steel (UNI EN 10142, EN 10147) prepainted on HDG support with polyester resin (antislip) and with a protective plastic film to prevent damages to the panels in the workshop, during transport and on site. The steel sheet characteristics are the following:

- Film thickness — µm 25 (ECCA T-1)
- Gloss 60° — 40 (EN 13523-2)
- Pencil scratch resistance (Koh-i-noor scale) — "F" degree (ECCA T-1)
- Bending resistance (no crakcs) — 3.0 T (ECCA T-7)
- Bending resistance (adherence) — 1.5 T (ECCA T-7)
- Reticulation degree — 100 d.c. (AICC n°23)
- Salt spray fog resistance — 500 h blister max 8, penetration max. 3 mm (ECCA T-8)
- Humidity resistance — 1000 h blister max 8 (ASTM D2247)
- Ageing resistance — Q.U.V.B 400 h (EN 13523-10)

The interior surface of the panels is treated to facilitate the anchorage of the injected polyurethane foam.

Aluminium sheet specifications:

Aluminium sheet (5754 P-AlMg3 alloy) with a protective plastic film to prevent damages to the panels in the workshop, during transport and on site.

Stainless steel sheet specifications:

AISI 304 stainless steel sheet with a protective plastic film to prevent damages to the panels in the workshop, during transport and on site.

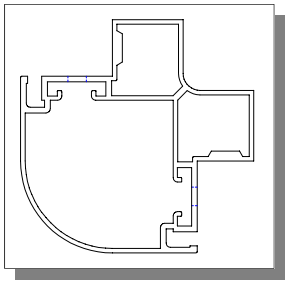
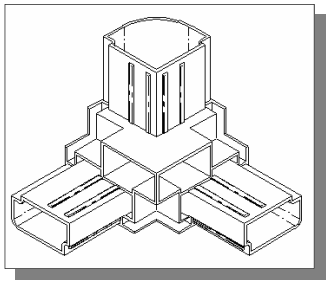
Aluminium with anti-bacteria treatment specifications:

For the patented anti-bacteria treatment specifications, please, consult paragraph 1.2.

Fire resistance:

The panels with injected polyurethane insulation have class resistance to fire 0 (zero) - 4 (four) whereas with rock ewool insulation it is possible to reach resistance class 0 (zero) - 0 (zero).
Tests certificates are available on request.

2.3.2 FRAME

The frame is made from UNI 6060 aluminium alloy extruded profiles with round corners for a lower dust accumulation and an easier cleaning and maintenance of the air handling units.
The profiles are connected by fibreglass reinforced nylon corners and are completely closed to reduce the thermal bridges and to eliminate the air by-passes around the internal components of the air handling unit.

For heavy operating conditions (very low air temperatures or ambients with a very high relative humidity) the frame is available also in thermal cut execution.
The frame is available also in anodized aluminium UNI 6060 with or without thermal cut.

2.3.3 BASE

To grant an adequate strength to the casing, a full C-section base, 120 mm high, is provided on all the units.
The base is available in the following versions:

- Galvanized steel (standard);
- AISI 304 stainless steel.

2.3.4 ROOF

If required, a canopy made from 12/10 thick prepainted galvanized steel sheet is provided. The galvanized steel sheet specifications are the same as the ones of the panels. For different materials please contact the Technical Dept..
The canopy protrudes 50 mm beyond the casing on all the four sides.

2.4 AIR INLETS

Considering the indications given in the normative—legislative documents (point 7.2.2. of the "Guidelines for the prevention and control of legionellosis") which aim at limiting the speed of the inlet air to prevent dirt from entering the AHU, the external air intake dampers have been sized so as to have an inlet air velocity lower than 2 m/s.
The installation of the dampers, when possible, is out of the air flow so that no polluting particles may accumulate inside the unit.
The dampers are in aluminium in aerofoil baldes equipped with sealing gaskets both on their sides and on the blades profiles and on the wheels protection frame.
It is not recommended to place the air vents close to sources of pollution. However, the dampers may be equipped with cowls thus preventing water or dirt from entering the unit.

The dampers may not be required: as an alternative the inlets may be constituted by simples apertures, with flanges or with blind panels on which apertures of the required dimensions may be opened directly on site.
In AHU's supplied with complete controls the dampers are equipped with wired actuators.

2.4.1 FRONT DAMPERS

The following types are available:

Damper position	**Installation**
• Front side	External
• Upper side	External
• Lower side	External
• Right side	External
• Left side	External

For dimensions please refer to the schemes in chapter 3.

2.4.2 2-WAYS MIXING BOXES

The following types are available:

Dampers position	**Installation**
• Front and upper sides	External
• Front and lower sides	External
• Upper and right sides	External
• Upper and left sides	External
• Front and right sides	External
• Front and left sides	External
• Right and left sides	External
• Both on front sides	External

For dimensions please refer to the schemes in chapter 3.

2.4.3 3-WAYS MIXING BOXES

The following types are available:

- two upper dampers and one internal recirculation dampers;
- two front dampers and one horizontal internal recirculation damper (for overlapped AHU's);
- two external side dampers and one internal recirculation damper.

For overlapped AHU's the condensate discharge, from the draining panels of the upper sections, takes place from the side through the 120 mm thick base.
For dimensions please refer to the schemes in chapter 3.

2.5 FILTERS

The choice of the filter is extremely important in order to obtain a good quality of the treated air and a correct hygiene of all the ducted air distribution system. Hereunder the characteristcs and the data tables for the various filters are indicated.

The minimum filtrating performances, according to the previously-mentioned recent documents (point 7.2.3. of the "Guidelines for the prevention and control of Legionellosis"), have to comply with the following:

- class F7 for the filters placed upstream of the AHU;
- class F8 / F9 for the filters placed downstream of the AHU and of the sound attenuators (if any);
- class F7 for the filters placed on the external air inlets.

It is possible to use panel pre-filters, bag filters, absolute filters, activated carbon filters and germicyde lamps.

The FM-H air handling units (both with or without controls) are complete with pressure switches for filters (the exact position is agreed when ordering and it is visible in the controls diagram supplied by our Technical Dept.).

As an example, please find hereunder a filter classification table.

Classification according to EN 779			
Initial colourimetric efficiency (E_A)		E_A < 20 %	E_A >= 20 %
Characteristic		Weight efficiency	Colourimetric efficiency
		A_m (%)	E_m (%)
Filter assembly	Filter class	Class limits	
Gross dust (G)	G 1	A_m < 65	-
	G 2	65 <= A_m < 80	-
	G 3	80 <= A_m < 90	-
	G 4	A_m >= 90	-
Thin dust (F)	F 5	-	40 <= E_m < 60
	F 6	-	60 <= E_m < 80
	F 7	-	80 <= E_m < 90
	F 8	-	90 <= E_m < 95
	F 9	-	E_m >= 95

Classification of HEPA and ULPA filters according to EN 1822		
Filter class	Overall efficiency value	Local efficiency value
	Efficiency (%)	Efficiency (%)
H 10	85	-
H 11	95	-
H 12	99,5	-
H 13	99,95	99,75
H 14	99,995	99,975
U 15	99,9995	99,9975
U 16	99,99995	99,99975
U 17	99,999995	99,9999

2.5.1 ANTI-BACTERIA FILTERS

As an alternative to the standard filters, to avoid them from originating microorganisms, it is possible to supply panel pre-filters, bag-filters and absolute filters with bactericyde and fungicyde properties.
The substance used in these special filters has been:

- officially approved and registered in the USA from the Enviromental Protection Agency (EPA);
- officially approved and registered in order to be used in Europe as per European Guidelines 67/548/ECC and 92/32/ECC.

Several tests have confirmed the bactericyde efficiency of the filters with microbiotic growth inhibiting properties (biostatic filters), so much so that the German normative VDI 6022 part 4.3.3, concerning the filters for Air Conditioning installation, recommends the use of biostatic filters to obtain a state-of-the-art filtration.
The bactericyde efficiency for the whole duration of the filters, until the pressure drop which requires to change the filter is reached, is confirmed by laboratory tests carried out at the IHL Indipendent Institute for Air Hygiene in Berlin.
On request, the lab tests are available.

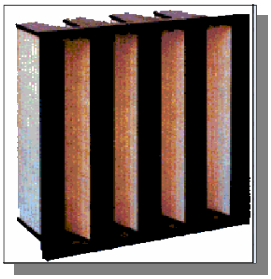
2.5.2 CORRUGATED PANEL PRE-FILTERS

The corrugated panel pre-filters of the extractable type are used for gross filtration and, however, to keep a high efficiency of the following filters. The filters may be in synthetic or metallic material, according to the use to which they are destinened and in confomity to the efficiency required in the specifications.
The filters can be regenerated by simple immersion in water and common domestic detergents and, after adequate rinse, they can be used again. Only metallic filters, usually required for air flows with greasy vapours, may be washed with specific solvents and dried with compressed air.
Quantity and dimensions of the installed cells are reported in the following tables.

FM-H	Celle	Celle	Celle	Sup. Front. [m^2]	Veloc. (3 m/s sulla batteria) [m/s]
	592x592	490x592	287x592		
20		1		0,29	2,08
28		1		0,29	2,88
35		1		0,29	3,6
42			2	0,34	3,75
50		2		0,58	2,59
57	1		2	0,69	2,46
69	1	1	1	0,81	2,56

FM-H	Celle	Celle	Celle	Sup. Front. [m^2]	Veloc. (3 m/s sulla batteria) [m/s]
	592x592	490x592	287x592		
82	2		2	1,04	2,35
105	2		3	1,21	2,61
119	4			1,40	2,55
154	4		2	1,74	2,65
194	4		4	2,08	2,8
237	6		3	2,61	2,72
286	9			3,15	2,72
342	9		3	3,66	2,8

2.5.3 BAG FILTERS

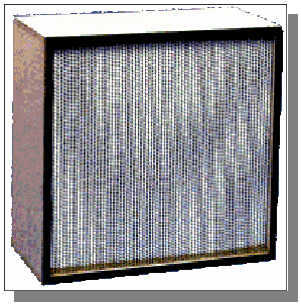


The bag filters are available both in soft and rigid bag versions. To increase their life they are generally preceded by panel filters, which stop the grossest polluting particles. They may also be followed by filters of an even higher efficiency.
The bag filtrating cells are fixed on a support frame with hermetic sealing systems to avoid any by-pass of non-treated air, and they may be withdrawn thanks to a proper inspection space upstream of the filters; the size of this inspection section allows for maintenance personnel operation.
Quantity and dimensions of the installed cells are reported in the following tables.

FM-H	Celle	Celle	Celle	Sup. Front. [m^2]	Veloc. (3 m/s sulla batteria) [m/s]
	592x592	490x592	287x592		
20		1		0,29	2,08
28		1		0,29	2,88
35		1		0,29	3,60
42		1		0,29	4,39
50		2		0,58	2,59
57		1	2	0,63	2,69
69		1	2	0,63	3,29

FM-H	Celle	Celle	Celle	Sup. Front. [m^2]	Veloc. (3 m/s sulla batteria) [m/s]
	592x592	490x592	287x592		
82		2	2	0,92	2,66
105		2	3	1,09	2,90
119	2	2		1,28	2,79
154	2	2	1	1,45	3,18
194	4		4	2,08	2,80
237	6		3	2,61	2,72
286	9			3,15	2,72
342	9		3	3,66	2,80

2.5.4 ABSOLUTE FILTERS

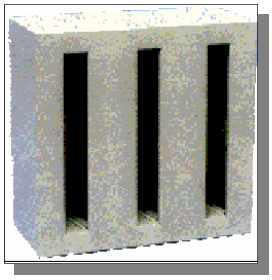


The absolute filters are usually required when an high purity level of the air has to be granted. The most common applications are in the AHU's for hospitals (operating theaters and alikes) and chemical and electronical industries. These filters are generally placed in the supply channel after the fan and must be preceded by filtrating systems with increasing effciency (panel filter and bag filters).
Special care has to be dedicated to the filter frame, to avoid any possible air by-pass and to make substitution and maintenance operations easier.

FM-H	Cells 592x592	Cells 490x592	Cells 287x592	Cells 287x287	Front. Surf. [m²]	Veloc. (3 m/s on coil) [m/s]
20		1			0,29	2,08
28		1			0,29	2,88
35		1		1	0,29	3,60
42		1		1	0,29	4,39
50		2			0,58	2,59
57		1	2		0,63	2,69
69		1	2		0,63	3,29

FM-H	Cells 592x592	Cells 490x592	Cells 287x592	Cells 287x287	Front. Surf. [m2]	Veloc. (3 m/s on coil) [m/s]
82		2	2		0,92	2,66
105		2	3		1,09	2,90
119	2	2			1,28	2,79
154	2	2	1	1	1,45	3,18
194	4		4	1	2,08	2,80
237	6		3		2,61	2,72
286	9				3,15	2,72
342	9		3		3,66	2,80

2.5.5 ACTIVATED CARBON FILTERS



The activated carbon filters are used for the absortion of smells and toxic substances in the air to be treated, both for supply or exhaust air (for example human body odours, smells from kitchens, smokes of any kind, vapours of hydrocarbours melted in water etc.).
These filtrating systems must be duly protected by high efficiency pre-filters, which prolong their life and grant their maximum efficiency throughout their life.
The frame section are perfectly accessible for proper maintenance operations.
Disposable or regeneratable filters cells may be used.

FM-H	Cells 592x592	Cells 490x592	Cells 287x592	Front. Surf. [m²]	Veloc. (3 m/s on coil) [m/s]
20		1		0,29	2,08
28		1		0,29	2,88
35		1		0,29	3,60
42		1		0,29	4,39
50		2		0,58	2,59
57		1	2	0,63	2,69
69		1	2	0,63	3,29

FM-H	Cells 592x592	Cells 490x592	Cells 287x592	Front. Surf. [m²]	Veloc. (3 m/s on coil) [m/s]
82		2	2	0,92	2,66
105		2	3	1,09	2,90
119	2	2		1,28	2,79
154	2	2	1	1,45	3,18
194	4		4	2,08	2,80
237	6		3	2,61	2,72
286	9			3,15	2,72
342	9		3	3,66	2,80

2.5.6 GERMICYDE LAMPS

They are usually installed downstream of filters with a very high efficiency, as final components before the immission of the air into the room. The use of germicyde lamps is recommended in all those applications where keeping the microorganisms concentration under control is necessary or mandatory, both for the supply and the exhaust air.
The number of lamps, their capacity and position have been chosen by the Tecnical Dept. to grant a very efficient germicyde action.
To facilitate all the cleaning and maintenance operations, the lamps are installed on withdrawable frames.
The whole structure of the frames and the internal surface of the panels in the section of the germicyde lamps are made from AISI 304 stainless steel.
The position of the lamps, their capacity and the length of the sections where they are installed have been chosen in order to grant a crossing time long enough to reduce, in theory, the “reference” bacterium *Escherichia coli* of the 9-9.99% at the conditions of 10°C and 80% R.H.
The sections are supplied with the lamps already wired and with a waterproof plug to connect to a 230 V electric supply.

2.6 HEAT EXCHANGERS

The heat exchanger is one of the most important components of an air handling unit because it is in the heat exchangers that the main fluid, hot and cold water, steam or refrigerant (direct expansion), interacts with the air to be treated (secondary fluid). The coils have to be correctly sized in relation to the required air treatment , also considering the materials in which they are made, chosen to obtain the necessary mechanical strength.
Even more so, the materials used for the coils are suggested by the normative-legislative documents listed in paragraph 1.1. In particular copper is well-known because of its bacteriostatic properties.

Standard coils:

- copper tubes - copper fins (frame and slides in stainless steel);

Alternative solutions:

- stainless steel tubes - copper fins (frame and slides in stainless steel);
- stainlees steel tubes - stainless steel fins (frame and slides in stainless steel);

Heat exchanging flluid:

- hot/cold water;
- superheated water;
- steam;
- refrigerant (direct expansion).

Side withdrawal: on stainless steel slides

For a higher hygienical level and an easier cleaning procedure, condensate drain pans are not present; however every section is provided with draining panels with central discharge.

For different solutions please contact the Technical Dept.

In the AHU’s supplied with complete controls, the coils are provided with 3-ways mixing valves equipped with wired actuators.

2.6.1 WATER COILS

Characteristics (P6030 geometry)

FM-H	Single zone				Heating for dual ducts sections			
	Front. Surf. [m^2]	Height [mm]	Length [mm]	Tubes/Rows [n°]	Front. Surf. [m^2]	Height [mm]	Length [mm]	Tubes/Rows [n°]
20	0,202	480	420	8	0,126	300	420	5
28	0,278	480	580	8	0,174	300	580	5
35	0,348	480	725	8	0,218	300	725	5
42	0,425	480	885	8	0,266	300	885	5
50	0,502	480	1045	8	0,314	300	1045	5
57	0,566	780	725	13	0,348	480	725	8
69	0,690	780	885	13	0,425	480	885	8
82	0,815	780	1045	13	0,502	480	1045	8
105	1,053	780	1350	13	0,648	480	1350	8
119	1,191	1140	1045	19	0,752	720	1045	12
154	1,539	1140	1350	19	0,972	720	1350	12
194	1,944	1440	1350	24	1,053	780	1350	13
237	2,369	1440	1645	24	1,283	780	1645	13
286	2,862	1740	1645	29	1,579	960	1645	16
342	3,419	1740	1965	29	1,886	960	1965	16

Connection diameters for the valves of the single zone water coils with P6030 geometry (depending on the circuits number)

FM-H	Diam. (R1,2)	Diam. (R2,2)	Diam. (R3,2)	Diam. (R4,1)	Diam. (R4,2)	Diam. (R6,1)	Diam. (R6,2)	Diam. (R8,1)	Diam. (R8,2)
20	1/2"	1"	1"	1"	1"	1"	1"	1"	1"
28	1/2"	1"	1"	1"	1"	1"	1"	1"	1"
35	1/2"	1"	1"	1"	1"	1"	1"	1"	1"
42	1"	1"	1"	1" 1/2	1" 1/2	1" 1/2	1" 1/2	1" 1/2	1" 1/2
50	1"	1"	1"	1" 1/2	1" 1/2	1" 1/2	1" 1/2	1" 1/2	1" 1/2
57	1"	1"	1"	1"	1"	1" 1/2	1" 1/2	1" 1/2	1" 1/2
69	1"	1"	1"	1" 1/2	1" 1/2	1" 1/2	1" 1/2	1" 1/2	1" 1/2
82	1"	1"	1" 1/2	1" 1/2	1" 1/2	1" 1/2	1" 1/2	2" 1/2	2" 1/2
105	1"	1"	1" 1/2	1" 1/2	1" 1/2	1" 1/2	1" 1/2	2" 1/2	2" 1/2
119	1"	1" 1/2	2"	2"	2"	2"	2"	2" 1/2	2" 1/2
154	1"	1" 1/2	2"	2"	2"	2" 1/2	2" 1/2	2" 1/2	2" 1/2
194	1" 1/2	1" 1/2	2"	2" 1/2	2" 1/2	2" 1/2	2" 1/2	3"	3"
237	1" 1/2	1" 1/2	2"	2" 1/2	2" 1/2	2" 1/2	2" 1/2	3"	3"
286	1" 1/2	2" 1/2	2"	2" 1/2	2" 1/2	3"	3"	4"	4"
342	1" 1/2	2" 1/2	2" 1/2	2" 1/2	2" 1/2	3"	3"	4"	4"

Connection diameters for the valves of the multizone water heating coils with P6030 geometry (depending on the circuits number)

FM-H	Diam. (R1,3)	Diam. (R2,3)	Diam. (R3,3)	Diam. (R4,3)
20	1"	1"	1"	1"
28	1"	1"	1"	1"
35	1"	1"	1"	1"
42	1"	1"	1"	1"
50	1"	1"	1"	1"
57	1"	1"	1"	1"
69	1"	1"	1"	1"

FM-H	Diam. (R1,3)	Diam. (R2,3)	Diam. (R3,3)	Diam. (R4,3)
82	1"	1"	1"	1"
105	1"	1"	1"	1"
119	1"	1"	1"	1" 1/2
154	1"	1"	1"	1" 1/2
194	1"	1"	1" 1/2	2"
237	1"	1"	1" 1/2	2"
286	1"	1"	1" 1/2	2"
342	1"	1"	1" 1/2	2"

2.6.2 DIRECT EXPANSION COILS

Dimensions

FM-H	Geometry	Front. Surf. [m^2]	Height [mm]	Length [mm]	Tubes/rows [n°]	Circuits							
						R 3.1	R 3.2	R 4.1	R 4.2	R 6.1	R 6.2	R 8.1	R 8.2
20	P2519	0,189	450	420	18	3	6	6	9	6	9	6	9
28	P2519	0,261	450	580	18	3	6	6	9	6	9	9	12
35	P2519	0,326	450	725	18	6	9	6	9	9	18	9	12
42	P2519	0,398	450	885	18	6	9	6	9	9	18	12	18
50	P2519	0,470	450	1045	18	6	9	6	9	9	18	12	18
57	P2519	0,544	750	725	30	7	9	10	15	15	18	15	20
69	P2519	0,664	750	885	30	7	9	10	15	15	18	15	20
82	P2519	0,784	750	1045	30	9	15	15	20	18	30	20	30
105	P2519	1,013	750	1350	30	9	15	15	20	22	30	24	30
119	P2519	1,176	1125	1045	45	13	22	22	30	22	45	30	36
154	P2519	1,519	1125	1350	45	13	22	22	30	27	45	36	45
194	P2519	1,958	1450	1350	58	22	29	29	58	29	58	58	77
237	P2519	2,385	1450	1645	58	29	43	29	58	43	58	58	77
286	P2519	2,879	1750	1645	70	35	52	35	70	52	70	70	140
342	P2519	3,439	1750	1965	70	35	52	46	70	70	105	70	140

2.6.3 ELECTRIC BATTERIES

The electric batteries are commonly used to compensate limited thermal capacities in small or middle size AHU's, most frequently as summer re-heating coils when the hot water supply is not possible or too expensive.
The electric batteries may also succesfully operate as anti-frost devices to protect filters or coils fed with water without glycol.
The electric batteries are armoured with stainless steel tubes with stainless steel fins and frames.
The standard electrical supply is 400 V.
A thermostat with automatic reset and a safety thermostat set at 90°C with manual reset are provided as standard.
The capacities and the number of the stages are reported in the following table:

FM-H	1st STAGE		2nd STAGE		3rd STAGE		4th STAGE	
	Capacity	Dt	Capacity	Dt	Capacity	Dt	Capacity	Dt
	kW	°C	kW	°C	kW	°C	kW	°C
20	2,1	4,4	6,3	13,1	8,4	17,5	12,6	26,3
28	3	4,5	9	13,4	12	17,8	18	26,7
35	3,6	4,3	10,8	12,9	14,4	17,1	21,6	25,7
42	3,9	3,8	11,7	11,5	15,6	15,3	23,4	22,9
50	4,5	3,8	13,5	11,3	22,5	18,8	31,5	26,3
57	7,2	5,3	18	13,3	25,2	18,6	32,4	23,9
69	7,8	4,7	23,4	14,1	31,2	18,8	42,9	25,9
82	9	4,6	27	13,8	36	18,4	49,5	25,3
105	10,8	4,3	32,4	12,8	48,6	19,2	64,8	25,6
119	13,5	4,7	40,5	14,2	54	18,9	67,5	23,6
154	18	4,9	54	14,6	72	19,5	90	24,3
194	24	5,1	60	12,9	90	19,3	120	25,7
237	30	5,3	70	12,3	110	19,3	150	26,4
286	36	5,2	80	11,7	130	18,9	180	26,2
342	42	5,1	90	11,0	150	18,3	210	25,6

The Dt temp. differences refer to the nominal air flow, corresponding to a face velocity of 2 m/s on the coils.

2.7 HUMIDIFIERS

The humidification is a very important treatment of the air to control the required comfort in the room.
As the normatives suggest, for obvious reasons of hygiene, only steam humidification has been adopted.
The minimum distances between the humidifier and the downstream components are respected to prevent condensate from spreading in the unit.

The following solutions are available:

- only steam manifold (direct steam humidification);
- manifold provided with submersed electrodes steam producer.

2.7.1 HUMIDIFIERS WITH STEAM MANIFOLDS ONLY

The system is provided with the steam manifold only, sized on the air flow and on the required humidification level; if necessary more than one manifold may be installed.
The manifold, supplied with condensate drain tube, is made from stainless steel.
To prevent condensate from spreading in the unit, the minimum distances between the manifold and the downstream components are respected.
For a higher hygienical level and an easier cleaning procedure, condensate drain pans are not present; however every section is provided with draining panels with central discharge.
It is recommended to stop the steam distribution when no air flow is present, in particular to stop the steam distribution when the fan stops.
In the air handling units provided with complete controls, this procedure is managed by the control logic.

2.7.2 HUMIDIFIERS WITH STEAM PRODUCER

The system is provided with a submersed electrodes steam producer and a steam manifold sized on the air flow and on the required humidification level; if necessary more than one manifold may be installed.
The manifold, supplied with condensate drain tube, is made from stainless steel.
To prevent condensate, the minimum distances between the manifold and the downstream components are respected.
For a higher hygienical level and an easier cleaning procedure, condensate drain pans are not present; however every section is provided with draining panels with central discharge.
In the air handling units provided without controls, the steam producer is provided.
It is suggested to stop the steam distribution when no air flow is present, in particular to stop the steam distribution when the fan stops.
In the air handling units provided with complete controls, this procedure is managed by the control logic.

2.8 DROPLET ELIMINATORS

The droplet eliminators have been designed to obtain the maximum efficiency when eliminating the droplets originating from the humidification or de-humidification treatments.
The droplet eliminators are withdrawable from the side on stainless steel slides.

Materials:

- Aluminium alloy, pre-painted with anti-bacteria treatment for the droplet eliminators, AISI 304 stainless steel slides and frames;

Alternative materials may be required (stainless steel in particular), please contact the Technical Dept.

2.9 FAN SECTIONS

2.9.1 FANS

The fans are among the most important components in AHU's, since the fan-motor assembly constitutes the only moving part in continous movement in the unit; as such it is subject to problems of wear, noise, maintenance, safety devices etc. A correct technological and dimensional selection of the fan grants the correct operation of the unit in time.
It is possible to use, for the same size of AHU, different types of fans to make them suit the real project situations, thus optimizing performances, sound levels and flexibility of operation.
The exclusive adoption of shroud-less plug fans allows for an easy cleaning of the propeller. Slides and brackets of the fan assembly are reduced to the minimum so as to avoid accumulation of dirt, otherwise difficult to eliminate.

Type: the fans are of the **"plug fan"** type, with backward blades and without shroud;

Materials: the fans are pre-painted with the anti-bacteria treatment;

Sizes: the size of the fan is chosen according to the air flow and the total static pressure as shown by the diagrams in chapter 5. In the following table the fan sizes available for each model of air handling unit are reported. The fan labels show the external diameter of the propeller expressed in mm;

FM-H	Fan sizes												
20	250	280											
28	250	280	315										
35		280	315										
42		280	315										
50		280	315										
57			315	355	400								
69				355	400	450							
82					400	450	500						
105						450	500						
119							500	560	630				
154									630	710	800		
194										710	800		
237											800	900	1000
286												900	1000
342												900	1000

Anti-virbration mounts: the standard execution includes high efficiency rubber a.v.m. (60°Sh) and anti-vibration canvas on the fan mouth. Special spring anti-vibration mounts are available on request.

As standard, the fan sections are equipped with earth wire between the motor support and the base frame.

2.9.2 MOTORS

The motors are directly coupled to the fans.
They are three-phase asynchronous with squirrel cage rotor, totally enclosed design with air-over cooling. The electrical characteristics of the motors comply with international norms (B3 construction).
The standard motors can work with frequency inverters responding to the indications given in the IEC 34-17 norm, paragraph 9.

Protection class: IP55 (on request, higher protection classes are available)
Stator winding class: F

Motors are single speed ones (2, 4, 6, 8 poli depending on the fan speed).
In AHU's provided with complete controls, the motors are equipped with wired inverters whereas in AHU's without controls the motors are wired to a plug outside the unit.

2.10 SOUND ATTENUATORS

It is necessary to limit the fans sound emissions to the minimum, with an accurate choice of the fans operating conditions. To further reduce the noise level it is possible to choose sound attenuators to be placed upstream and downstream the fan section.
In order to comply with the indications present in the normative-legislative documents, the sound attenuators may be easily withdrawn horizontally on stainless steel slides to clean the internal part of the unit. For sizes FM-H 105 - 154 - 194 - 237 - 286 - 342 the silencers are divided in two parts to facilitate disassembling.

Length of the silencers:

- mm 560
- mm 880
- mm 1200
- mm 1520

Silencers disposition: horizontal;

Silencers thickness: 150 mm up to size FM-H 50, 200 mm for the remaining sizes;

Materials:
The frame of the sound attenuators is in stainless steel. The sound abating media is rock wool covered by a protection polyester film and framed between microperforated stainless steel sheets.

Sound attenuation at various frequencies is shown in the following table:

	Sound attenuation [dB]							
Length [mm]	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
560	2	5	10	17	18	22	26	13
880	5	10	18	26	29	39	41	20
1200	7	14	24	35	39	48	48	28
1520	9	16	30	44	45	48	48	31

2.11 MULTIZONE / DUAL DUCT SECTIONS

Multizone/dual duct sections are generally used when the control of the room temperature is obtained by mixing two air flows of different temperatures, by acting on the dampers, thus serving different zones of the building indipendently with the same AHU.
The mutizone section besides containing the hot and cold water coil of adequate capacity in two different air flows, is equipped with interacting dampers, as many as the number of zones to be served.
The dual duct section is similar to the multizone section, but lacking the interacting dampers since the mixing of the two air flows is obtained by proper terminals placed inside the rooms.
When selecting the units it necessary to know how many zones must be served, their air flows and their position on the front surface on the multizone itself.

2.12 RECUPERATORS

The heat recuperator is one if the AHU's components most frequently required when the treated volumes of fresh or ricirculated air are necessarly large in order to keep the rooms comfortable or to respond to specific conditions (hospitals, chemical industry, pharmaceutical industry etc.).
The higher the air volume to be treated or the higher the temperature difference between the exhaust air and the fresh air, then the higher will be the efficiency of the recuperator.

Available recuperator types:

- static cross-flow recuperator with class G3 panel corrugated filters on the fresh air side;
- static cross-flow recuperator with by-pass damper (for free cooling operation) and class G3 panel corrugated filters on the fresh air side;
- static cross-flow recuperator with recirculation damper (3-ways mixing box with recuperator) and class G3 panel corrugated filters on the fresh air side.

The recuperator frames are made from stainless steel.

Please contact the Technical Dept. for the following alternative solutions:

- recovery wheel (only sensible exchange solution is admitted);
- run-around-coils (same materials indicated for the heating or cooling coils).

Standard installation:

- with horizontal axis

Air handling unit configuration:

- in-line exhaust and supply;
- overlapped exhaust and supply (only from the size FM-H 20 to the size FM-H 154 included).

Condensate drain pans are not present, however every section is provided with draining panels with central discharge.
In overlapped exhaust and supply the condensate of the upper sections drains through a tube down to the draining panels of the lower sections.

For different solutions please, contact the Technical Dept.

2.13 LIGHTS

Every section is provided with a light to facilitate the cleaning and maintenance procedures. The lights are wired to an external plug. Windows are provided in the sections equipped with lights.
In case of inadequate lighting, please refer to the installation, use and selection manual for the solutions to be adopted.

2.14 ACCESSORIES

To make the AHU's more complete and versatile, a large range of accessories is available; to facilitate the installation on site, all the accessories are installed on the unit in the factory.
Hereunder the most frequently required accessories are indicated; our Technical Dept. is available to examine different proposals or new solutions.

Technical rooms:

The technical rooms are designed to protect mixing valves with actuators, electirc and electronic devices and accessories supplied with AHU's to be installed on the outside. They are provided with a canopy and grant a good thermal insulation.
The technical room is made from a 30 mm aluminium frame and 25 mm thick panels with injected polyurethane.
The following dimensions are available:

- length: from 1 module (640 mm) to 3.5 modules (2240 mm);
- depth: 1 module (610 mm internal) up to size FM-H 105;
- depth: 1.5 modules (930 mm internal) from size FM-H 119 up to size FM-H 342.

The technical rooms are not provided with the bottom panel to leave free passage to the feeding pipes to coils or humidifiers.

Air inlets/outlets accessories:

- flange;
- blind panel (to be cut on site according to the duct dimensions);
- anti-vibration canvas on air inlets (with or without damper) with earth wire;
- anti-vibration canvas on supply mouth (with or without damper) with earth wire;
- aluminium grille with anti-bird mesh;
- manual actuator for the dampers;
- walkable grille for dampers installed on the AHU's floor.

Fan sections accessories:

- overpressure dampers;
- waterproof microswitches on inspection doors;
- flow-meter.

2.15 CONTROLS

2.15.1 DESCRIPTION

The air handling unit of the FM-H series is an innovative solution in the scenario of air conditioning and air treatment for specific sectors.
The controls too are not lacking innovative aspects; to facilitate the installation on site and to reduce the risk of dirt accumulation because of interventions inside the unit, the AHU's are available in the following configurations:

- **FM-H unit without thermoregulation**: the unit is however complete with all those components which would require the internal wiring and assembly. In this case, according to previously-agreed requirements, temeperature probes, humidity probes, safety thermostats, pressure switches etc. are supplied. The user will have to see to the completion of the thermoregulation in order to proceed with the CE labelling. In this case the unit is supplied with the II B attachment of the 89/392/CE directive and successive modifications and integrations.

- **FM-H unit equipped with thermoregulation**: the unit is provided with complete controls as agreed with the Customer and therefore ready to use. The unit is therefore complete with the electrical and electronic components needed for its correct operation. In this case the unit is supplied with the CE label which certifies its compliance with the safety requirements and applicable directives.

The diagrams of the control logic, the electrical diagrams and all the documentation necessary for a correct installation are provided with the air handling units.

2.15.2 COMPONENTS

In case of air handling unit **without thermoregulation**, according to previously-agreed requirements, the following components are supplied:

- temperature/humidity probes;
- filters differential pressure switches: they are placed in every filtrating section to indicate the filters choking. In the installation manual an indicative maintenance scheduling is suggested, considering that the life of the filters may change according to the operating conditions;
- air flow differential pressure switches: they are usually installed on the fan sections to generate inputs given to the frequency inverters;
- safety thermostat with manual reset: it is installed on the heating coil sections, set to 90°C limit temperature;
- safety thermostat with automatic reset: it is installed on the electric battery sections and allows the setting of the limit temperature (anyway lower than 90°C, limit temperature of the safety thermostat with manual reset);
- anti-frost thermostat: it is installed on the first water (or steam) coil which the fresh air flow meets inside the unit;
- smoke sensors kit: (please, contact the Technical Dept.);

Every accessible section is provided with lights with IP65 protection degree.

The previously-mentioned devices are wired to external waterproof boxes and are identified with specific labels (please refer to the tables on pag. 28 and 29).

In case of air handling units **equipped with thermoregulation**, according to the previously-agreed requirements and to the installed components (coils, humidifiers, 3-ways mixing boxes etc.) the following devices may be supplied:

- temperature/humidity probes;
- filters differential pressure switches: the are placed in every filtrating section to indicate the filters choking. In the installation manual an indicative maintenance scheduling is suggested, considering that the life of the filters may change according to the operating conditions;
- air flow differential pressure switches: they are usually installed on the fan sections to generate inputs given to the frequency inverters;
- inverters: one inverter for each motor is supplied (twin fans are controlled by a single inverter, managing a weekly fans alternation as well). In case of inverter failure, its manual by-pass is possible;
- actuators for dampers, modulating or ON/OFF version, with or without spring return;
- safety thermostat with manual reset: it is installed on the heating coil sections, set to 90°C limit temperature;
- safety thermostat with automatic reset: it is installed on the electric battery sections and allows the setting of the limit temperature (anyway lower than 90°C, limit temperature of the safety thermostat with manual reset);
- 3-ways mixing valves with actuators provided for heating and cooling coils;
- 2-ways mixing valves with actuators and spring return (normally closed);
- anti-frost thermostat: it is installed on the first water (or steam) coil which the fresh air flow meets inside the unit;
- air quality probes (please, contact the Technical Dept.);
- smoke sensors kit (please, contact the Technical Dept.);
- electric panel: waterproof power supply section with main switch, sized to host future microswitches on inspection doors. The electric panel may be controlled by a remote device (please, contact the Technical Dept.). We recommend to protect the feeding cable with a magnetothermic differential switch, not included in the controls supplied with the unit;
- lights electrical panel: waterproof lights power supply with magnetothermic differential switch; it is supplied separated from the main electrical panel in order to allow the lighs ON/OFF for maintenance procedures when the main electrical panel is excluded;
- microprocessor control with software and interface display (please, consult paragraph 2.15.2);

Every accessible section is provided with wired lights with IP65 protection degree.
.

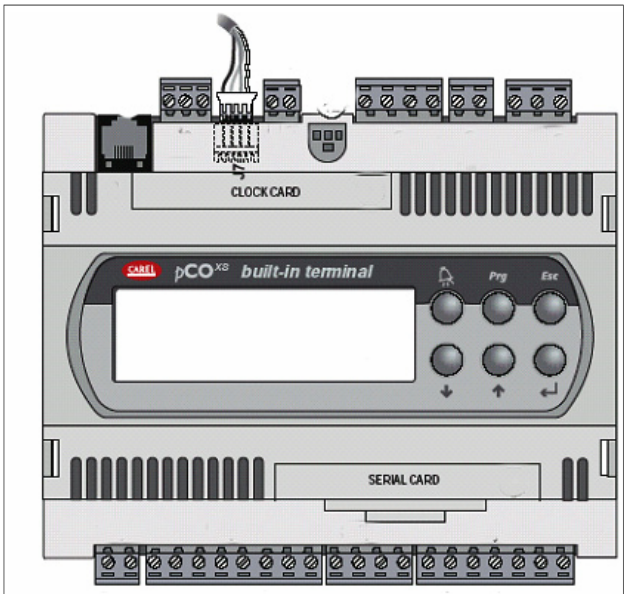
All the internal wirings are minimized in order to avoid niches with dirt accumulation, hard to be cleaned.
The materials chosen for the wirings are inert to the detergents usually adopted to clean the units.

2.15.3 MICROPROCESSOR

The **programmable microprocessor**, installed on the FM-H units provided with thermoregulation, offers the following features:

- 16 bit microprocessor controller operating the control software and provided with connections to the transducers and all the controlled devices (valves, inverters, etc.). The software and all the set parameters are written on a FLASH memory, thus keeping the information safe also in case of voltage failure (without emergency batteries);

- Terminal board with display, keyboard and LED placed on the back of the board. The setting of the control parameters (Set Point, differential values, alarm thresholds) and the main user operations (ON/OFF, display of the controlled values, optional printing) are allowed;



Microprocessor control board

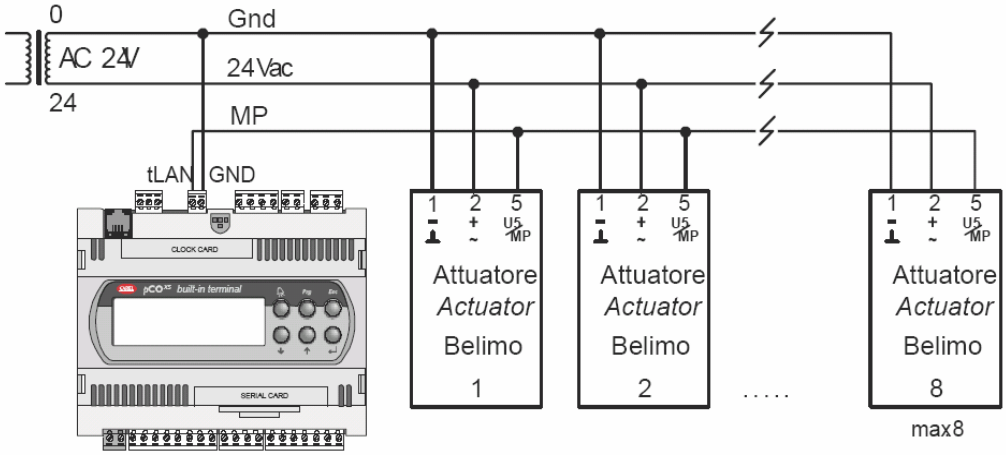
- The controller allows the connection to a local pLAN network (optional serial boards are required). Every board exchanges data with fast transmission; to share data, up to 32 units may be connected. The connection and the data transfers are based on the RS485 standard. The Carel or ModBus comunication protocols are applied (the Technical Dept. may examine the insertion of Gateways as accessories for data transfers with different communication protocols);

2.15.4 SOFTWARE

The **software**, present on FM-H units provided with thermoregulation, controls the following main devices:

- fresh air external damper and mixing boxes with free-cooling, free heating and enthalpic controls;
- exhaust and supply fans with inverters;
- water heating coils and electric batteries with pre-heating control;
- water cooling coils;
- direct expansion coils with condensing unit control with 3-steps ON/OFF;
- cross-flow heat recuperators and run-around-coils;
- filtrating sections on exhaust and supply;
- ON/OFF and modulating steam humidifiers;
- integrated daily/weekly chronothermostat;
- integrated CAREL / Modbus® control;
- alarms display, control and resume;

The control system applies an exclusive communication protocol (MP-Bus) which allows to connect up to 8 actuators and 8 sensors (active or passive) or a digital contact by wiring a single 3-poles cable, so that all the wiring and maintenance operations are simplified.

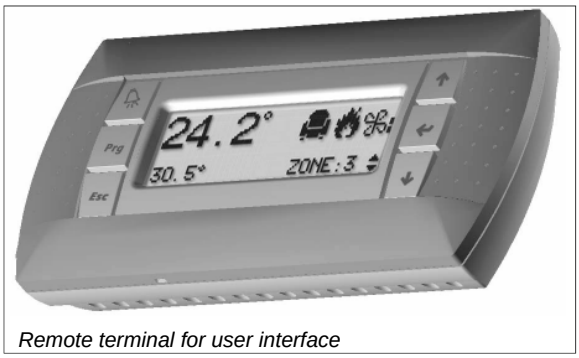


Communication between microprocessor and actuators based on MP-Bus protocol

The **terminal** allows the following operations:

- setting of the base parameters, with password-protected access;
- modification of the unit operating parameters with optional password protection;
- display of the alarms with acoustic signal;
- display of the active functions by means of LEDs;
- display of the measured parameters;
- optional alarms print-out and optional periodical print-out of the unit main parameters;
- possibility of simulating function buttons fromthe standard keyboard, with LED indication if such function has been selected (depending on the software);
- possibilty of simulating a numerical keyboard from the standard keyboard for data setting (depending on the software).

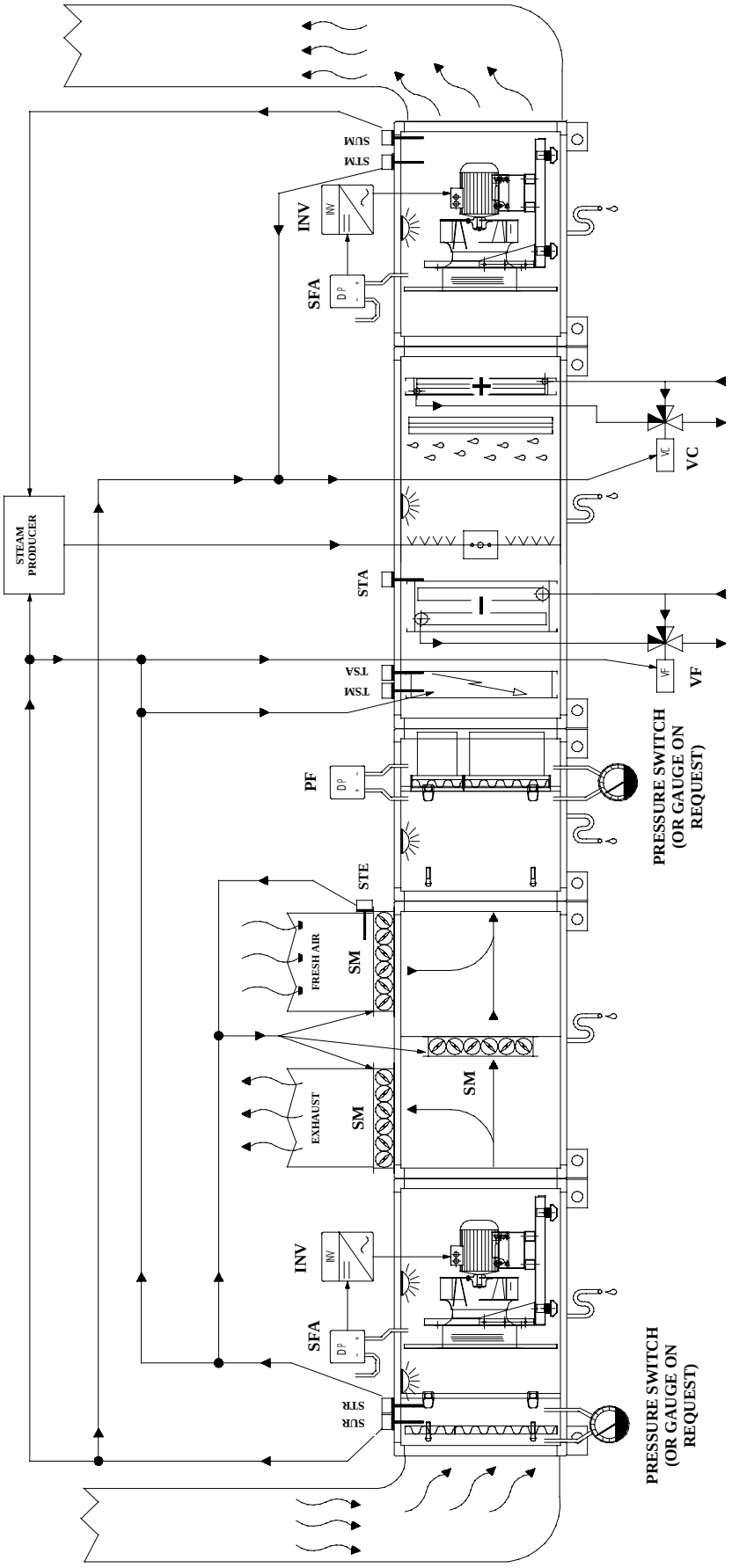
A **remote LCD terminal** is available for user interface (accessory) for positioning in the room, built-in or wall installation:



Remote terminal for user interface

For more information, please contact the Technical Dept.

2.15.5 AN EXAMPLE OF CONTROLS POSITIONING (FM-H PROVIDED WITH CONTROLS)



LEGENDA	
INV	INVERTER
STA	ANTI-FREEZE TEMPERATURE PROBE
TTA	ANTI-FREEZE THERMOSTAT
STE	EXTERNAL TEMPERATURE PROBE
SUE	EXTERNAL HUMIDITY PROBE
STR	EXHAUST TEMPERATURE PROBE
STM	SUPPLY TEMPERATURE PROBE (LIMIT)
SUM	SUPPLY HUMIDITY PROBE
SUR	EXHAUST HUMIDIFTY PROBE
TSM	SAFETY THERMOSTAT - MANUAL RESET
TSA	SAFETY THERMOSTAT - AUTOMATIC RESET
VF	3-WAYS VALVE ACTUATOR - COLD WATER COIL
VC	3-WAYS VALVE ACTUATOR - HOT WATER COIL
SFA	AIR FLOW DIFFERENTIAL PRESSURE SWITCH
PF	FILTERS PRESSURE SWITCH
SM	DAMPER ACTUATORS

NOTE: the presence of the component is to be agreed upon and defined when ordering according to the configuration of the AHU

2.15.6 ELECTRIC AND ELECTRONIC DEVICES TABLE

COMPONENT	POSITION, REMARKS	TYPE, FEATURES	LABEL	FM-H with controls	FM-H without controls
Filters differential pressure switch	Placed by every filters assembly	assembled in series with all the other filters pressure switches, digital output	**PF**	●	●
Differential pressure gauge	Placed by every filters assembly	Read-only device		○	○
Flowmeter	Placed by every fan section	Read-only device		○	○
Room temperature probes / combined room temperature-humidity probes, external air probes	Generally placed in the room (temp. probes, temp./humid.) The presence is defined in accordance to the configuration of the AHU and of the air treatment	Outputs: temperature (NTC res.) + humidity (4-20 mA or 0-1 Vdc)	**STR SUR STE SUE**	●	○
Air flow differential pressure switch		Output: 0-10 Vdc	**SFA**		●
		MP-Bus protocol		●	
Dampers actuators	Installed externally with output signal: 0-10 Vdc	ON/OFF, ON/OFF with spring return, modulating, modulating with spring return	**SM**		○
	Installed externally and managed with MP-Bus protocol	ON/OFF, ON/OFF with spring return, modulating, modulating with spring return	**SM**	●	

● = standard

○ = accessory

continues…

COMPONENT	POSITION, REMARKS	TYPE, CHARACTERISTIC	LABEL	FM-H with controls	FM-H without controls
Anti-freeze thermostat	Placed by the water heat exchanger	Digital ouptput	**TTA**		●
Valves actuators	Modulating	Output: 0-10 Vdc	**VF VC**		
		MP-Bus protocol		●	
Inverter	one for each motor (or one for the two fans in case of twin fans)	manages the weekly (or settable) alternation in case of twin fans	**INV**	●	
Electric panel	Waterproof electric panel, suitable for external applications	Power board		●	
		Lights power board		●	
Microprocessor	inside the electric panel			●	
Smoke sensors kit				○	○
Air quality probes	Generally placed in the room	Output: 0-10 Vdc	**SQA**	○	○

● = standard

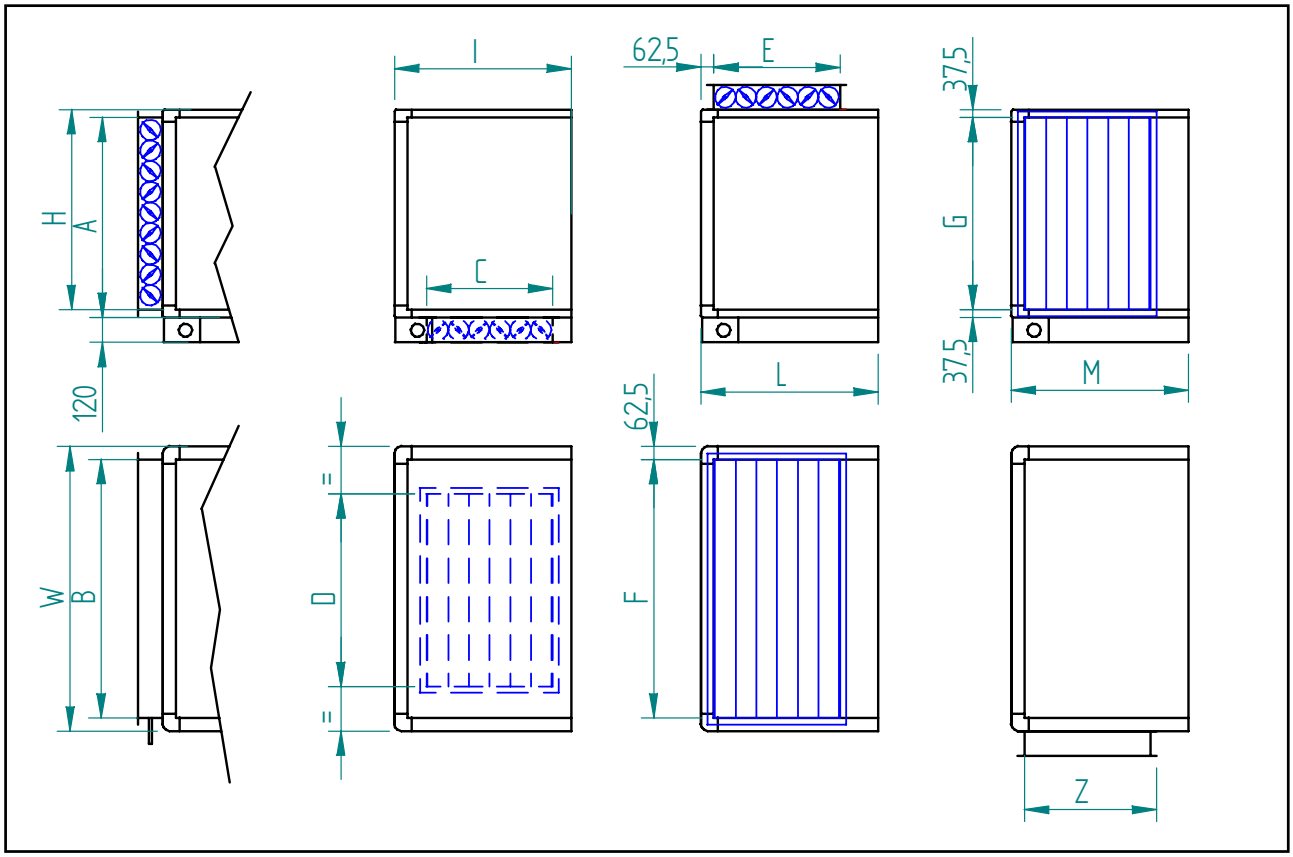
○ = accessory

Further information available, please, contact the Technical Dept.

3. Dimensions

N.B. The dimensions given in the following drawings do not include handles or control devices.

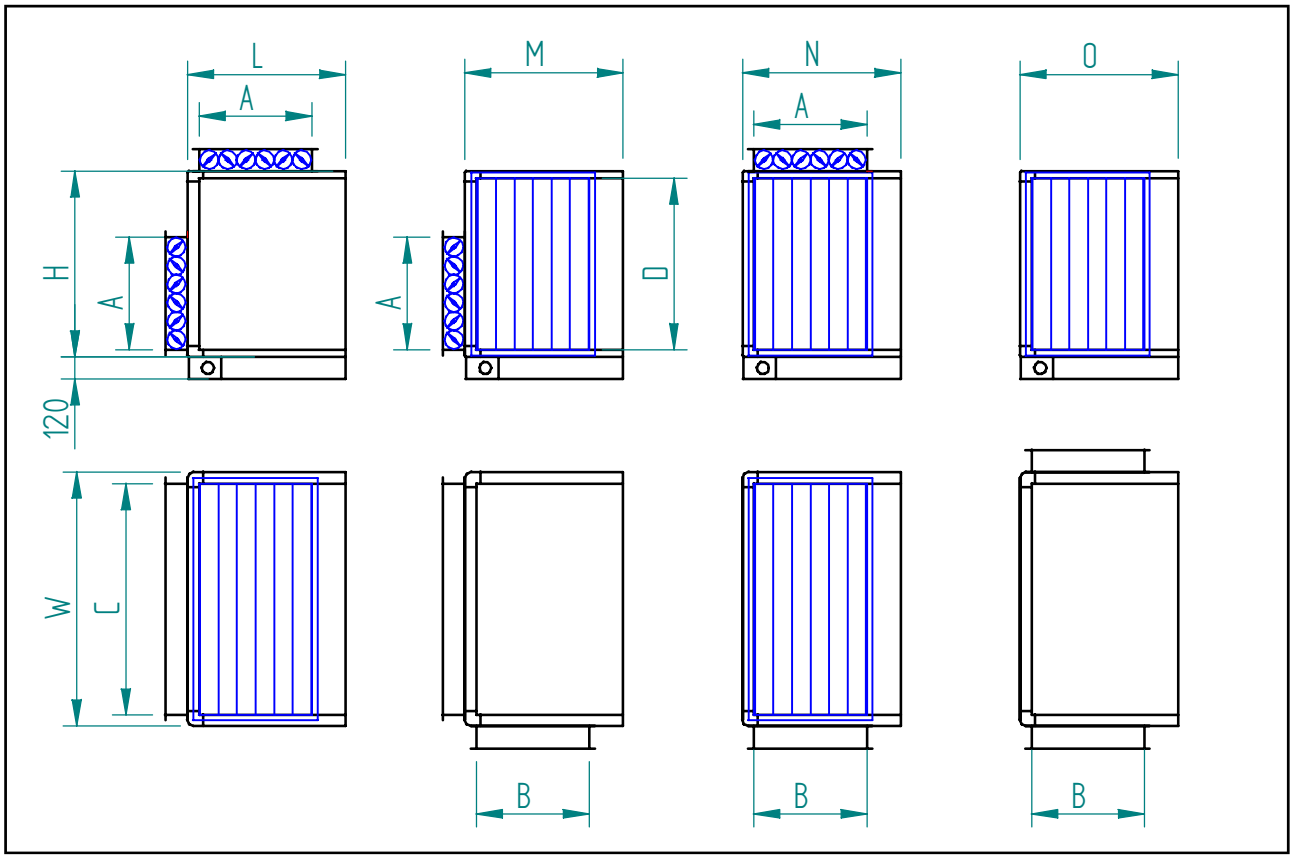
3.1 FRONT DAMPERS



FM-H	W	H	A	B	C	D	E	F	G	I	L	M	Z
20	735	685	610	610	610	450	610	610	610	960	640	640	610
28	895	685	610	770	610	610	610	770	610	960	640	640	610
35	1055	685	610	930	610	610	610	930	610	960	640	640	610
42	1215	685	610	1090	610	930	610	1090	610	960	960	640	930
50	1375	685	610	1250	610	930	610	1250	610	960	960	640	930
57	1055	1005	930	930	930	770	930	930	930	1280	960	960	930
69	1215	1005	930	1090	930	930	930	1090	930	1280	960	960	930
82	1375	1005	930	1250	770	1090	930	1250	930	960	960	960	930
105	1695	1005	930	1570	930	1250	930	1570	930	1280	960	1280	1250
119	1375	1325	1250	1250	1570	930	1250	1250	1250	1920	1280	1280	1250
154	1695	1325	1250	1570	1250	1250	1250	1570	1250	1600	1600	1280	1570
194	1695	1645	1570	1570	1570	1250	1570	1570	1570	1920	1600	1600	1570
237	2015	1645	1570	1890	1570	1570	1570	1890	1570	1920	1600	1600	1570
286	2015	1965	1890	1890	1890	1570	1890	1890	1890	2240	1920	1600	1570
342	2335	1965	1890	2210	1890	1890	1890	2210	1890	2240	1920	1920	1890

* dimensions in mm

3.2 2-WAYS MIXING BOXES



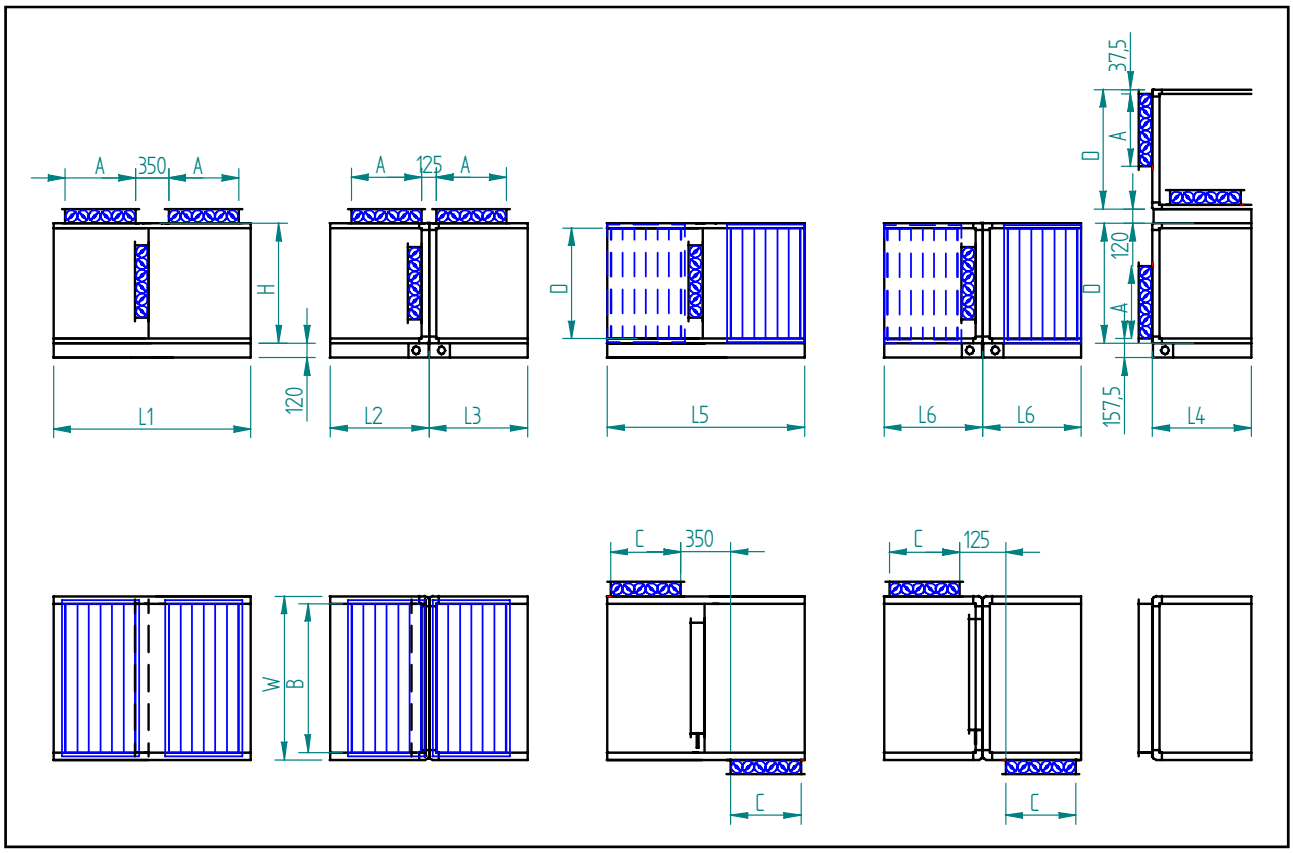
The fresh air external dampers are sized for a crossing air velocity lower than 2 m/s to comply with the specifications given in the normatives.

FM-H	W	H	A	B	C	D	L	M	N	O
20	735	685	300	300	610	610	320	320	320	320
28	895	685	300	300	770	610	320	320	320	320
35	1055	685	300	450	930	610	320	480	480	480
42	1215	685	300	610	1090	610	320	640	640	640
50	1375	685	300	610	1250	610	320	640	640	640
57	1055	1005	300	300	930	930	320	320	320	320
69	1215	1005	450	610	1090	930	480	640	640	640
82	1375	1005	450	610	1250	930	480	640	640	640
105	1695	1005	450	610	1570	930	480	640	640	640
119	1375	1325	610	610	1250	1250	640	640	640	640
154	1695	1325	610	770	1570	1250	640	800	800	800
194	1695	1645	610	610	1570	1570	640	640	640	640
237	2015	1645	610	770	1890	1570	640	800	800	800
286	2015	1965	930	930	1890	1890	960	960	960	960
342	2335	1965	930	1250	2210	1890	960	1280	1280	1280

* dimensions in mm

** For 2-ways mixing boxes with dampers on the lower side, please contact the Technical Dept.

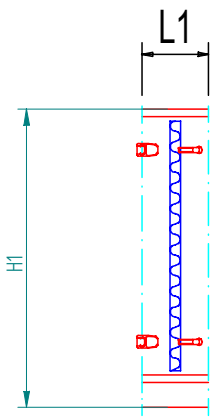
3.3 3-WAYS MIXING BOXES



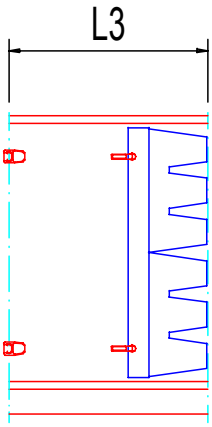
FM-H	W	H	L1	L2	L3	L4	L5	L6	A	B	C	D
20	735	685	960	320	320	640	640	320	300	610	300	610
28	895	685	960	320	320	640	1280	480	300	770	450	610
35	1055	685	960	320	320	640	1600	640	300	930	610	610
42	1215	685	960	320	320	640	1600	640	300	1090	610	610
50	1375	685	960	320	320	640	1600	640	300	1250	610	610
57	1055	1005	1600	640	640	960	1600	640	610	930	610	930
69	1215	1005	1600	640	640	960	1600	640	610	1090	610	930
82	1375	1005	1600	640	640	960	1920	800	610	1250	770	930
105	1695	1005	1600	640	640	960	2560	1120	610	1570	1090	930
119	1375	1325	1600	640	640	960	1600	640	610	1250	610	1250
154	1695	1325	1600	640	640	1280	1920	800	610	1570	770	1250
194	1695	1645	2240	960	960	1280	2240	960	930	1570	930	1570
237	2015	1645	2240	960	960	1280	2880	1280	930	1890	1250	1570
286	2015	1965	2240	960	960	1280	2240	960	930	1890	930	1890
342	2335	1965	2240	960	960	1280	2560	1120	930	2210	1090	1890

* dimensions in mm

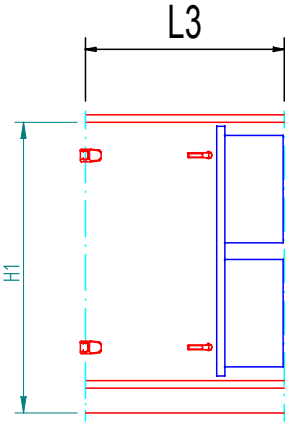
3.4 FILTERS



PRE-FILTERS



BAG FILTERS



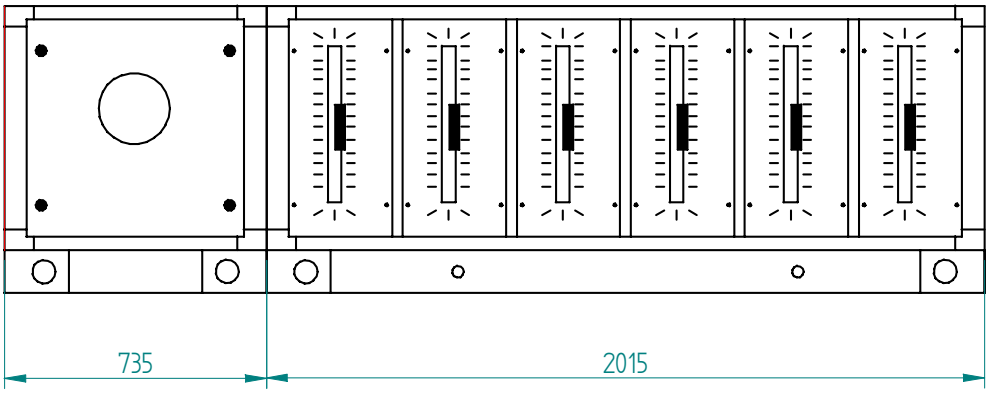
ABSOLUTE FILTERS

FM-H	H1	L1	L3
20	805	320	960
28	805	320	960
35	805	320	960
42	805	320	960
50	805	320	960
57	1125	320	960
69	1125	320	960
82	1125	320	960
105	1125	320	960
119	1445	320	960
154	1445	320	960
194	1765	320	960
237	1765	320	960
286	2085	320	960
342	2085	320	960

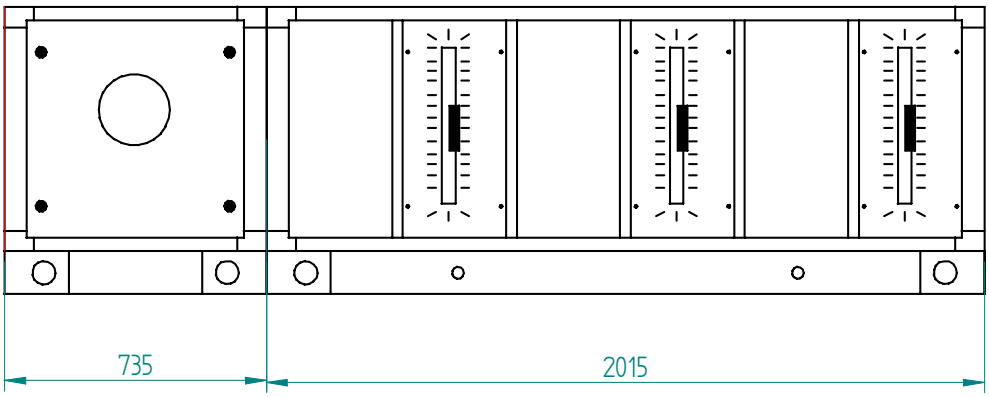
* dimensions in mm

3.5 GERMICYDE LAMPS

From FM-H 20 to FM-H 119



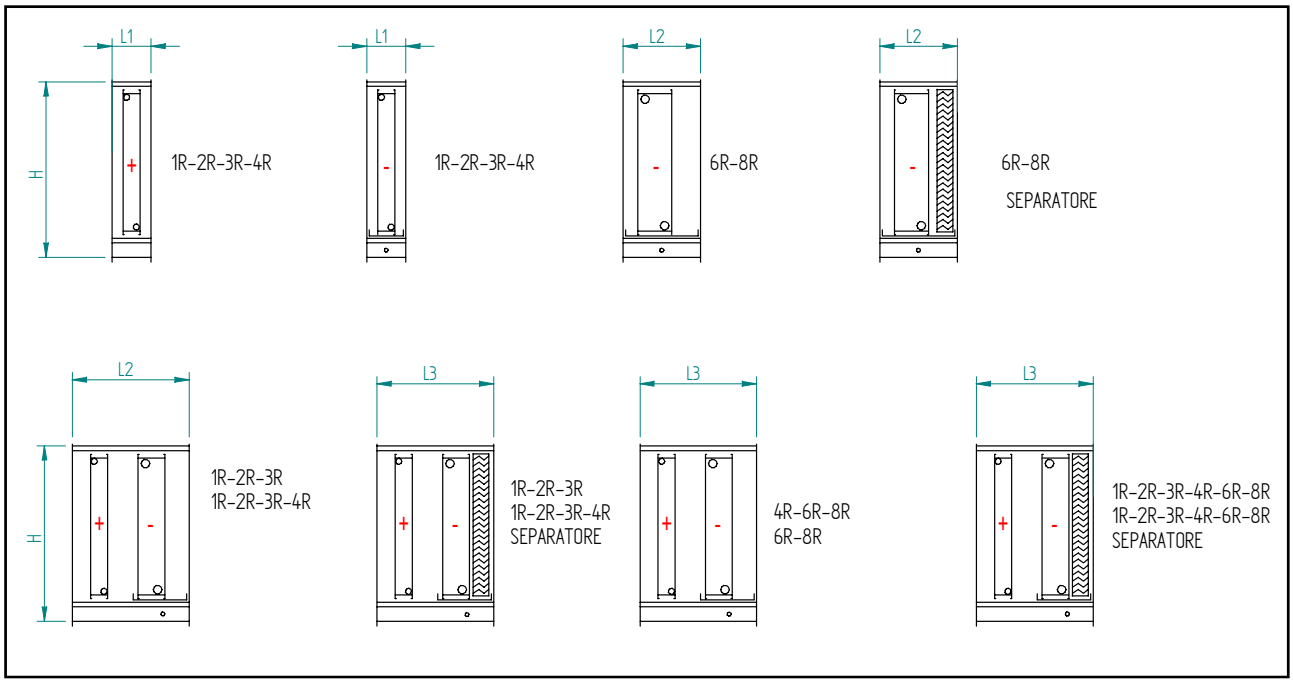
From FM-H 154 to FM-H 342



FM-H	number of decks	number of lamps for each deck	Lamp capacity [W]
20	6	8	15
28	6	10	15
35	6	12	15
42	6	14	15
50	6	16	15
57	6	12	15
69	6	14	15
82	6	16	15
105	6	20	15
119	6	16	30
154	3	20	30
194	3	20	36
237	3	24	36
286	3	24	36
342	3	28	36

* dimensions in mm

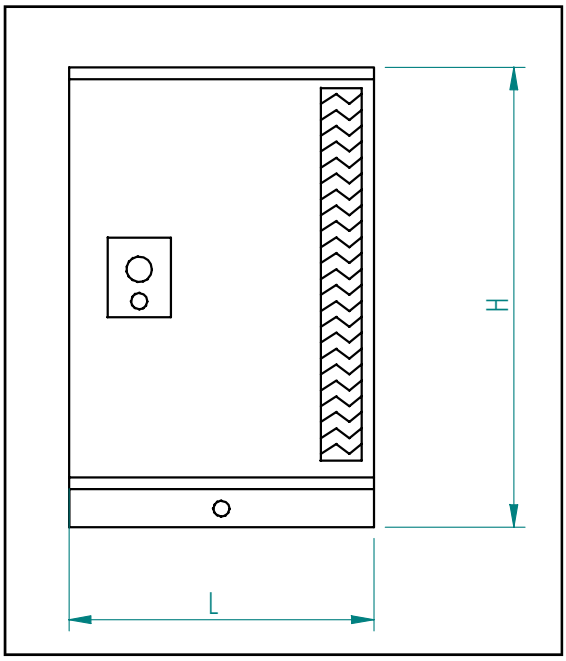
3.6 COILS



FM-H	H	L1	L2	L3
20	805	320	640	960
28	805	320	640	960
35	805	320	640	960
42	805	320	640	960
50	805	320	640	960
57	1125	320	640	960
69	1125	320	640	960
82	1125	320	640	960
105	1125	320	640	960
119	1445	320	640	960
154	1445	320	640	960
194	1765	320	640	960
237	1765	320	640	960
286	2085	320	640	960
342	2085	320	640	960

* dimensions in mm

3.7 HUMIDIFIERS

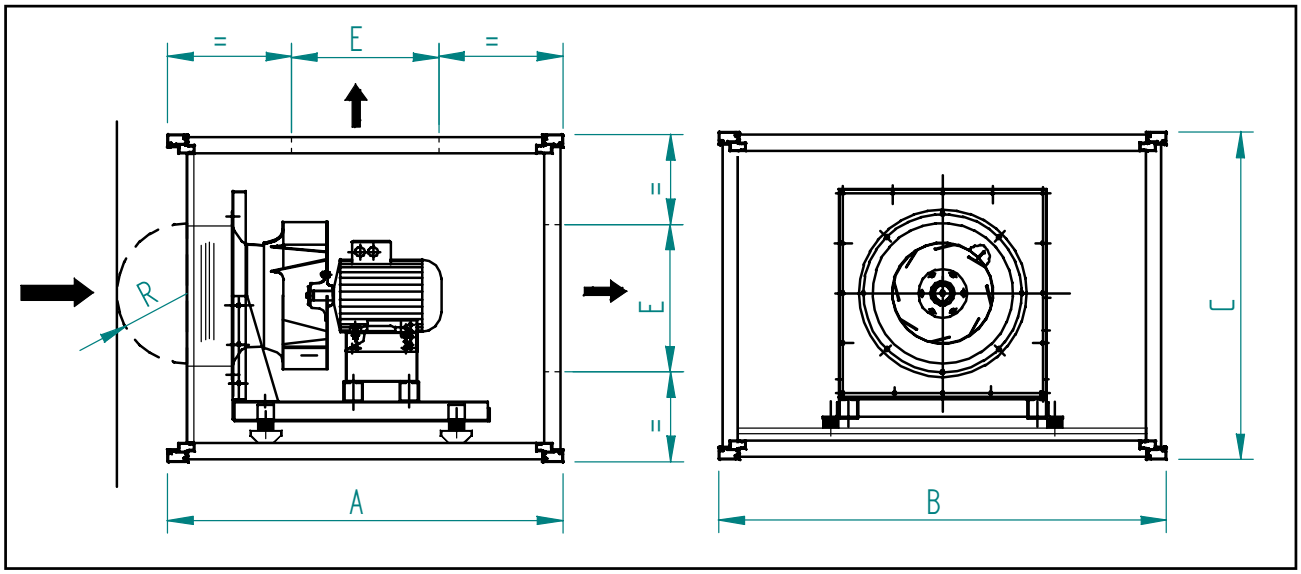


FM-H	W	H	L
20	735	685	960
28	895	685	960
35	1055	685	960
42	1215	685	960
50	1375	685	960
57	1055	1005	960
69	1215	1005	960
82	1375	1005	960
105	1695	1005	960
119	1375	1325	960
154	1695	1325	960
194	1695	1545	960
237	2015	1545	960
286	2015	1965	960
342	2335	1965	960

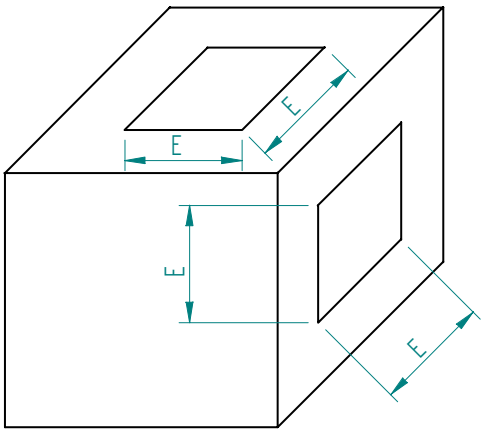
* dimensions in mm

The dimensions given refer to a configuration with a maximum of two steam manifolds. For more than 2 manifolds these dimensions may change. For additional details, please contact the Techical Dept.

3.8 FAN SECTIONS

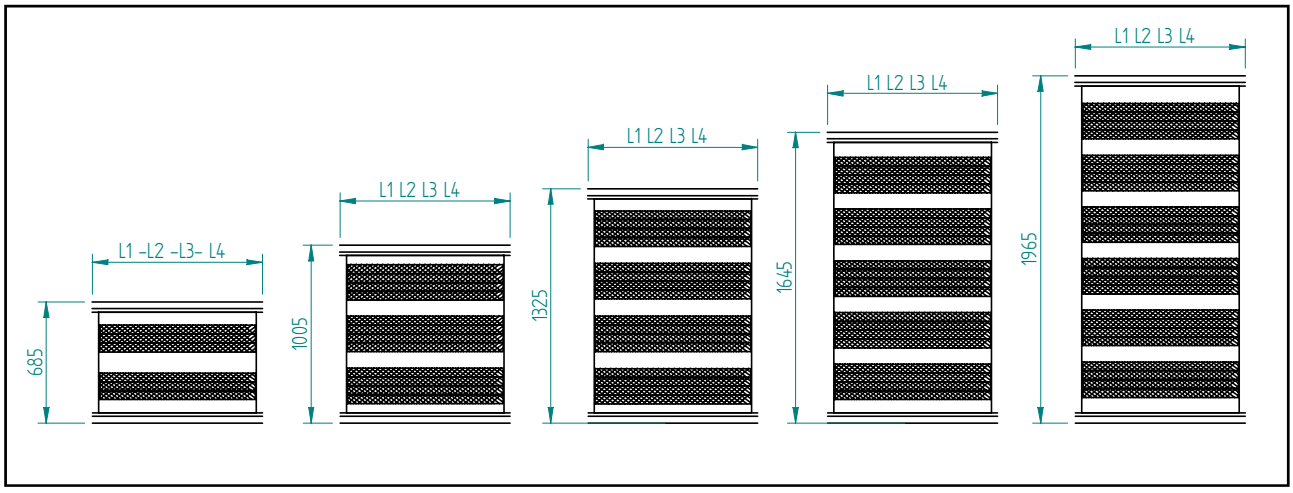


FM-H	Fan	A	B	C	E	R
20	250	1055	735	685	256	160
	280	1055			288	160
28	250	1055	895	685	256	160
	280	1055			288	160
	315	1055			322	180
35	280	1055	1055	685	288	160
	315	1055			322	180
42	280	1055	1215	685	288	160
	315	1055			322	180
50	280	1055	1375	685	288	160
	315	1055			322	180
57	315	1055	1055	1005	322	180
	355	1055			361	200
	400	1055			404	220
69	355	1055	1215	1005	361	200
	400	1055			404	220
	450	1215			453	240
82	400	1055	1375	1005	404	220
	450	1215			453	240
	500	1215			569	280
105	450	1215	1695	1005	453	240
	500	1215			569	280
119	500	1215	1375	1325	569	280
	560	1375			638	320
	630	1375			715	360
154	630	1375	1695	1325	715	360
	710	1535			801	480
	800	1535			898	480
194	710	1535	1695	1645	801	480
	800	1535			898	480
237	800	1535	2015	1645	898	480
	900	1695			1007	640
	1000	1855			1007	640
286	900	1695	2015	1965	1007	640
	1000	1855			1007	640
342	900	1695	2335	1965	1007	640
	1000	1855			1007	640



* dimensions in mm

3.9 SOUND ATTENUATORS

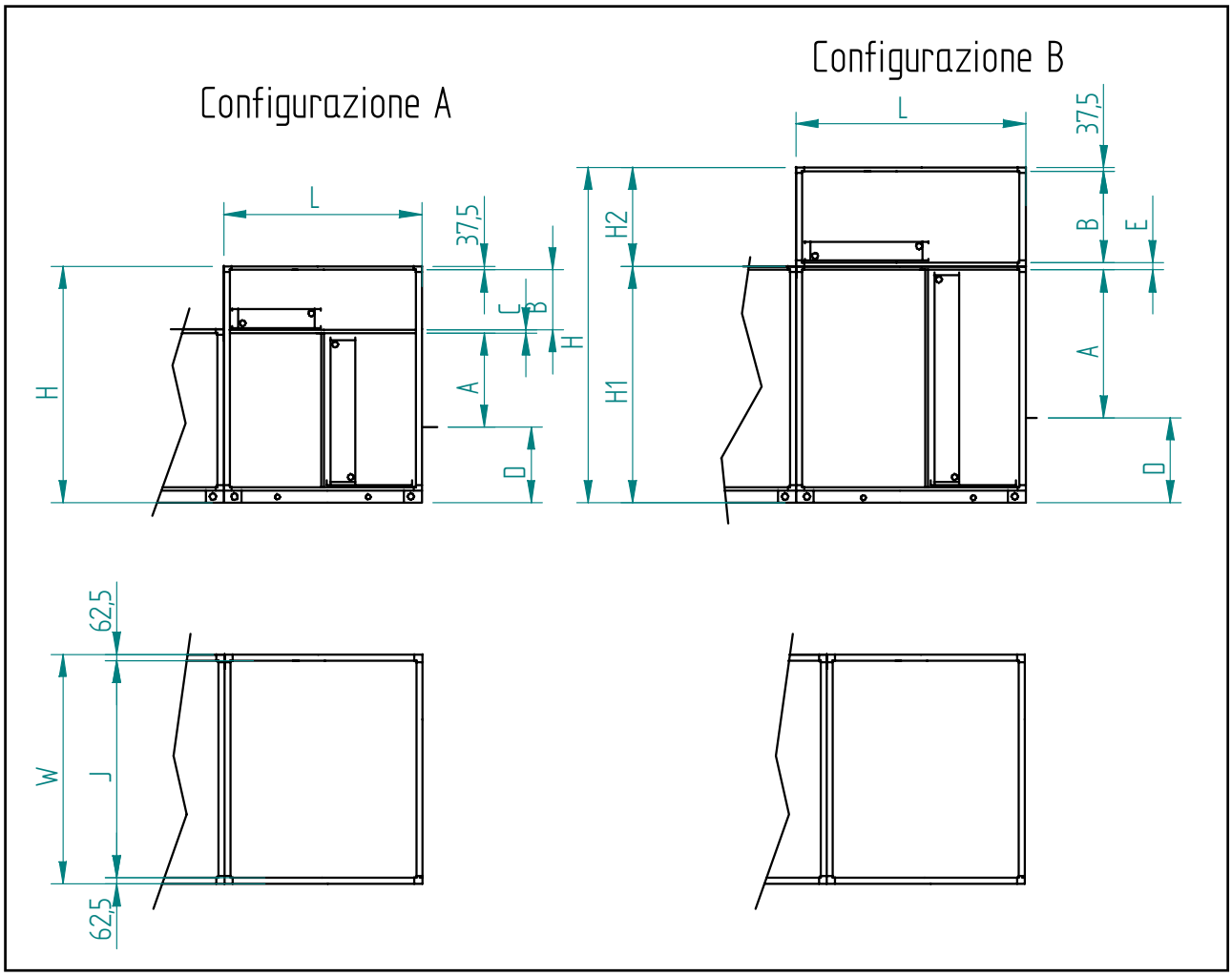


FM-H	20	28	35	42	50	57	69
L1	640	640	640	640	640	640	640
L2	960	960	960	960	960	960	960
L3	1280	1280	1280	1280	1280	1280	1280
L4	1600	1600	1600	1600	1600	1600	1600
n° of silencers	2	2	2	2	2	3	3
Thickness	150	150	150	150	150	200	200

FM-H	82	105	119	154	194	237	286	342
L1	640	640	640	640	640	640	640	640
L2	960	960	960	960	960	960	960	960
L3	1280	1280	1280	1280	1280	1280	1280	1280
L4	1600	1600	1600	1600	1600	1600	1600	1600
n° of silencers	3	3	4	4	5	5	6	6
Thickness	200	200	200	200	200	200	200	200

* dimensions in mm

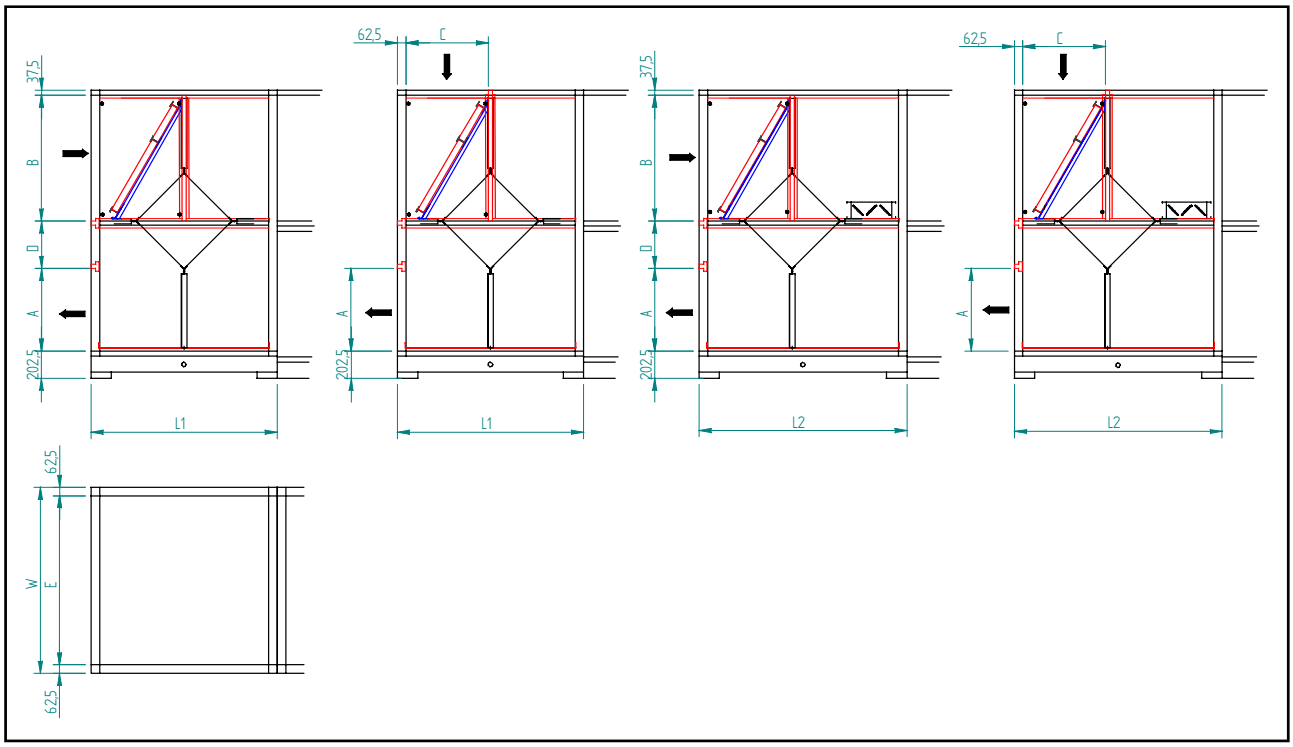
3.10 MULTIZONE / DUAL DUCTS SECTIONS



FM-H	W	L	Config.	H1	H2	H	J	A	B	C	D	E
20	735	1375	A	-	-	1125	610	450	290	30	317,5	75
28	895	1375	A	-	-	1125	770	450	290	30	317,5	75
35	1055	1375	A	-	-	1125	930	450	290	30	317,5	75
42	1215	1375	A	-	-	1125	1090	450	290	30	317,5	75
50	1375	1375	A	-	-	1125	1250	450	290	30	317,5	75
57	1055	1695	A	-	-	1765	930	610	610	30	477,5	75
69	1215	1695	A	-	-	1765	1090	610	610	30	477,5	75
82	1375	1695	A	-	-	1765	1250	610	610	30	477,5	75
105	1695	1695	A	-	-	1765	1570	610	610	30	477,5	75
119	1375	1695	A	-	-	2085	1250	930	610	30	477,5	75
154	1695	1695	A	-	-	2085	1570	930	610	30	477,5	75
194	1695	2015	A	-	-	2405	1570	930	610	30	797,5	75
237	2015	2015	A	-	-	2405	1890	930	610	30	797,5	75
286	2015	2015	B	2085	685	2770	1890	1250	610	30	797,5	75
342	2335	2015	B	2085	685	2770	2210	1250	610	30	797,5	75

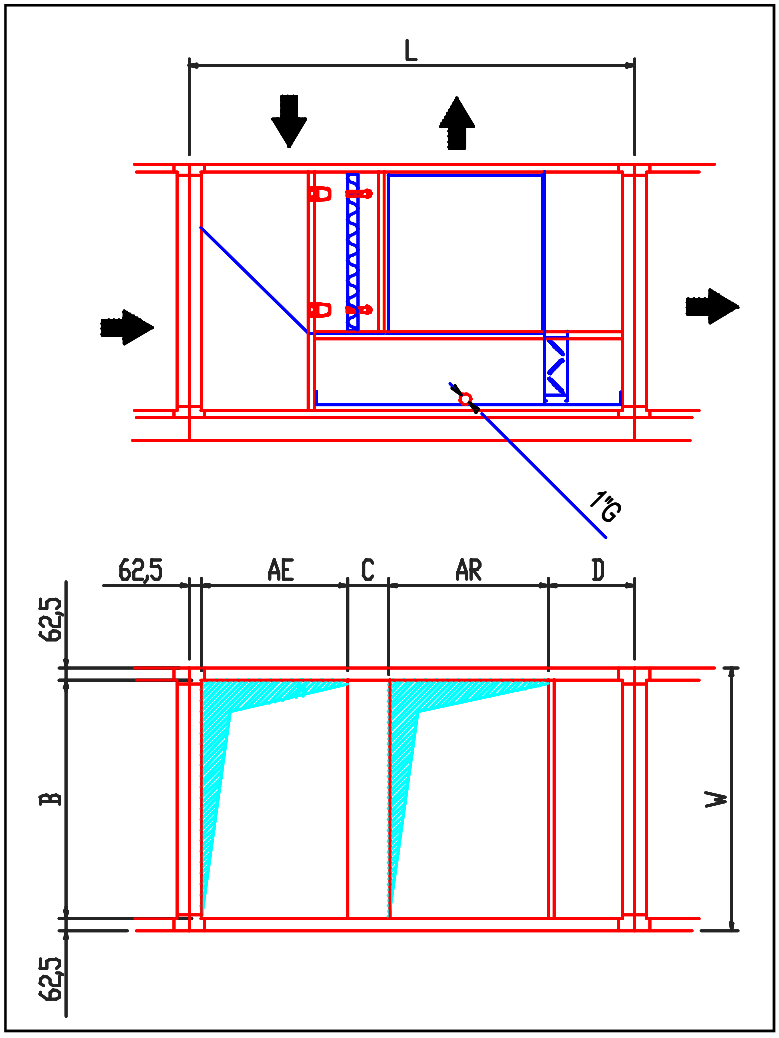
* dimensions in mm

3.11 RECUPERATORS



FM-H	W	H	A	B	C	D	E
20	735	1490	290	610	450	350	610
28	895	1490	290	610	450	350	770
35	1055	1490	290	610	450	350	930
42	1215	1490	290	610	450	350	1090
50	1375	1490	290	610	450	350	1250
57	1055	2130	610	930	610	350	930
69	1215	2130	610	930	610	350	1090
82	1375	2130	610	930	610	350	1250
105	1695	2130	610	930	610	350	1570
119	1375	2450	610	930	770	670	1250
154	1695	2450	610	930	770	670	1570

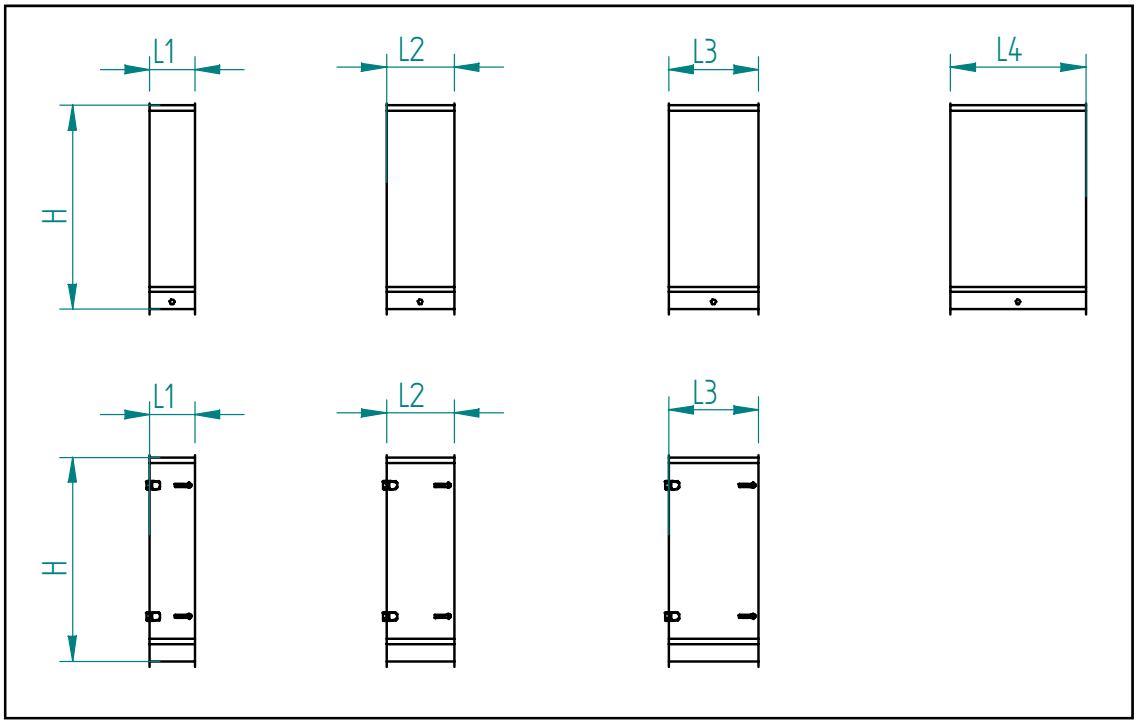
* dimensions in mm



FM-H	W	H	L	AE	AR	C	D	B
20	735	805	1375	450	450	190	225,5	610
28	895	805	1375	450	450	190	225,5	770
35	1055	805	1375	450	450	190	225,5	930
42	1215	805	1375	450	450	190	225,5	1090
50	1375	805	1375	450	450	190	225,5	1250
57	1055	1125	1695	610	450	190	382,5	930
69	1215	1125	1695	610	450	190	382,5	1090
82	1375	1125	1695	610	450	190	382,5	1250
105	1695	1125	1695	610	450	190	382,5	1570
119	1375	1445	2335	770	770	350	382,5	1250
154	1695	1445	2335	770	770	350	382,5	1570
194	1695	1765	2335	770	770	350	382,5	1570
237	2015	1765	2335	770	770	350	382,5	1890
286	2015	2085	2655	930	930	350	382,5	1890
342	2335	2085	2655	930	930	350	382,5	2210

* dimensions in mm

3.12 PLENUMS AND EMPTY SECTIONS



FM-H	H	L1	L2	L3	L4
20	805	320	480	640	960
28	805	320	480	640	960
35	805	320	480	640	960
42	805	320	480	640	960
50	805	320	480	640	960
57	1125	320	480	640	960
69	1125	320	480	640	960
82	1125	320	480	640	960
105	1125	320	480	640	960
119	1445	320	480	640	960
154	1445	320	480	640	960
194	1765	320	480	640	960
237	1765	320	480	640	960
286	2085	320	480	640	960
342	2085	320	480	640	960

* dimensions in mm

4. Weights

N.B: the following weights are only indicative and refer to AHU's supplied without controls.
For an accurate weight measure, please contact the Technical Dept.

The total weight of an air handling unit is obtain by the sum of:

- casing: weight shown in the table times the length of the air handling unit in meters;
- canopy (if required): weight shown in the table times the length of the air handling unit in meters;
- front panel;
- required components;
- required fan-motor assembly (the weight includes the fan, the motor and their frame);
- control devices and accessories.

COMPONENTS		FM-H	20	28	35	42	50	57	69	82	105	119	154	194	237	286	342
Casing		kg/m	34	38	42	46	49	49	53	57	65	65	72	80	88	96	103
Front panel		kg	6	7	9	10	11	13	15	17	20	22	27	33	40	48	55
Std canopy		kg/m	7	9	11	12	14	11	12	14	17	17	17	17	20	20	23
1 R coil		kg	7	8	9	10	11	13	14	15	17	20	23	27	30	34	38
2 R coil		kg	9	10	12	13	14	16	18	22	25	29	33	40	45	52	59
3 R coil		kg	10	12	14	16	19	21	24	26	31	35	41	50	57	71	80
4 R coil		kg	13	15	17	20	22	27	30	33	39	45	53	68	77	97	108
6 R coil		kg	16	19	22	25	28	34	38	43	51	58	69	88	100	125	141
8 R coil		kg	21	25	28	32	36	41	46	52	62	74	88	113	130	166	187
10 R coil		kg	27	32	35	40	45	52	58	65	78	93	110	142	163	208	234
12 R coil		kg	33	38	42	48	54	63	70	78	94	112	132	170	196	250	280
Panel filters		kg	6	7	7	8	9	10	11	12	14	14	16	19	21	24	27
Rigid bag filters		kg	8	8	8	10	14	17	19	24	28	31	38	45	56	66	76
Absolute filters		kg	19	25	31	38	44	44	50	56	69	88	113	138	165	198	238
Activated carbon filters		kg	42	42	43	56	83	109	122	162	189	215	268	321	401	480	559
Humidifier		kg	6	7	8	9	11	8	9	11	13	11	13	13	16	16	18
Droplet eliminator		kg	4	5	6	6	7	9	10	12	14	16	20	25	30	36	42
Recuperator section		kg	123	141	160	190	203	244	254	265	308	361	410	502	557	670	742
Tecnical room 1M	670mm	kg	25	25	25	25	25	35	35	35	35	50	50	60	60	70	70
Tecnical room 1.5M	990mm	kg	30	30	30	30	30	40	40	40	40	60	60	70	70	80	80
Tecnical room 2M	1310mm	kg	35	35	35	35	35	45	45	45	45	65	65	80	80	90	90
Tecnical room 2.5M	1630mm	kg	40	40	40	40	40	50	50	50	50	75	75	85	85	100	100
Tecnical room 3M	1950mm	kg	45	45	45	45	45	55	55	55	55	80	80	95	95	110	110
Tecnical room 3.5M	2270mm	kg	50	50	50	50	50	65	65	65	65	90	90	105	105	120	120
Sound attenuators	560 mm	kg	20	20	29	29	39	45	45	60	75	82	103	130	156	188	220
	880 mm	kg	30	30	45	45	60	71	71	95	118	129	160	204	244	296	345
	1200 mm	kg	41	41	62	62	82	97	97	129	161	176	220	278	333	403	470
	1520 mm	kg	52	52	78	78	104	122	122	163	204	222	278	352	422	511	596

FAN-MOTOR ASSEMBLY PFN3 FAN SIZE		250	280	315	355	400	450	500	560	630	710	800	900	1000
Motor power 0.18 kW	kg	26												
Motor power 0.25 kW	kg	26	33	38										
Motor power 0.37 kW	kg	30	37	42	48	54								
Motor power 0.55 kW	kg	30	37	42	48	54	62	72						
Motor power 0.75 kW	kg	34	41	46	52	60	66	76	86					
Motor power 1.1 kW	kg	34	41	46	52	60	66	76	86					
Motor power 1.5 kW	kg	45	52	57	63	71	79	89	99	109				
Motor power 2.2 kW	kg	45	52	57	63	71	79	89	99	109	120			
Motor power 3 kW	kg	55	62	67	73	81	90	100	110	120	130	150		
Motor power 4 kW	kg		70	75	81	90	98	118	128	138	150	170	220	
Motor power 5.5 kW	kg			106	112	120	130	140	150	160	172	192	240	260
Motor power 7.5 kW	kg				112	120	130	140	150	160	172	192	240	260
Motor power 11 kW	kg						200	210	220	230	245	265	305	325
Motor power 15 kW	kg								220	230	245	265	305	325
Motor power 18.5 kW	kg									230	245	265	305	325
Motor power 22 kW	kg									240	260	280	330	350
Motor power 30 kW	kg										385	405	460	480
Motor power 45 kW	kg												510	530
Motor power 55 kW	kg													650

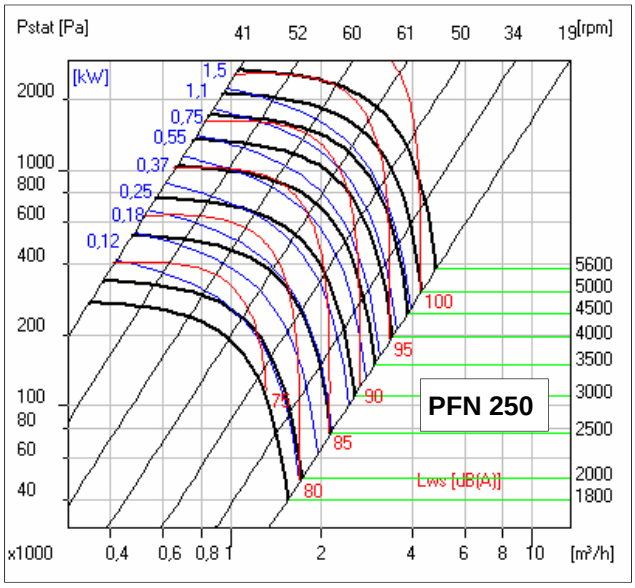
5. Fan performance curves

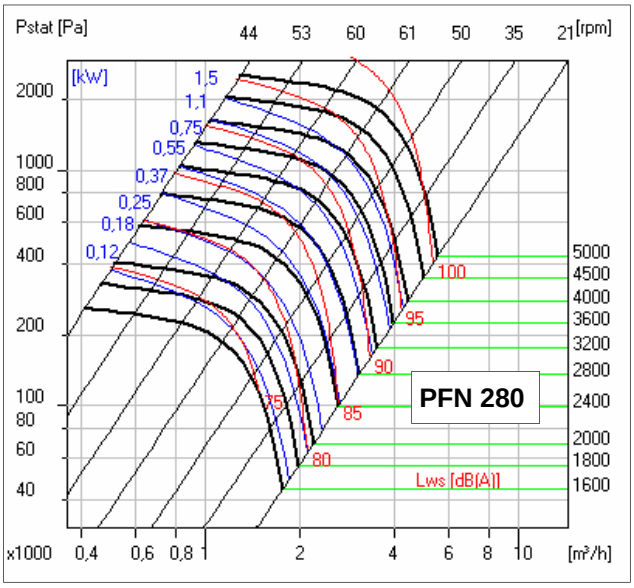
The performance curves of the fans installed in the FM-H series air handling units are hereunder reported.

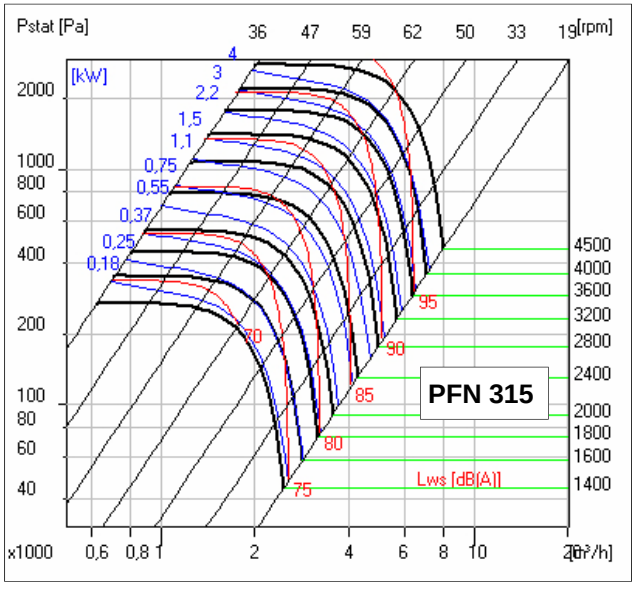
The diagrams indicate:

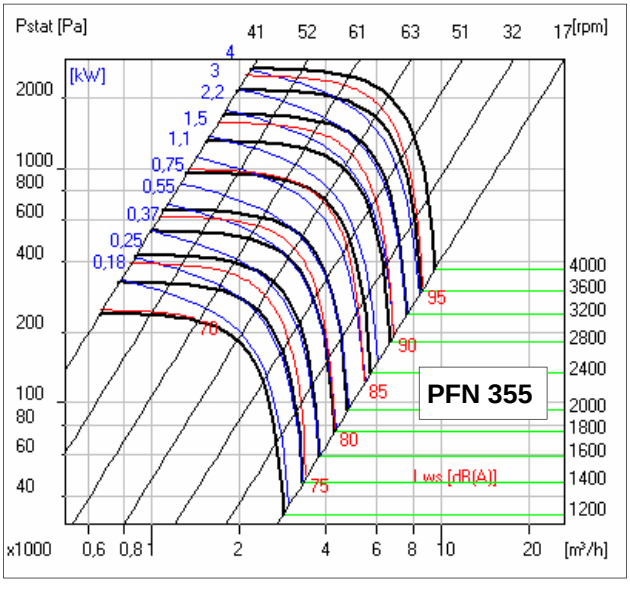
- the air flow [mc/h] on X-axis;
- the static pressure [Pa] on Y-axis.

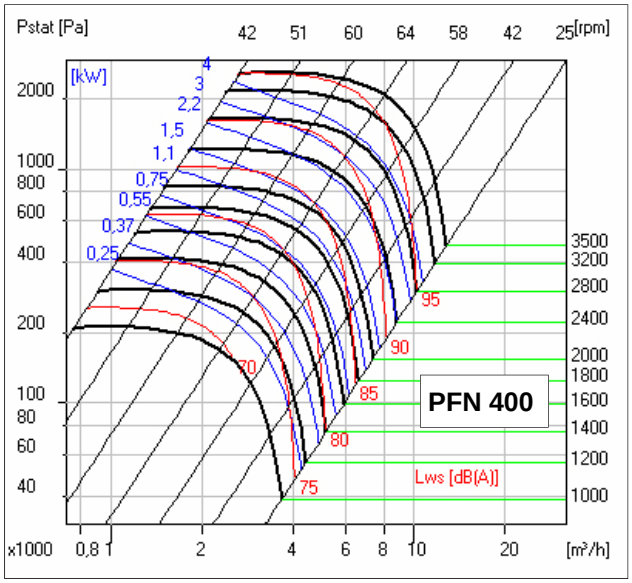
In the diagrams it is possible to determine the working point, the rotations per minute, the efficiency, the input power and the sound power (measured on the suction side).
The performances refer to a Free inlet - Free outlet installation.

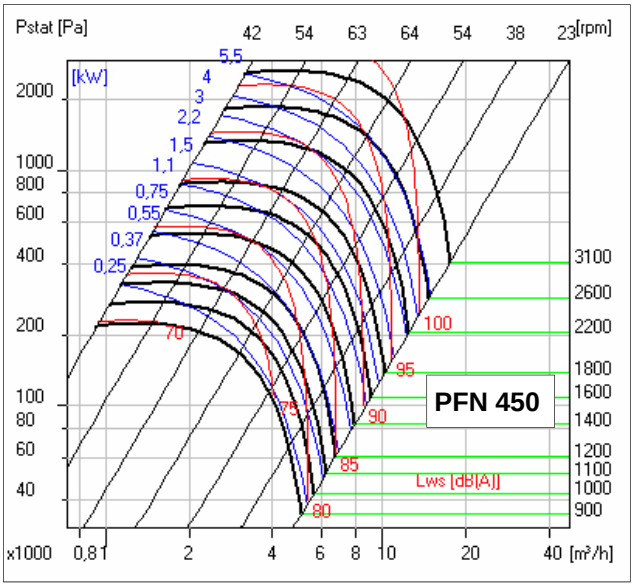









Pstat [Pa]
[kW]
[rpm]
[m³/h]
x1000
Lws [dB(A)]
PFN 400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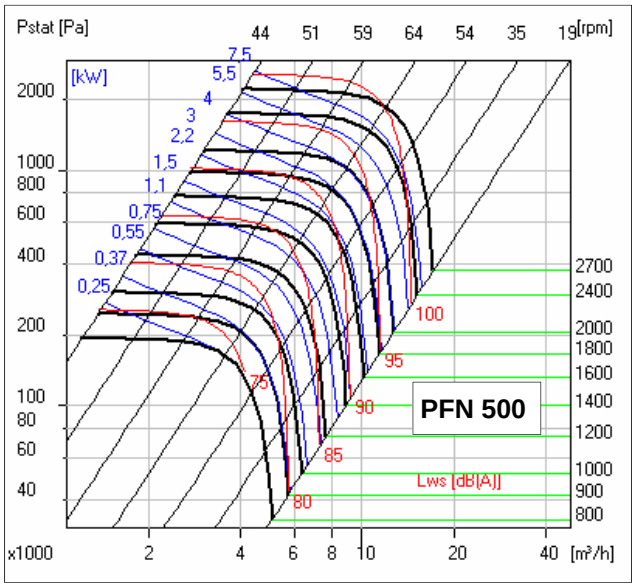
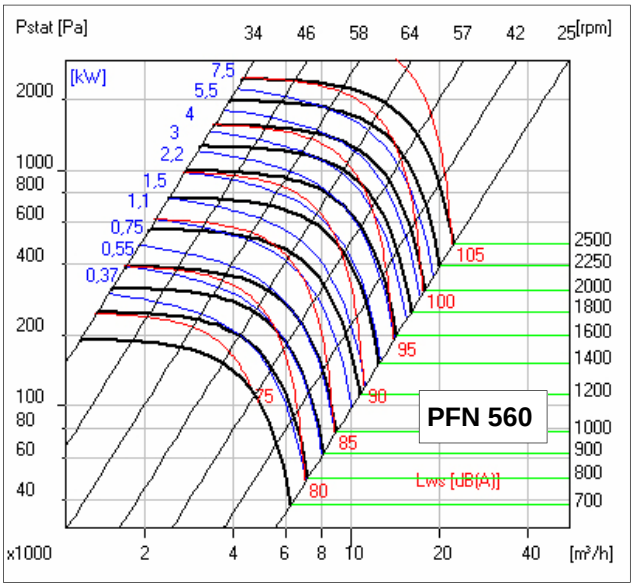
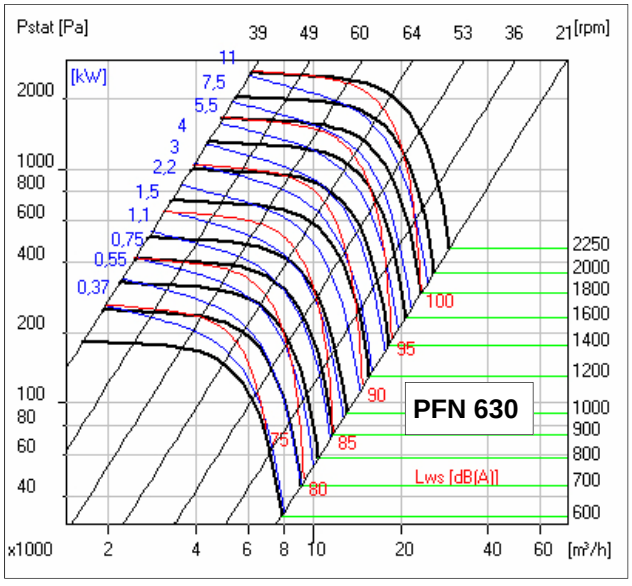
[kW]
[rpm]
[m³/h]
x1000
Lws [dB(A)]
PFN 450


Pstat [Pa]
[kW]
[rpm]
[m³/h]
x1000
Lws [dB(A)]
PFN 500


Pstat [Pa]
[kW]
[rpm]
[m³/h]
x1000
Lws [dB(A)]
PFN 560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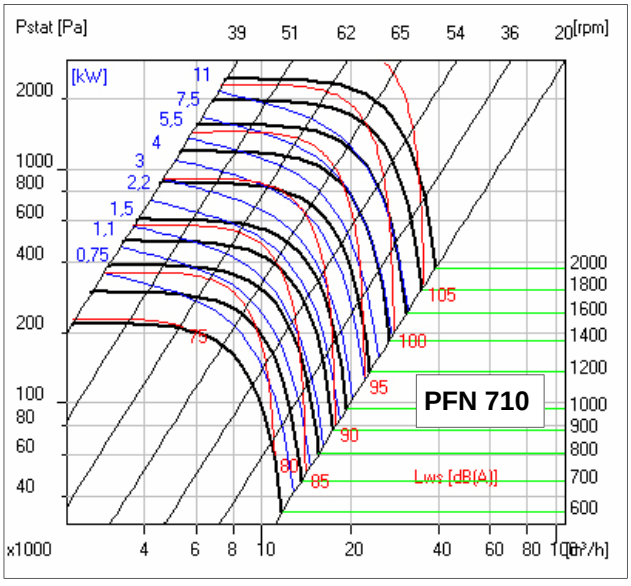
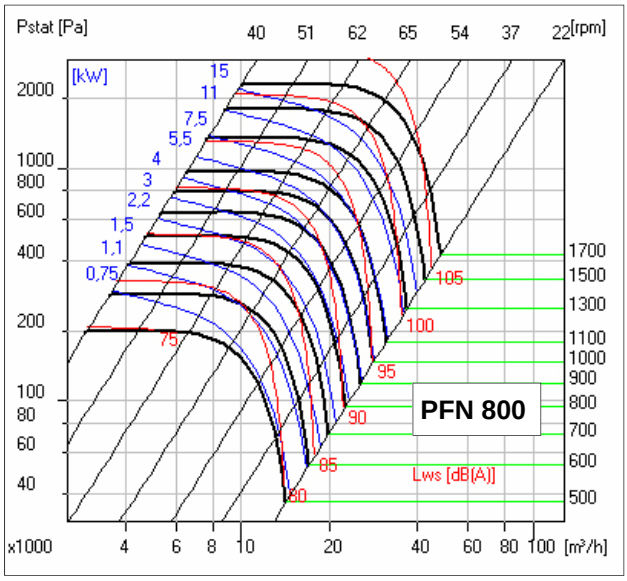
[m³/h]
x1000
Lws [dB(A)]
PFN 630


Pstat [Pa]
[kW]
[rpm]
[m³/h]
x1000
Lws [dB(A)]
PFN 710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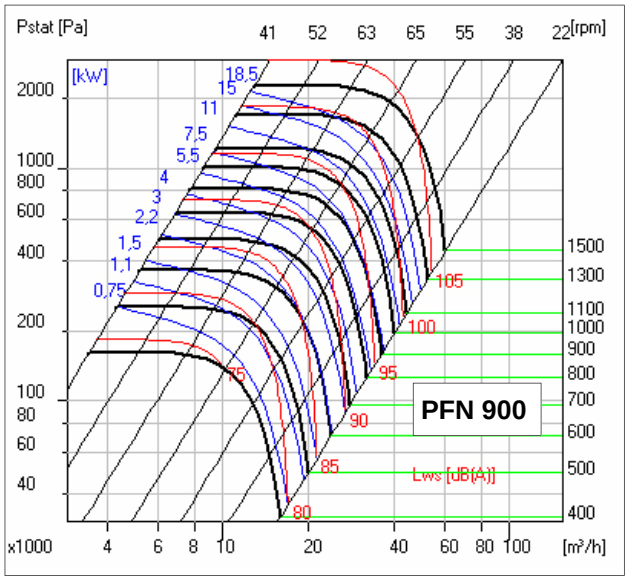
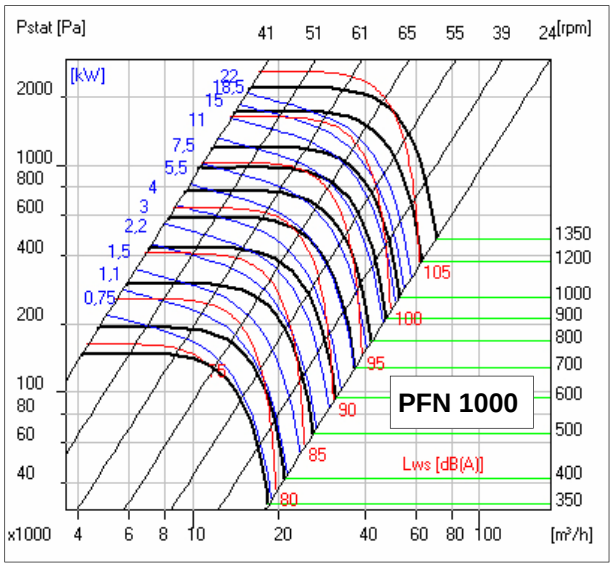
40 51 62 65 54 37 22[rpm]
[kW]
15
11
7,5
5,5
4
3
2,2
1,5
1,1
0,75
2000
1000
800
600
400
200
100
80
60
40
105
100
95
90
85
80
75
1700
1500
1300
1100
1000
900
800
700
600
500
Lws [dB(A)]
PFN 800
x1000
4 6 8 10 20 40 60 80 100 [m³/h]


Pstat [Pa]
41 52 63 65 55 38 22[rpm]
[kW]
18,5
15
11
7,5
5,5
4
3
2,2
1,5
1,1
0,75
2000
1000
800
600
400
200
100
80
60
40
105
100
95
90
85
80
75
1500
1300
1100
1000
900
800
700
600
500
400
Lws [dB(A)]
PFN 900
x1000
4 6 8 10 20 40 60 80 100 [m³/h]


Pstat [Pa]
41 51 61 65 55 39 24[rpm]
[kW]
22
18,5
15
11
7,5
5,5
4
3
2,2
1,5
1,1
0,75
2000
1000
800
600
400
200
100
80
60
40
105
100
95
90
85
80
75
1350
1200
1000
900
800
700
600
500
400
350
Lws [dB(A)]
PFN 1000
x1000
4 6 8 10 20 40 60 80 100 [m³/h]

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0509-6180607

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