FAST
TRATTAMENTO DELL'ARIA

Trattamento dell'aria

ROOFTOP UNIT

MFS - Modular Fast System Series

0907-6180691-rev.0

CE

FAST
COMPANY QUALITY SYSTEM
ICIM
CISQ IQNet
FAST S.p.A.

SELECTION AND INSTALLATION MANUAL

GB

English

Summary

FAST S.p.A.
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MFS

Modular Fast System

DECLARATION OF CONFORMITY

We declare under our own responsability that the above equipment described as follows:

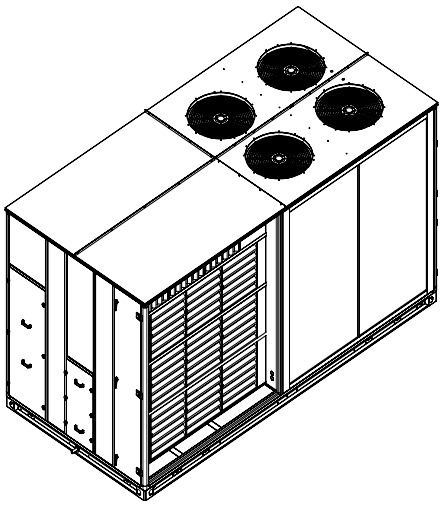
ROOF-TOP Serie MFS

has been:

1. designed, manufactured and commercialized in compliance with the following technical specifications:
   Harmonized standards:
   - EN 378-1: Refrigerating system and heat pumps - Safety and environmental requirements - Part 1: Basic requirements, definitions, classification and selection criteria.
   - EN 378-2: Refrigerating system and heat pumps - Safety and environmental requirements - Part 2: Design, construction, testing, marking and documentation.
   - EN 378-3: Refrigerating system and heat pumps - Safety and environmental requirements - Part 3: Installation site and personal protectiion.
   - EN 378-4: Refrigerating system and heat pumps - Safety and environmental requirements - Part 4: Operation, maintenance, repair and recovery.
   - EN 12735: Copper and copper alloys - seamless, round copper tubes for air conditioning and refrigeration.

   Others:
   - UNI 1285-68: calculation of metal tubes resistance to inside pressure;

2. designed, manufactured and commercialized in compliance with the following EEC Directive:
   - PED Directive 97/23/CE MODULO A1.
   - Machinery safety 98/37/EC;
   - Low voltage equipment 73/23/EEC;
   - Electromagnetic compatibility 89/336/EEC.



This declaration loses its validity in case the units are modified performed without the written authorisation from the manufacturer.

Montagnana, 01/01/2006

Managing Director

Paolo Gasparini

General norms

This manual is an integral part of the documentation enclosed with the unit. It must be preserved for future reference and must accompany the machine throughout its life.The manual defines the purpose for which the machine has been built and establishes its correct installation and the limits of its use.

• This manual provides all the technical instructions and instructions for the installation of this unit and the main accident prevention regulations. Read carefully and thoroughly all the information referred to in this manual.

Pay particular attention to the usage instructions accompanied by the words "DANGER" or "WARNING" because, if not observed, they can cause damage to the machine and/or property and/or injury to people.

If any malfunctions are not included in this manual, contact the local After Sales Service immediately.

• FAST S.p.A. declines all liability for any damage due to improper use of the machine or the partial or superficial reading of the information contained in this manual.

• The installation and the maintenance must be done by expert and qualified personnel.

THE MANUFACTURER DECLINES ALL LIABILITY FOR DAMAGE TO THINGS OR INJURY TO PERSONS AND ANIMALS CAUSED BY THE FAILURE TO OBSERVE THE INSTRUCTIONS AND STANDARDS IN THIS MANUAL.

Even though during the design phase of the RTP unit adequate assessment of the risks was made, pay ATTENTION to the pictograms on the machine that helps the reading the manual by drawing the reader's attention rapidly to the risk situations that cannot be avoided or sufficiently limited by using measures and technical means of protection.

GENERAL HAZARD SIGNAL
Carefully adhere to all the indications next to the icon. Failure to comply with the instructions may generate hazardous situations with possible damage to the health of the operator and user in general.

DANGEROUS ELECTRICAL VOLTAGE SIGNAL
Carefully adhere to all the indications next to the icon. The signal indicates components of the unit or, in this manual, specifies actions that could generate electrically-related risks.

GENERAL PROHIBITION SIGNAL
Carefully adhere to all the indications next to the icon that limit actions in order to guarantee better operator safety.

MAIN WARRANTY CONDITIONS

- The warranty does not include payment for damage due to the incorrect installation of the unit by the installation engineer.
- The warranty does not include payment for damage due to the improper use of the unit by the user.
- The manufacturer does not consider itself liable for accidents to the user or the installer due to the incorrect installation or improper use of the unit.
- The unit has to be installed so as to make the maintenance and reparation operations possible.
- The warranty does not cover in any case costs of elevators, electric staircases or other lifting devices which ought to be necessary to perform interventions in warranty.

The warranty is not valid when:
- the services and the repairs have been carried out by non-authorised personnel or companies;
- the unit has been repaired or modified in the past with non OEM spare parts;
- the unit has not been adequately maintained;
- if the instructions described in this manual have not been followed;
- if non-authorised modifications have been made.

Note:
The Manufacturer reserves the right at all times to make any modification for the improvement of its product and is not obliged to add these modification to machines of previous manufacture that have already been delivered or are being built.
The warranty conditions are any subject to the general sales conditions at the moment the contract is finalised.

Description of the unit

Generalities

The " ROOFTOP " units of the MFS series have been designed taking into account the precise requirements in the system necessary for treating large air volumes, typical of supermarket and hypermarket buildings and environments for shows, fairs and industrial uses in general.

These units are usually situated on the roofs or anyway in the open air, offering these main advantages:
- because they are installed on the roof they do not take operational space away from the room;
- they are complete with a control board and automatics, therefore are very easy and quick to instal;
- they offer the maximum modularity, therefore making it possible to differentiate the treatments in different volumes with different destination characteristics (food, clothing department etc.);
- they offer high levels of environmental comfort by controlling the exchange, filtering and humidification or dehumidification of the air in addition to the temperature;
- the environmental noise level is kept low due to the careful soundproofing of the machine.

In particular the MFS series features the combination of a newly-designed condensing unit with traditional sections of air-handling units (cross-flow heat recovery sections, hot air generator sections, 3-ways mixing boxes etc.).

Moreover, the exclusive type of fixing of the panels to the aluminium frame ensures an excellent seal to air leakages, with a B classification according to the EN1886 norm carried out at TUV laboratories.

Versions

The rooftop units of the MFS series are available in two versions:
- MFS F: rooftop unit in cooling only mode
- MFS H: rooftop unit in cooling only and heat pump mode

Condensing side arrangement

The units of the MFS series include:
- condensing unit arranged 'in line' with respect to the air-handling side (see Figure 1): available option up to the size 220 included. Beyond the size 220 only the 'T' arrangement is available (see Figure 2);
- condensing unit arranged 'as a T' with respect to the air handling side: option available for all sizes;

Sizes

The units of the MFS series are available in 10 sizes (085-105-130-160-190-220-250-270-300-340) in cooling only or heat pump mode. By aptly combining the many available accessories, it is possible to configure each model so as to satisfy all the specific installation requirements.

Base supply

The units of the MFS series in their base supply are equipped compelte with:

- condensing unit with axial fans and scroll compressors;
- cooling circuit complete with thermostatic valves, filters, liquid sight glasses;
- undulated synthetic filters class G4 (according to the norm EN779);
- direct expansion heat exchanger with aluminium condensate drain pan;
- centrifugal twin supply fan, with forward-curved blades, with transmission by means of belts and pulley with variable pitch up to 15 kW (for larger capacity the pulley has a fixed pitch);
- control board;
- microprocessor control complete with sensors and actuators.

For the specific description of the different components, please refer to the following paragraphs.

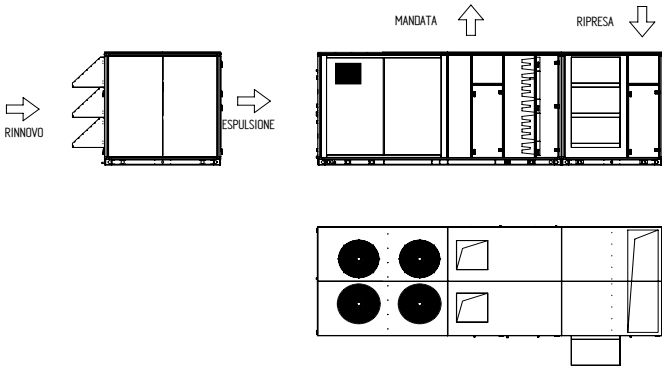


Figure 1 - MFS 220 - in line arrangement

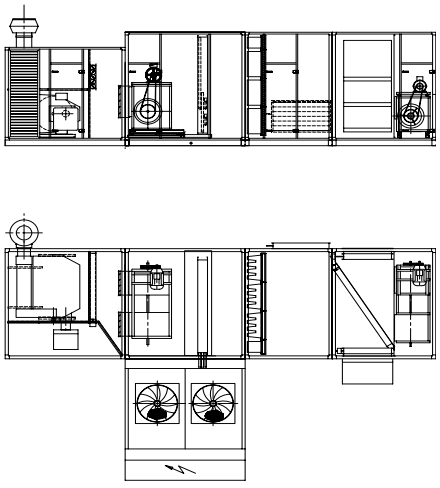


Figure 2 - MFS 220 - T arrangement

Description of components - base unit

Structure

The structure is composed of:
- base frame in galvanised steel to give the necessary rigidity to the unit;
- main frame in extruded aluminium profile, UNI 6060 alloy, connected one to another by glass-fiber reinforced nylon corner pieces. The profiles constituting the frame are completely sealed and therefore the thermal bridges are reduced to the minimum and the air 'by-passes' around the various components are eliminated;
- double-skin sandwich panels (both for the condensing unit side and for the air-handling side) with 50mm thickness, fixed to the frame by counterprofiles slotting into the frame. This system ensures a uniform pressure on the gasket between the panel and the farme, and therefore a better seal both in positive and negative pressure situations.
  The standard execution of the panels include:
  - external wall in prepainted galvanised steel;
  - insulation in inyected hot polyurethane foam with density of 42 kg/m^3;
  - internal wall in galvanised steel.
  Upon specific evaluation, other executions are also available.
  The sections of the unit are accessible by means of inspection doors;
- prepainted gavlanised steel weatherproof hoods;

Compressors

The compressors are of tandem scroll type with specific protection for low temperature start-up, by means of crankcase heaters and motor thermal protection with an internal temperature sensor. The heater is automatically fed during the stop of the unit, provided the unit is under tension. A direct start is required. The compressors are fixed on rubber anti-vibration dampers and placed inside a technical cabinet. This cabinet is separated from the air flow, thus making maintenance operations easier, which can then be performed also with the unit in operation. The wrong roration of the spiral of the compressor is prevented by means of a safety device, the phase sequence relay.

Heat exchangers

Air-handling unit coil

Made of copper pipes and aluminium fins, blocked by mechanical expansion of the pipes. The crossing velocity of the air though the finned pack does not overcome 2,6 m/s in order to avoid the condensate carry-over. A condensate drain pan is present, in aluminium, to gather and carry the condensate outside of the unit.

External coil

Made of copper pipes and aluminium fins, blocked by mechanical expansion of the pipes.

Fans

Air-handling section fans

Centrifugal type, double-inlet with forward-curved blades, balanced dynamically and statically, capable of granting high efficiency and low niose level.
Three-phase electric motors with protection class IP55, assembled together with the fans on a suitable frame with rubber anti-vibration dampers. For capacities larger than 7,5kW the start is of the Star-Delta type, in order to limit the starting current value.
The transmission between the motor and the fan is of the belt-pulley type, with variable pitch pulley up to 15 kW. For larger capacities the pulley has a fixed pitch.
In case a different available pressure is required, other than the one indicated in the technical datasheet, the sizing of the motors and transmission is carried out on purpose.

External condensing section fans

Axial fans, balanced dynamically and statically, protected mechanically by double anti-intrusion grilles.
The vents are areo-dynamically moulded in order to minimise the noise level and increase the efficiency.
The electric motors are equipped with an internal thermal protection.

Filtration

The base unit is equipped with a series of filters class G4 (according to the norm EN779), made up of undulated synthetic filtrating media contained in an electrowelded mesh and a galvanised steel frame. The filtering cells are easily accessible and inserted on a filter frame with reduced by-pass. Upon request also F7 or F9 bag filters are available.

Cooling circuit

The units are supplied with two independent cooling circuits, equipped with:

Liquid receiver

(only for the heat pump versions)
Holds the excess of liquid refrigerant when the operating conditions change, from summer/winter and suring the defrosting cycles.

Thermostatic valve

The valve with external equaliser (in order to grant a quickeer response to the fluctuations of the installation), modulates the gas flow to the evaporator according to the thermal load. In this way a sufficient gas superheat degree is ensured in the suction line to the compressor.

Dehydrating filter

Filter of the mechanical type, in ceramic and hygroscopic material, which withholds the dirt and possible traces of humidity present in the cooling circuit.

Liquid sight glass

Useful to check the refrigerant gas charge and the possible presence of humidity into the cooling circuit.

4-ways cycle inversion valve

(only for the heat pump versions)
This valve inverts the refrigerant cycle according to the oepration type summer/winter and during defrosting cycles.

Cooling circuit safety valve

Set at 27 bars relative, intervenes unloading the overpressure in case of anomalous pressures.

Single-flow valves

(only for the heat pump versions)
These allow the refrigerant to flow in one direction only.

High pressure switch

Two pressure switches on the high pressure side of the cooling circuit to stop the compressor in case of anomalous pressures.

Low pressure switches

The pressure switch on the lowside of the cooling circuit stops the compressor in case of anomalous pressures.

High and low pressure transducers

(standard for the heat pump version)
Placed on the high and low sides of the cooling

circuit, allow to view the pressure value on the display. These are optional in the cooling only versions.

Control board, microprocessor card and safety components

Control board

The control board, with a double door and easily accessible, includes:
• the transformer for the control circuit;
• the microprocessor;
• the main switch;
• the magnetothermal terminals to protect the power circuit and auxiliary circuit;
• the contactors for the compressors and fans and the service terminal plate.
The control board complies with the CEI 60204-1 norms and electromagnetic compatibility directive EMC 89/336/CEE and successive modifications.

Door-lock switch

Allows the access to the control board only when the power supply is off, by acting on the lever of the board itself.

Microprocessor card

The microprocessor card allows the complete control of the unit. It is equipped with a comand keyboard and on-board display. For a detailled description please refer to the users' manual.

Antifreeze probe (only with BTR accessory)

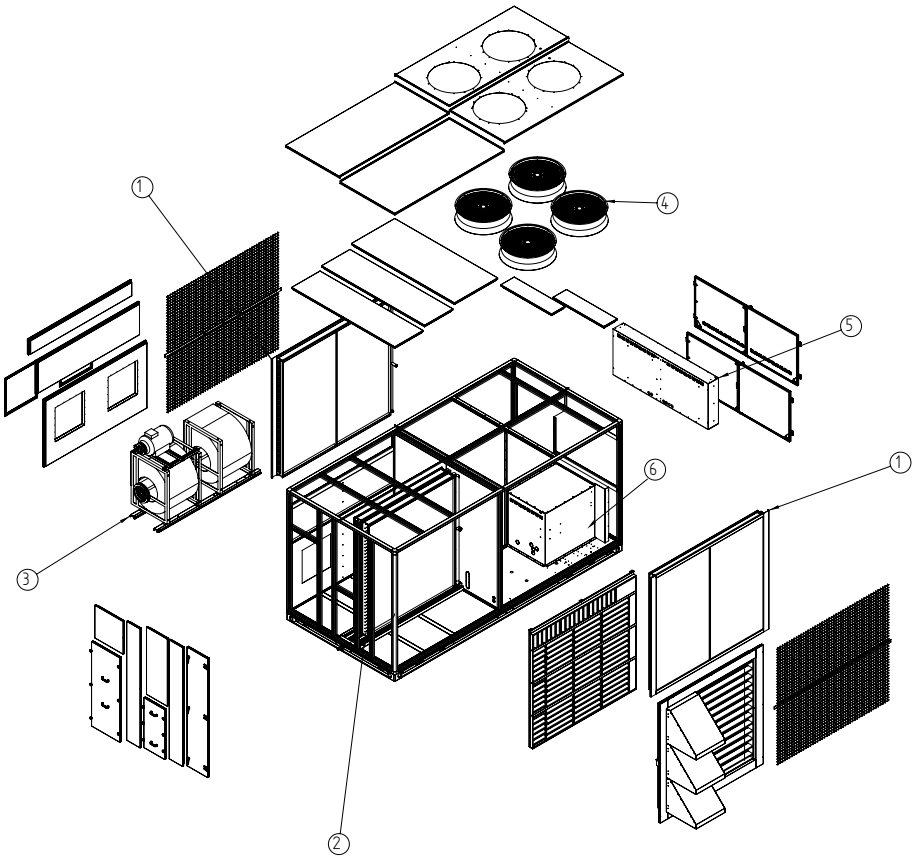
In order to prevent the BTR heat exchanger from being damaged, when the water temperature is lower than +5°C , the dedicated software, present in the control card, will open the 3-way valve completely, thus putting hot water in circulation.

Flow switch

Has the task of controlling the presence of air flow inside the air-handling side. if not, it will stop the unit.

Filters differential pressure switch

Has the task of controlling the presence of air-flow inside the air-handling side. if not, it will generate an alarm signal.



KEYS	
1	Condensing coils
2	Evaporating coil
3	Fan section
4	Axial fans
5	Control board
6	Compressor cabinet

Figure 3 - exploded view

Control system

The architecture of the microprocessor control (fig. 02) provides for:

• a BASE CARD with microprocessor dedicated to the execution of the control program, provided with display, keyboard and LED to allow for the programming of the set-points and the basic user operations (on/off, display of checked values, optional print-out).

• the program is written on the EPROM while the set-points set are memorised permanently on EPROM, so that they can be kept even when there is no power (without the need for a support battery).

It is possible to connect the basic card with the pLAN local network (pCO Local Area Network) consisting of different basic cards and terminals. Each board can exchange data (any parameter, whether digital or analogue, depending on the program) at high transmission speeds. Up to sixteen units can be connected (between cards and terminals) for a maximum of 5 rooftops in such a way as to share the information quickly.

The connection through the serial supervision/remote assistance line in accordance with the RS485 standard, is made through optional serial cards and MODBUS communication protocol.

Thanks to its versatile software, the user terminal permits:

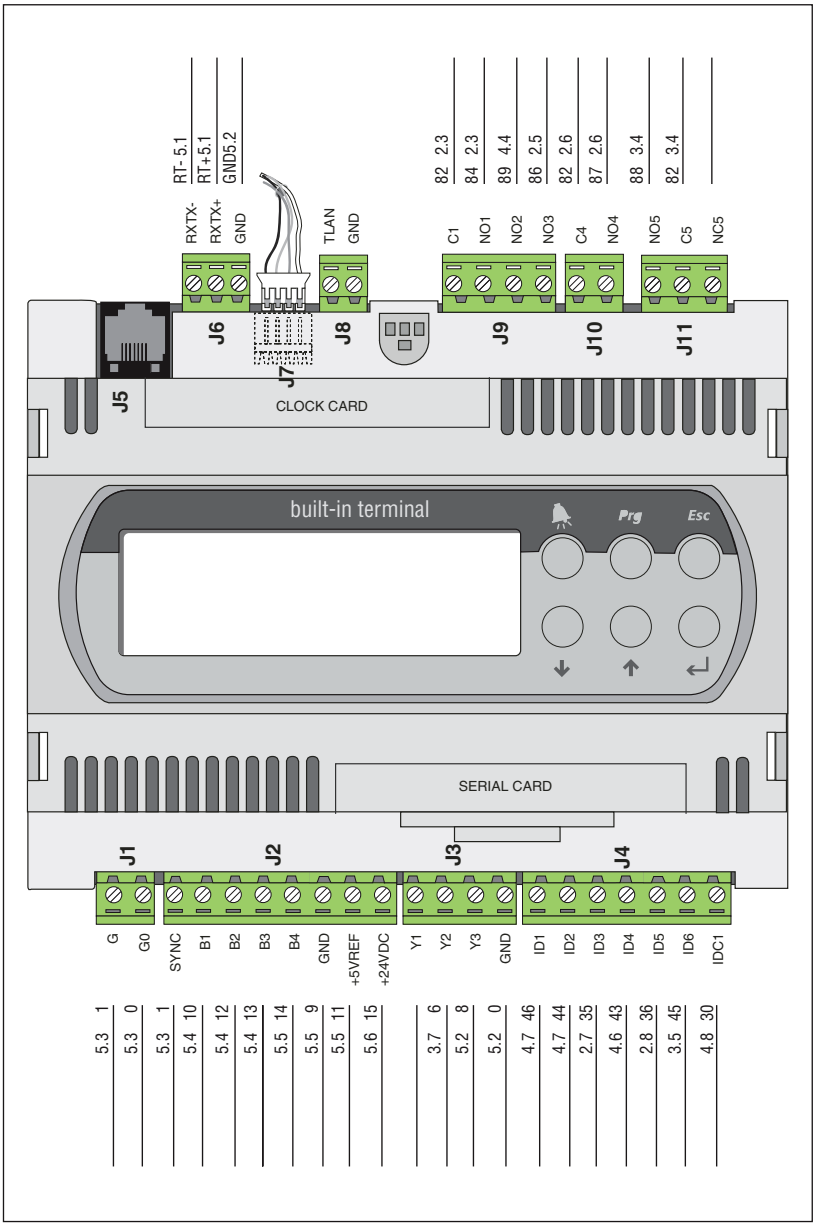
• to modify the basic set points at any moment which may be protected with a password

• the display of the detected alarms and their acoustic detection by means of a beeper

• the indication of the active functions by means of leds.

• the display of all the measured parameters.

The parameters which can be viewed on the display vary according to the accessories of the unit. For a detailled description please refer to the control manual.



Optional Arrangements

The base unit is arranged for the treatment of 100% of recirculated air.
Other sections to combined with the base unit are available, if it is needed to change the air in the room or for other specific requirements. Here follows the list of some of the optional arrangements to add to the base unit to configure the machine according to specific needs.

2-ways mixing box, SM2

Made up of a 2-zones damper which allows the mix of external and recirculated air flows.

3-ways mixing box, SM3

Made up of a section equipped with three dampers which may be placed so as to divide the room air into in a partial exhaust and a partial recirculation. The return fans section in included.

Hot air generator, FG

Made up of a suitable section hosting a forced draught air burner, a gas ramp (compliant to the laws in force) and all the necessary control and safety devices.

Condensation hot air generator, Gxxx

The hot air condensation generator is fed by methane gas. The air is heated through the passage over the surface of the combustion chamber and heat exchanger pipes. The combustion chamber is fully made of AISI 430 stainless steel, while the surfaces in contact with the condensate (exchanger, fume hood) are made of AISI 304 L stainless steel to give outstanding resistance to corrosion. It is provided with an automatic reset safety thermostat.
It is not possible to combine it with the electrical heating coil, BRE.

Cross flow plate type heat recovery, REC

Section with an aluminum cross-flow heat recuperator. In winter operations its efficiency is over 50%, with an excellent sensible heat recovery from exhaust air. The two air flows (supply and exhaust) are completely separated and therefore all types of contamination are avoided.

Considering its features of complete conFigurebility, the MFS range can also be equipped with further arrangements. Please contact FAST for more details.

In Figure 4 an example of a unit with arrangements is shown.

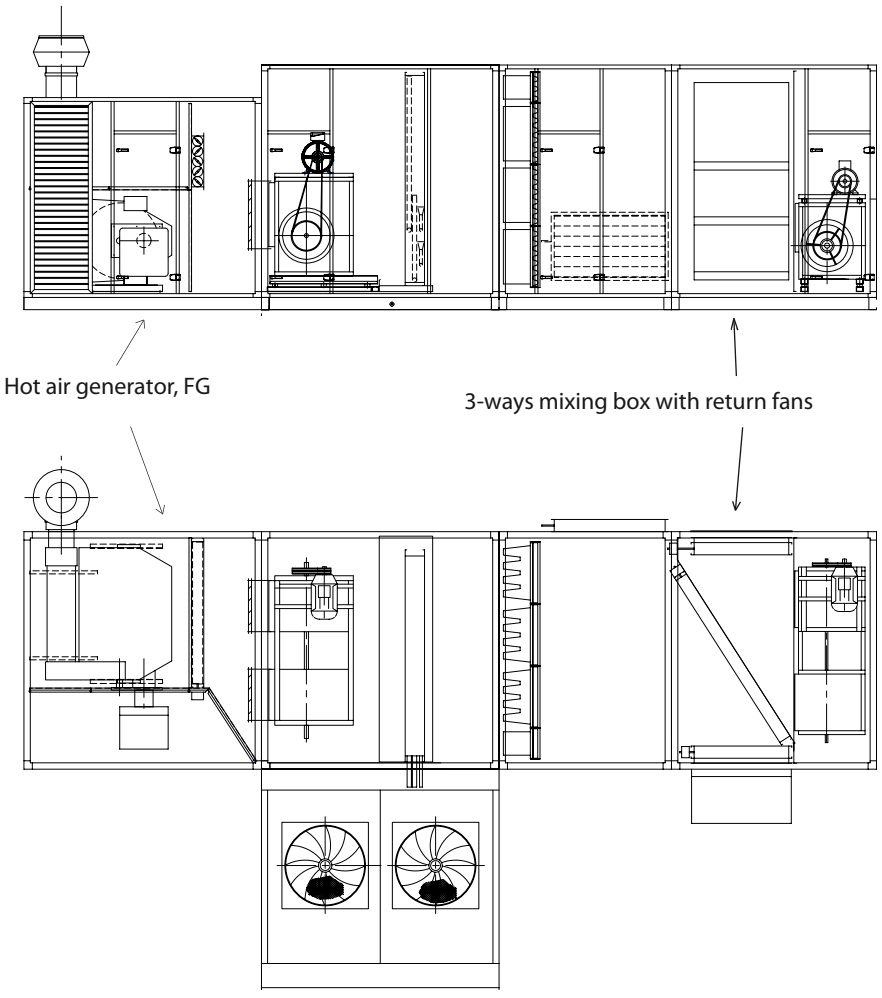


Figure 4 - Example of MFS 220 unit with arrangements.

Accessories

Rigid bag filters, F7
The filtrating cells with rigid bags are fixed to their support frame with hermetic fixing devices, in order to avoid any by-pass of non-treated air. Tehy can be withdrawn through and inspection chamber upstream the filters, adequately sized to allow the maintenance personnel to have access to it.

Low temperature device, DPCR
This accessory allows for the proper functioning of the unit with outside temperatures down to – 20 °C. It consists of an electronic control card which varies the number of condenser unit fan rpms on the basis of condensation pressure, measured by the two high-pressure transducers TP, with the aim of keeping it sufficiently high to supply the thermostat valve correctly.

Pressure transducers , TP (standard on heat pumps)
These show the high and low pressures on a display, manage the compressor and valve activities during defrosting and inhibit their operation when the pressure exceeds the set limits.

External coils protection grills, GP
They protect the external coils from accidental blows, weather conditions and hail.

2-rows heating coil, BTR
Two-rows hot water coil with three-way modulating valve. This can only be managed in the post-heating phase with the DP accessory. It is possible to combine it with the accessory G72 or G92.

Electrical heating coil, BRE
Two-stage electric heating battery provided with double safety thermostat, one automatic resetting and the other manual resetting. The capacities proposed are 36, 48, 60 and 72 kW (or in the order phase indicated the capacity required). These can only be managed in the post-heating phase with the DP accessory.
It is not possible to combine it with the accessory G72 or G92.

Pre-arrangement for humidification control, PUC
ON/OFF contact (normally open) for humidification enabling. The unit in this case has humidity sensor situated on the ambient air recovery. A humidity valve is also supplied with the unit (not mounted) to be placed downstream the humidification section.

Kit for the management of the humidification and post heating, DP
The control will force the operation of the compressors to dehumidify the air up to the humidity set point set. If there is a water or electric coil, it will also be possible to manage the post heating. The PUC accessory can be combined (humidification contact).

Enthalpic Free-cooling, FCH
Only with three damper mixing box.
It manages the outside air flow and recovery referring to their enthalpic values.

Remote panel, PR2
This enables rooftop control operations to be carried out at a distance.

RS485 Serial interface for supervision, SSV
Serial card necessary for the supervision system interface.

Air quality sensor, SQA
This analyses the quality of the air on the basis of a mixed gas SnO2 VOC sensor by assessing the contamination by polluting gases. The presence of the sensor combined with the rooftop control permits:
- the setting of a sensibility threshold depending on the maximum contamination of the air predicted.
- the ventilation of the rooms only when necessary so as to ensure energy saving.

Special coils, BSP
Condensing coil with copper pipes and prepainted aluminium fins.

Special coils, BSR
Condensing coil with copper pipes and copper fins.

Special coils, BSS
Condensing coil with copper pipes and tin plated copper fins.

Silencers, SU
Section equipped with silencers made of mineral wool panels, whose surface is in contact with the air flow, protected by a polyestirene film between two layers of microperforated galvanised metal sheet.

Steam humidification, UV
For the steam humidification two types are available:
- steam type with steam producer with submerged electrodes;
- only with steam ramp.

MFS F technical data (cooling only)

MFS F		085	105	130	160	190
Total cooling capacity	kW	85.5	105.4	130.4	161.1	188.3
Sensible cooling capacity	kW	59.8	73.8	91.9	107.8	125.7
Total input power	kW	29.5	36.3	41.5	54.2	63.0
E.E.R		2.9	2.9	3.1	3.0	3.0

Refrigerating circuit R407C

Compressor type		tandem scroll				
Number/circuit	n°	2/2	2/2	4/2	4/2	4/2
Capacity step control	%	0-50-100	0-50-100	0-25-50-75-100	0-25-50-75-100	0-25-50-75-100
Refrigerant charge	kg	15+15	18 + 18	25 + 25	28,5 + 28,5	30 + 30

Air handling fans *

Type		twin centrifugal				
Nominal air flow rate	m^3/h	16000	19000	23000	26000	30000
Minimum air flow rate	m^3/h	13600	16000	19500	22100	25500
Maximum air flow rate	m^3/h	18800	22300	27000	30600	35300
Number of fans	n°	2	2	2	2	2
Total installed power	kW	5,5	5,5	7,5	9,0	9,0
Available static pressure with std motor	Pa	200	200	200	200	200

Axial fans

Type		axial				
Number / Input power	n°/kW	2/1,8	2/1,8	2/1,8	2/1,8	4/1,2
Nominal air flow rate	m^3/h	50500	47200	47600	46600	59000

Heat exchangers

Air treatment coil rows	n°	3	3	4	4	4
External air coils rows	n°	2	2	3	4	3

Standard air filters

Thickness and type		50 mm, filter with synthetic filtrating media and galvanised steel frame				
Efficiency (EN779)		G4	G4	G4	G4	G4

Summer operating limits

Maximum external air temperature	°C	43	43	43	43	43
Minimum external air temperature	°C	20	20	20	20	20

Standard power supply

Power supply	V/Ph/Hz	400/3/50

Base version sizes

Height	mm	2110	2110	2110	2110	2430
Lenght	mm	2015	2015	2335	2335	2335
Width	mm	4255	4255	4895	4895	4895
Weight	kg	1960	2050	2360	2500	2780

Perfomances referring to:
Room air 27 °C b.s. / 19°C b.u.
External air temperature 35 °C b.s.
EER = Cooling power/Totali input power
* For different conditions please call FAST Technical Department . In this case thecnical data could not be the same.

MFS F technical data (cooling only)

MFS F		220	250	270	300	340
Total cooling capacity	kW	221.1	248.9	272.3	295.3	343.2
Sensible cooling capacity	kW	148.6	169.7	185.3	206.6	228.2
Total input power	kW	72.6	82.4	95.7	96.5	119.1
E.E.R		3.0	3.0	2.8	3.1	2.9

Refrigerating circuit R407C

Compressor type		scroll tandem				
Number/circuit	n°	4/2	4/2	4/2	4/2	4/2
Capacity step control	%	0-25-50-75-100	0-25-50-75-100	0-25-50-75-100	0-25-50-75-100	0-25-50-75-100
Refrigerant charge	kg	32 + 32	36 + 36	40 + 40	46 + 46	52 + 52

Air handling fans *

Type		twin centrifugal				
Nominal air flow rate	m^3/h	34000	40000	45000	50000	55000
Minimum air flow rate	m^3/h	28900	34000	38600	42500	46700
Maximum air flow rate	m^3/h	40000	47000	53000	58800	64700
Number of fans	n°	2	2	2	2	2
Total installed power	kW	11	15	15	18,5	18,5
Available static pressure with std motor	Pa	200	200	200	200	200

Axial fans

Type		axial				
Number / Input power	n°/kW	4/1,8	4/1,8	4/1,8	6/1,8	6/1,8
Nominal air flow rate	m^3/h	76600	85200	80400	84000	86600

Heat Exchangers

Air treatment coil rows	n°	4	4	4	4	4
External air coils rows	n°	4	3	4	4	5

Standard air filters

Thickness and type		50 mm, filter with synthetic filtrating media and galvanised steel frame				
Efficiency (EN779)		G4	G4	G4	G4	G4

Summer operating limits

Maximum external air temperature	°C	43	43	43	43	43
Minimum external air temperature	°C	20	20	20	20	20

Standard power supply

Power supply	V/Ph/Hz	400/3/50

Base version sizes

Height	mm	2430	2430	2430	2430	2430
Lenght	mm	2335	2335	2335	2335	2335
Width	mm	4895	5215	5215	5855	5855
Weight	kg	3140	3320	3410	3630	3720

Perfomances referring to:
Room air 27 °C b.s. / 19°C b.u.
External air temperature 35 °C b.s.
EER = Cooling power/Totali input power
* For different conditions please call FAST Technical Department. In this case thecnical data could not be the same.

MFS H technical data (heat pump)

MFS H		085	105	130	160	190
Total cooling capacity	kW	88.3	107.8	132.4	163.7	190.8
Sensible cooling capacity	kW	60.0	73.3	90.0	111.3	125.9
Heating capacity	kW	87.8	108.8	131.3	162.8	191.6
Total input power in cooling mode	kW	30.1	37.2	42.4	56.0	63.9
Total input power in heat pump mode	kW	28.1	34.9	40.1	53.9	61.2

E.E.R		2.9	2.9	3.1	2.9	3.0
C.O.P.		3.1	3.1	3.3	3.0	3.1

Refrigerating circuit R407C

Compressor type		tandem scroll				
Number/circuit	n°	2/2	2/2	4/2	4/2	4/2
Capacity step control	%	0-50-100	0-50-100	0-25-50-75-100	0-25-50-75-100	0-25-50-75-100
Refrigerant charge	kg	33+33	36+36	43+43	46+46	52+52

Air handling fans *

Type		twin centrifugal				
Nominal air flow rate	m^3/h	16000	19000	23000	26000	30000
Minimum air flow rate	m^3/h	13600	16000	19500	22100	25500
Maximum air flow rate	m^3/h	18800	22300	27000	30600	35300
Number of fans	n°	2	2	2	2	2
Total installed power	kW	5,5	5,5	7,5	9,0	9,0
Available static pressure with std motor	Pa	200	200	200	200	200

Axial fans

Type		axial				
Number / Input power	n°/kW	2/1,8	2/1,8	2/1,8	2/1,8	4/1,2
Nominal air flow rate	m^3/h	50500	47200	47600	46600	59000

Heat Exchangers

Air treatment coil rows	n°	3	3	4	4	4
External air coils rows	n°	2	2	3	4	3

Standard air filters

Thickness and type		50 mm, filter with synthetic filtrating media and galvanised steel frame				
Efficiency (EN779)		G4	G4	G4	G4	G4

Summer operating limits

Maximum external air temperature	°C	43	43	43	43	43
Minimum external air temperature	°C	20	20	20	20	20

Winter operating limits

Maximum external air temperature	°C	20	20	20	20	20
Minimum external air temperature	°C	-10	-10	-10	-10	-10

Standard power supply

Power supply	V/Ph/Hz	400/3/50

Base version sizes

Height	mm	2110	2110	2110	2110	2430
Lenght	mm	2015	2015	2335	2335	2335
Width	mm	4255	4255	4895	4895	4895
Weight	kg	1990	2090	2410	2560	2850

Perfomances referring to:

- Summer mode: room temperature 27 °C b.s. / 19°C b.u. External air temperature 35 °C b.s.
- Winter mode: room temperature 20 °C b.s. / 19°C b.u. External air temperature 7 °C b.s. / 5°C b.u.

EER = Cooling capacity/Total input power in cooling mode COP = Heating capacity/ Total input power in heating mode

* For different conditions please call FAST Technical Department . In this case thecnical data could not be the same.

MFS H technical data (heat pump)

MFS H		220	250	270	300	340
Total cooling capacity	kW	224.3	250.6	274.4	299.3	345.3
Sensible cooling capacity	kW	148.1	165.4	181.1	203.4	238.3
Heating capacity	kW	223.5	249.0	272.0	300.1	334.5
Total input power in cooling mode	kW	74.0	83.2	97.2	99.1	120.6
Total input power in heat pump mode	kW	69.9	80.1	91.7	93.0	112.6

E.E.R		3.0	3.0	2.8	3.0	2.9
C.O.P.		3.2	3.1	3.0	3.2	3.0

Refrigerating circuit R407C

Compressor type		tandem scroll				
Number/circuit	n°	4/2	4/2	4/2	4/2	4/2
Capacity step control	%	0-25-50-75-100	0-25-50-75-100	0-25-50-75-100	0-25-50-75-100	0-25-50-75-100
Refrigerant charge	kg	54+54	58+58	62+62	68+68	74+74

Air handling fans *

Type		twin centrifugal				
Nominal air flow rate	m^3/h	34000	40000	45000	50000	55000
Minimum air flow rate	m^3/h	28900	34000	38600	42500	46700
Maximum air flow rate	m^3/h	40000	47000	53000	58800	64700
Number of fans	n°	2	2	2	2	2
Total installed power	kW	11	15	15	18,5	18,5
Available static pressure with std motor	Pa	200	200	200	200	200

Axial fans

Type		axial				
Number / Input power	n°/kW	4/1,8	4/1,8	4/1,8	6/1,8	6/1,8
Nominal air flow rate	m^3/h	76600	85200	80400	84000	86600

Heat Exchangers

Air treatment coil rows	n°	4	4	4	4	4
External air coils rows	n°	4	3	4	4	5

Standard air filters

Thickness and type		50 mm, filter with synthetic filtrating media and galvanised steel frame				
Efficiency (EN779)		G4	G4	G4	G4	G4

Summer operating limits

Maximum external air temperature	°C	43	43	43	43	43
Minimum external air temperature	°C	20	20	20	20	20

Winter operating limits

Maximum external air temperature	°C	20	20	20	20	20
Minimum external air temperature	°C	-10	-10	-10	-10	-10

Standard power supply

Power supply	V/Ph/Hz	400/3/50

Base version sizes

Height	mm	2430	2430	2430	2430	2430
Lenght	mm	2335	2335	2335	2335	2335
Width	mm	4895	5215	5215	5855	5855
Weight	kg	3190	3380	3480	3700	3810

Perfomances referring to:

- Summer mode: room temperature 27 °C b.s. / 19°C b.u. External air temperature 35 °C b.s.
- Winter mode: room temperature 20 °C b.s. / 19°C b.u. External air temperature 7 °C b.s. / 5°C b.u.

EER = Cooling capacity/Total input power in cooling mode COP = Heating capacity/ Total input power in heating mode

* For different conditions please call FAST Technical Department . In this case thecnical data could not be the same.

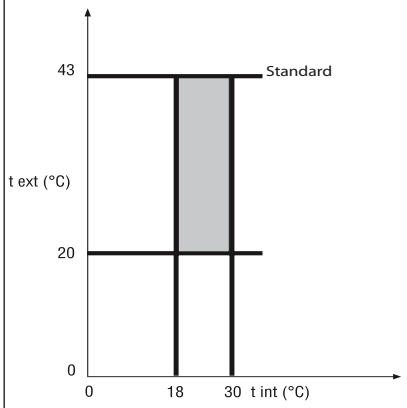
Operating limits

The units, in their standard configuration, are not suitable for installation in a salty environment.

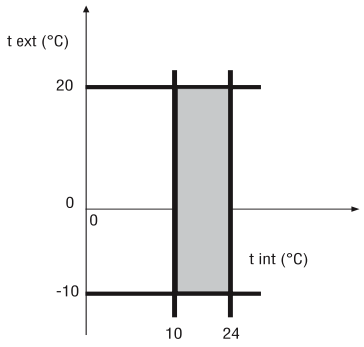
N.B: If you wish to operate the machine beyond the limits indicated in the diagram, please contact FAST engineering/commercial department.

If the unit is situated in particularly windy environments it is necessary to install a wind break protection to avoid unstable operation of the DCPR device.

Summer mode



Winter mode
(heat pump)



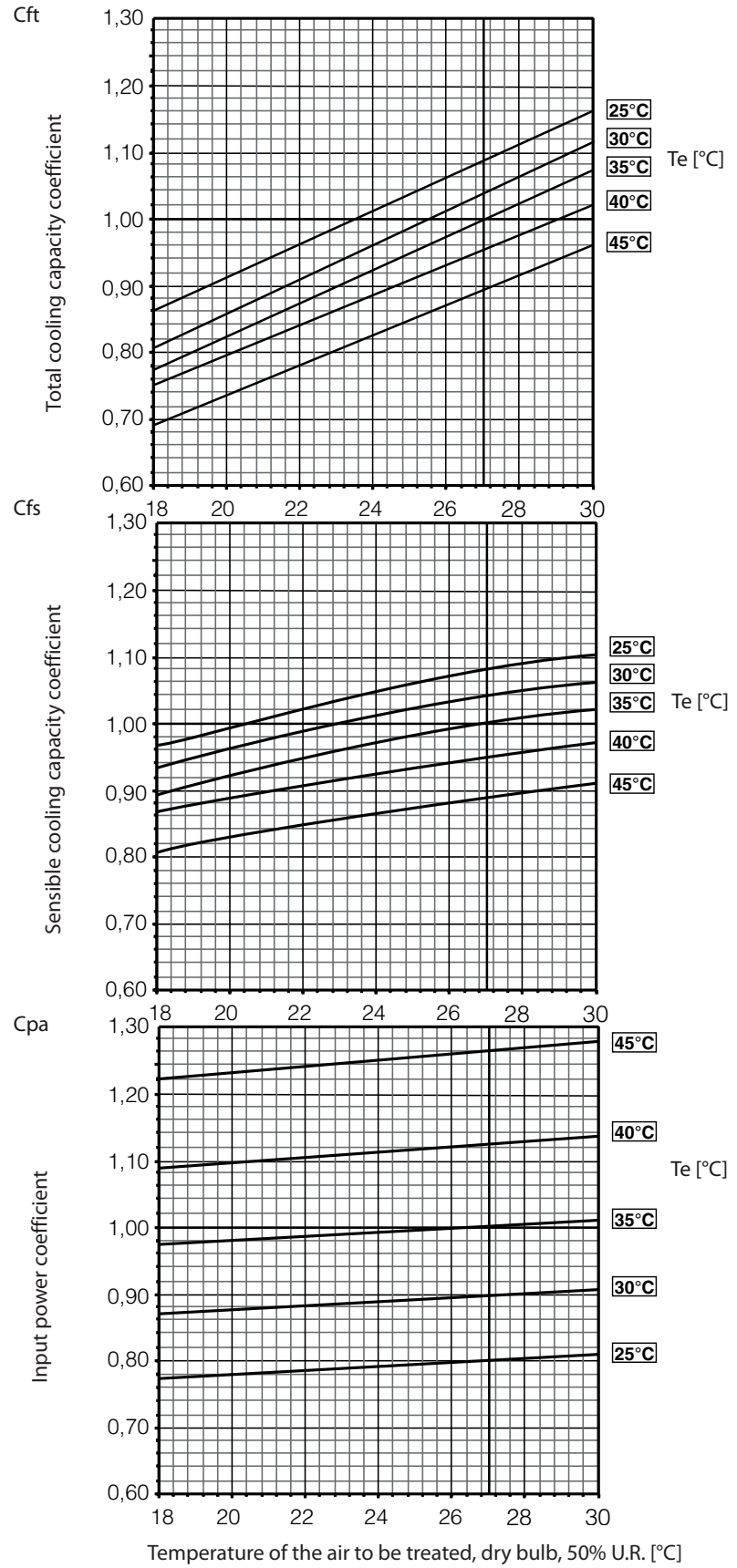
(dry bulb temperature)

Model		085	105	130	160	190	220	250	270	300	340
Max. external temperature in cooling mode	°C	43	43	43	43	43	43	43	43	43	43
Min. external temperature in cooling mode	°C	20	20	20	20	20	20	20	20	20	20
Max. input temp. to evaporating coil in cooling mode	°C	30	30	30	30	30	30	30	30	30	30
Min. input temp. to evaporating coil in cooling mode	°C	10	10	10	10	10	10	10	10	10	10
Min. external temperature in heat pump mode	°C	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10
Max. external temperature in heat pump mode	°C	20	20	20	20	20	20	20	20	20	20
Max. input temp. to evaporator coil in heat pump mode	°C	24	24	24	24	24	24	24	24	24	24
Min. input temp. to evaporator coil in heat pump mode	°C	10	10	10	10	10	10	10	10	10	10

Cooling capacity and input power variations

The following diagrams allow to obtain the corrective coefficient to be used for the MFS rooftop units in the cooling mode. Alongside each curve, the temperature of the outside air, Te, it refers to is reported. The total cooling capacity, the sensible cooling capacity and the electrical input power in conditions other than the nominal ones are obtained by multiplying the nominal values in the technical data table for the respective correction coefficients (Cft, Cfs e Cpa).

Example: if MFS 220 F on the technical data sheet capacities with nominal air flow at 27°C and 50% R.H. gives total refrigerating capacity of 221,1 kW and sensible refrigerating capcapacity 148,6 kW with outside air 35°C; then at 24°C and 50% H.R. will supply respectively : 221,1x0,92=203,4 kW and 148,6x0,97=144,1 kW.

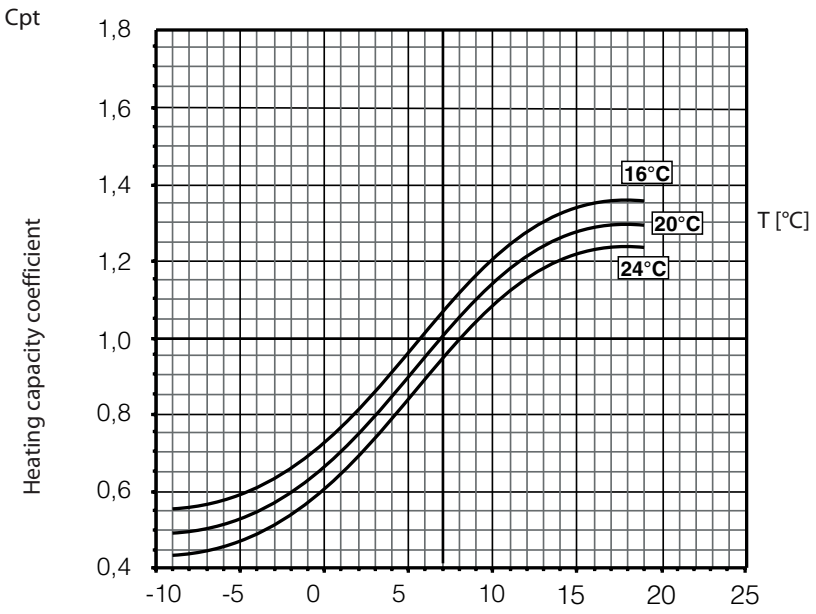


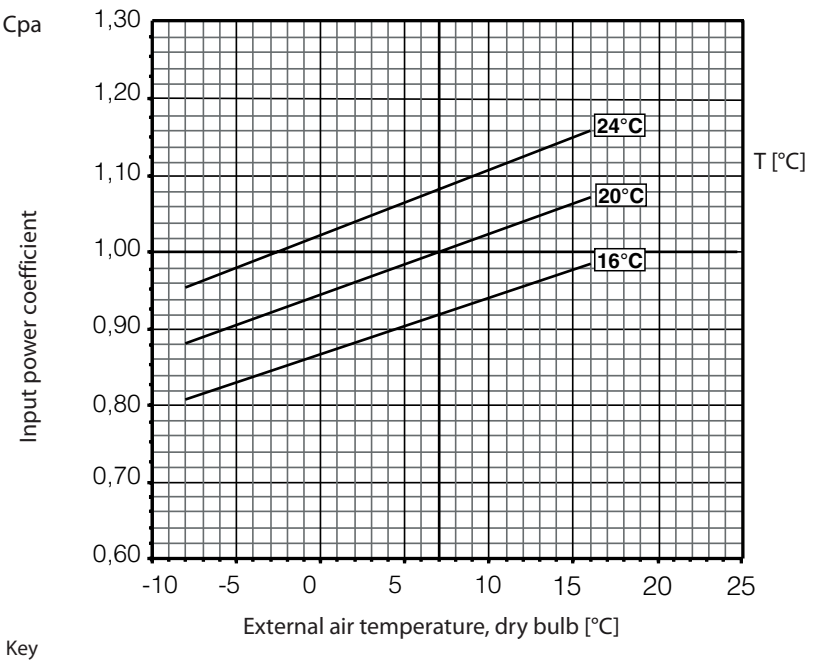
Key

Cft	Total cooling capacity coefficient	Te	External air temperature °C
Cfs	Sensible cooling capacity coefficient	b.s.	Dry bulb
Cpa	Input power coefficient	U.R.	Relative Humidity

Heating capacity and input power variations

The following diagrams give the corrective coefficients to be used for the rooftop units operating in heat pump mode. Each curve refers to a specific room temperature (16-20-24°C). The x-axis shows the dry temperature of the external air with variable relative humidity, according to the data shown in the table below.
The performances are given net of the defrosting cycles.
The corrective coefficients (Cpt, Cpa) allow to calculate the heating capacity and the electrical input power at conditions other than the nominal ones, simply multiplying them.





Key

Cpt	Heating capacity coefficient
Cpa	Input power coefficient
b.s	Dry bulb
T °C	Dry bulb temperature of the handled air

In the performance diagrams of the heat pump version, the axys X indicates a temperature referring to the following humidity conditions. For different conditions please contact FAST engineering-commercial departments.

External air temperature	°C	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16
Dry bulb temp.	°C	-8	-6	-4	-2	0	2	4	6	8	10	12	14	16
R.H.	%	90	90	85	80	75	75	70	70	70	65	65	65	65

Corrective coefficients for different air flow rates

The data given by the diagrams on pages 17-18 refer to nominal air flowrates (Wn). For different flowrates (W) please apply the capacity corrective coefficients shown in the tables on the right.

The absorbed power does not change significantly with the variation of the air-flow to treat.

Correction coefficients for flow rates other than the rated flow rates by total cooling capacity					
W/Wn	0,85	0,9	1	1,10	1,15
Cft	0,980	0,987	1	1,014	1,027

Correction coefficients for flow rates other than the rated flow rates by sensible cooling capacity					
W/Wn	0,85	0,9	1	1,1	1,15
Cfs	0,920	0.953	1	1.048	1.095

Correction coefficients for flow rates other than the rated flow rates by total heating capacity					
W/Wn	0,85	0,9	1	1,1	1,15
Cpt	0,982	0,987	1	1,014	1,027

Key
Cft Total cooling capacity corrective coefficient
Cfs Sensible cooling capacity corrective coefficient
Cpt Total heating capacity corrective coefficient

Total capacity variations for different relative humidity

The table gives the corrective coefficients to calculate the TOTAL COOLING CAPACITY for different relative humidities, dry bulb temperature unchanged.

Total cooling capacity correction coefficients for different relative humidity						
R.H	%	30	40	50	60	70
Coefficient		0.89	0.94	1	1.06	1.12

The table gives the corrective coefficients to calculate the SENSIBLE COOLING CAPACITY for different relative humidities, dry bulb temperature unchanged.

Total cooling capacity correction coefficients for different relative humidity						
R.H	%	30	40	50	60	70
Coefficient		1.25	1.11	1	0.89	0.80

Example: if MFS 220F on the technical data sheet supplies at 27°C and 50% R.H.: total refrigerating capacity of 221,1 kW and sensible cooling capacity of 148,6 kW with outside air 35°C, then at 27°C and 70% R. H. supplies respectively: 221,1x1.12=247,6 kW and 148,6x0.79=117,4 kW.

Technical data for water heating coil, BTR

Technical data 2 rows water heating coil (accessory BTR2)

MFS model		085	105	130	160	190
Heating capacity	kW	129,2	145,1	189,5	201,7	234,0
Water flow rate	l/h	11109	12476	16294	17343	20120
Water pressure drop	kPa	65	75	63	71	73

MFS model		220	250	270	300	340
Heating capacity	kW	249,0	288,8	305,6	374,0	391,8
Water flow rate	l/h	21410	24832	26277	32158	33689
Water pressure drop	kPa	82	54	60	79	86

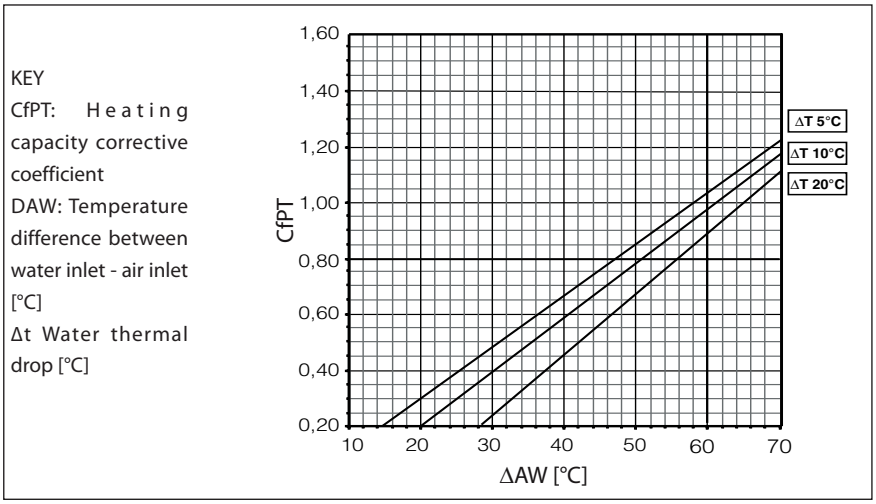
Capacities of the hot water coil referred to: air inlet 20°C; water 80/70°C.
Operating conditions different from the ones above are available on request.
In the calculation of the water side, the pressure drop of the 3-way valve are included.

Performance variations for water heating coils

The diagram shows the corrective coefficients to be applied to the nominal performances of the hot water coil.

Example :
Calculate the performances of the hot water coil installed on a MFS 105 at the following design conditions:
· Heating water inlet temperature: 70 °C;
· Room temperature: 22 °C;
· Water thermal drop ΔT20=20 °C.
The coil heating capacity, with air at 20°C and water 80/70°C, is 145,1 kW according with the technical data sheet.
The temperature difference between the water inlet and the air is DAW=70- 22=48°C.
The diagram gives the corrective coefficient Cfpt=0.63.
Hence the coil heating capacity at the given condition is 145,1 x 0.63 = 91,4 kW.

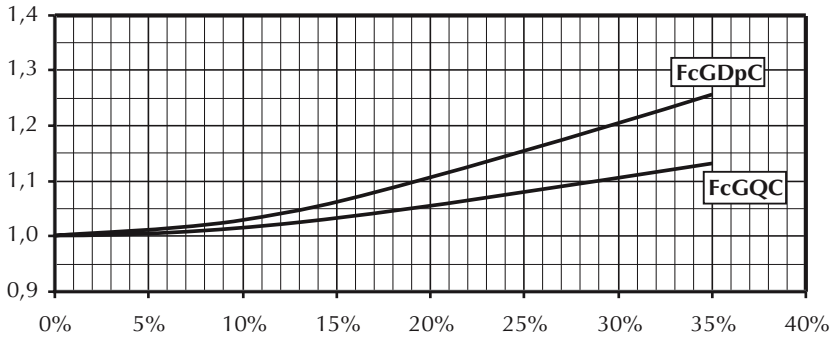
KEY
CfPT: Heating capacity corrective coefficient
DAW: Temperature difference between water inlet - air inlet [°C]
Δt Water thermal drop [°C]



Corrective coefficient for pressure drop and flow rate with glycoled water

The water flowrate and pressure drop corrective coefficients have to be applied directly to the data for normal conditions (no glicole percentage).

FcGDpC = Pressure drop corrective coefficient
FcGQC = Flow rate corrective coefficient



Percentage of ethylene glycols

Technical data Gxxx hot air generator

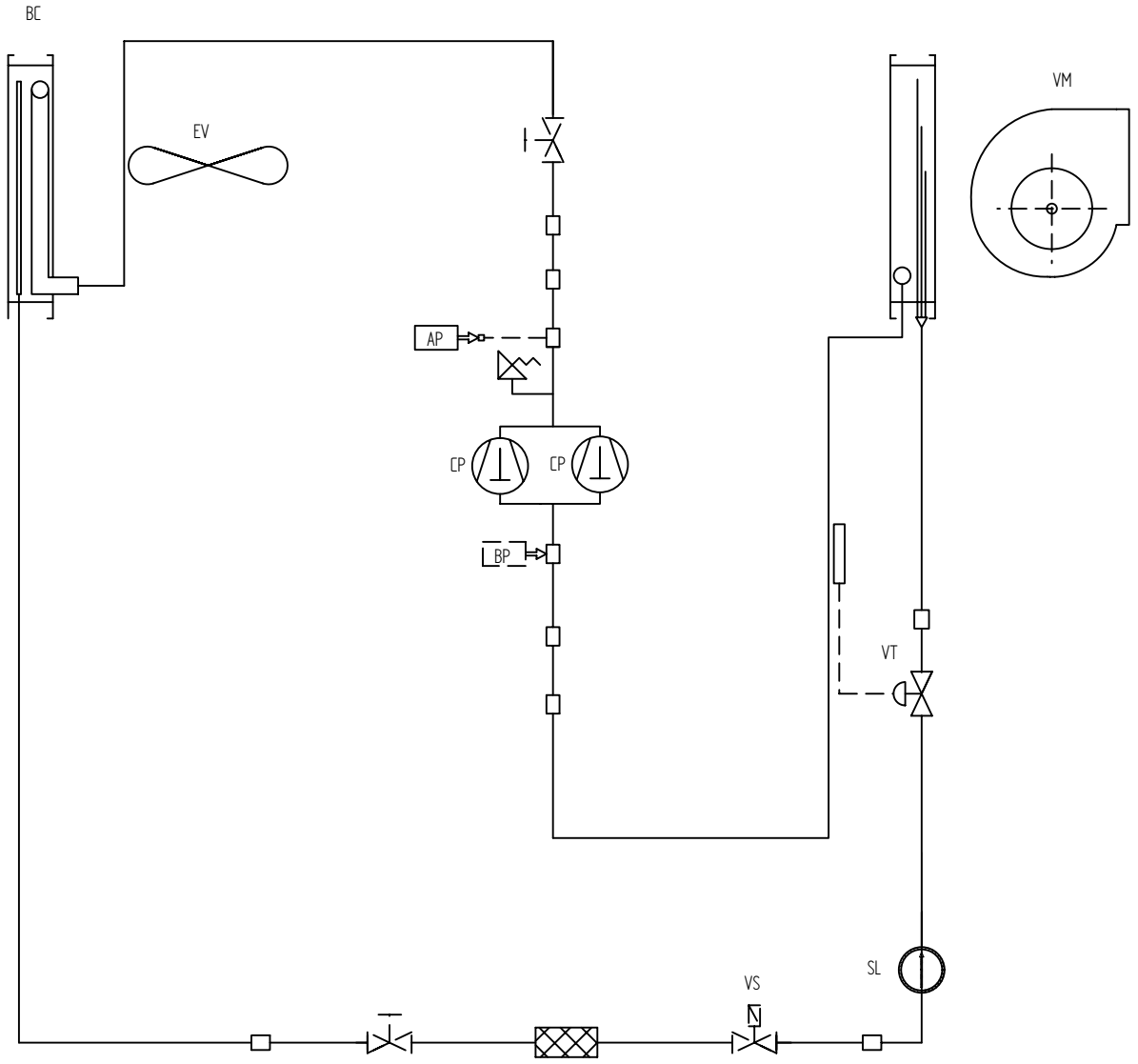
Gxxx model		G092	G150		G200	G230	G280	G300		G350	G400
Coupling with MFS units	MFS model	MFS 085	MFS 105	MFS 130	MFS 160	MFS 190	MFS 220	MFS 250	MFS 300	MFS 300	MFS 340
Combination of thermal modules	n°x model	1x092	2x072	2x072	2x092	1x072 + 1x150	1x092 + 1x150	1x150 + 1x150	1x150 + 1x150	1x150 + 1x200	1x200 + 1x 200
Thermal gap (at the nominal air flow and at the maximum thermal capacity)	°C	17,4	23	19	21,4	21,7	20,9	21,6	17,3	20,4	18,4

Note: other combinations available on request.

Thermal model		072		092		150		200	
		min.	max.	min.	max.	min.	max.	min.	max.
Nominal thermic input	kW	22	78	30	98	44	155	53	215
Efficiency	%	105	93,8	105	95,3	105,2	93,5	105,1	91,6
Nominal thermic output	kW	23,1	73,2	31,5	93,4	46,3	145	55,7	197
Produced condensate	l/h	2,2		2,6		3,9		4,9	
NOx	mg/kWh	38		37		43		39	
Diameter gas inlet		UNI ISO 7/1 - 1" M		UNI ISO 7/1 - 1" M		UNI ISO 7/1 - 1" M		UNI ISO 7/1 - 1" M	
Diameter air inlet/exhaust tube	mm	100 / 100		100 / 100		130 / 130		130 / 130	
Exhaust gas available pressure	Pa	120		120		100		140	
Minimum ambient temperature	°C	-15		-15		-15		-15	
Power supply	V / Hz	230 / 50		230 / 50		230 / 50		230 / 50	
Category		II 2H 3B/P							
Inlet pressure Methane G20	mbar	20 (min. 17; max. 25)							
Consumption G20 (15°C - 1013mbar)	m^3/h	2,33 - 8,26		3,18 - 10,38		4,50 - 15,80		5,60 - 22,30	
Carbon dioxide CO_2 G20	%	8,7 +/- 0,2							
Inlet pressure Propane G30	mbar	37				-		-	
Consumption G30 (15°C - 1013mbar)	m^3/h	1,41 - 5,00		1,92 - 6,28		-		-	
Carbon dioxide CO_2 G30	%	9,5 +/- 0,3				-		-	
Inlet pressure Propane G31	mbar	37							
Consumption G31 (15°C - 1013mbar)	m^3/h	1,39 - 4,89		1,88 - 6,14		2,76 - 9,71		3,32 - 13,47	
Carbon dioxide CO_2 G31	%	9,5 +/- 0,3							

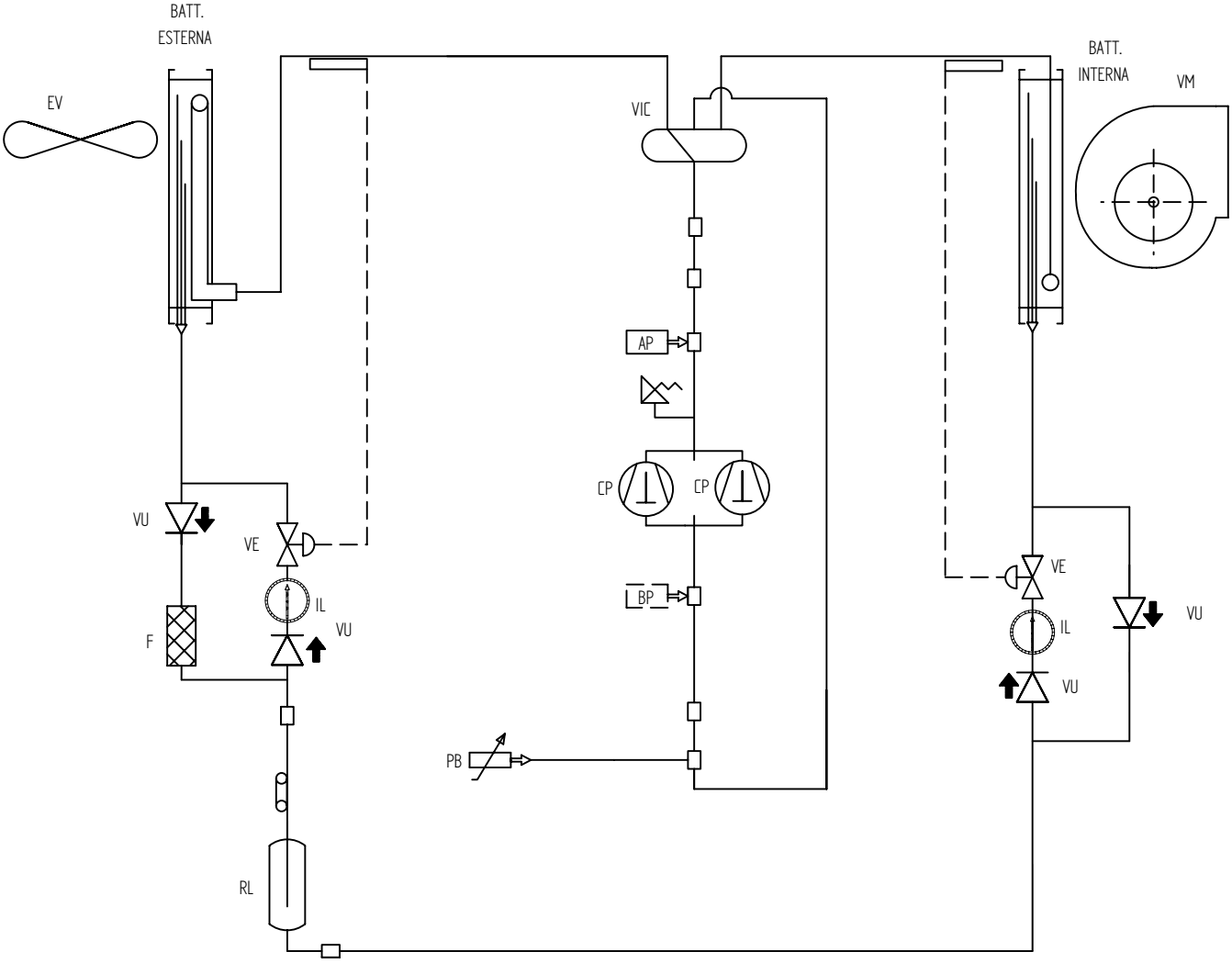
Refrigerating circuits

Cooling only mode



THE SCHEME REFERS TO ONE OF THE TWO CIRCUITS

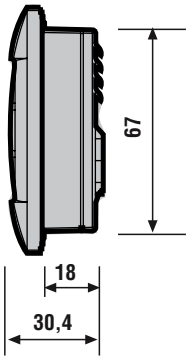
Heat pump mode

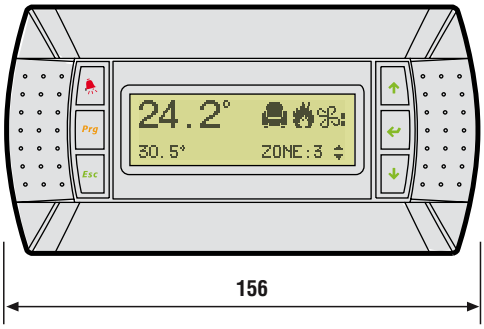


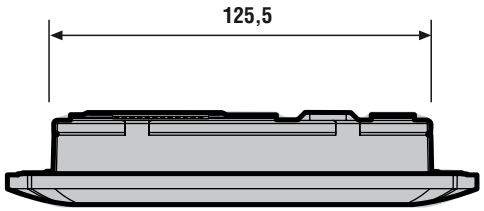
THE SCHEME REFERS TO ONE OF THE TWO CIRCUITS

Remote panel (accessory), PR2

The graphic display is an electronic device which permits the complete management of the graphics through the display of icons (defined at the level of software application development) and the management of two dimension international fonts: 5x7 e 11x15 pixel.
The application software is only resident on the card. The terminal does not need any additional software in the usage phase. In addition, the terminal offers a wide range of operating temperature and in the wall built-in version, the front guarantees a high degree of electrical protection (IP65).







Safety

The machine has been designed so as to reduce to the minimum the risks for the safety of the people interacting with it. During the design phase, it was not technically possible to completely eliminate the risk causes. Therefore it is imperative to refer to the following instructions.

Access to the unit

Access to the unit once it has been installed must only be permitted to qualified operators and technicians. The operator is a person who has been authorised by the owner of the machine to carry out operations on the said machine (in accordance with that indicated in the present manual). The technician is a person authorised by FAST or subordinate under their own responsibility by a FAST distributor, to carry out operations on the machine. The owner of the machine is the legal representative of the company, entity or individual owner of the system in which the FAST machine is installed. These people are responsible for the observance of all safety standards indicated in the present manual and the existing law. In the event that access by unauthorised persons to the machine can not be prevented due to the nature of the location in which it is installed, a cordoned area must be defined around the machine and at least 1.5 meters from the external surface, inside of which only operators and technicians are permitted.
The operators and technicians must operate on the machine wearing suitable safety clothing (shoes, gloves, safety helmets, etc) and with suitable tools.

Residual risks

The installation, start-up, shutdown and maintenance of the machine must be carried out in accordance with that stipulated in the technical documentation of the product and in such a manner that no hazardous situations are generated. Risks that have not been able to be eliminated during the design phase are indicated in the following table.

CONSIDERED PART	RESIDUAL RISK	METHOD	PRECAUTIONS
Heat exchanger coil	small cuts	contact	avoid contact, use protective gloves
Fan grille and fan	lesions	introduction of pointed objects through the grille while the fan is running	do not insert objects of any kind through the grille of the fan and do not place objects over the grille
Inside the unit: compressor and delivery pipes	burns	contact	avoid contact, use protective gloves
Inside the unit: metal parts and electrical cables	intoxication, electrocution, severe burns	insulation defect of the power supply cables upstream of the unit's electric panel; live metal parts	suitable electrical protection of the power supply line; maximum care when earthing the metal parts
Outside the unit: area around the unit	intoxication, severe burns	fire due to short circuit or overheating of the power supply line upstream of the unit's electric panel	cable section and power supply line safety system conforming with existing laws

Unit installation and use

Packaging

The MFS series units are usually supplied without packaging with the exception of high-efficiency filtering cells and assembly accessories, which are supplied in cardboard boxes and have to be installed by the customer. Upon request, the units can be supplied packaged with polyethylene fim on pallets + polyethylene film, in a cage or in a crate.

Receipt and stocking

On receipt of the goods, check that they have not undergone damage and that they correspond with that indicated on the accompanying documents. Possible damage or incomplete delivery must be opportunely signalled. The unit can be stored in an area protected from weather with temperatures from -20°C to a maximum of +55°C.

Handling

Before moving the unit make sure that it has not been damaged during transport and make sure that the equipment to be used for lifting and positioning is adequate in terms of capacity and complies with security regulations currently in force.
Particular attention must be paid to all the loading, unloading and lifting operations so as to avoid dangerous situations for people and damage to the structure and operational parts of the machine.
The holes in the base to be used for lifting are indicated with yellow stickers showing a black arrow.
The iron bars, which must be suitably sized, must protrude from the base unit for a sufficient length so that the lifting straps can be tightened upwards without encountering any interference.
Make sure that the belts have been approved for supporting the weight of the unit, make sure they are properly fixed to the upper frame and to the lifting poles. The safety closures must guarantee that the belts do not come out of their seats.
The hooking point of the lifting frame must be on the vertical of the centre of gravity.
The positioning must be done using two transpallet, one for each side of the section, preferably acting on the longer sides.
Alternatively the positioning can be done by sliding the centre on the tubes that act as rollers.
Under no circumstance should anybody or anything stay, even for short periods, under the unit.

Positioning

If the unit is situated in particularly windy environments it is necessary to install a wind break barrier to avoid unstable operation of the DCPR device.

Minimum operative spaces

WARNING:
The machines in the MFS series must be installed externally in an area suitable for this purpose, which has the required technical spaces (see figure 5 below).
This is essential to allow ordinary and extraordinary maintenance and for functioning reasons as the device must gather air from the outside along the perimeter sides and expel it upwards.
For the proper functioning of the unit, this must be installed on a perfectly flat surface. Make sure that the resting surface is able to bear the weight of the machine.

The warranty for the equipment does not cover, in any case, costs due to electric staicases, lifts or other heaving devices which ought to be necessary to perform the interventions under warranty.

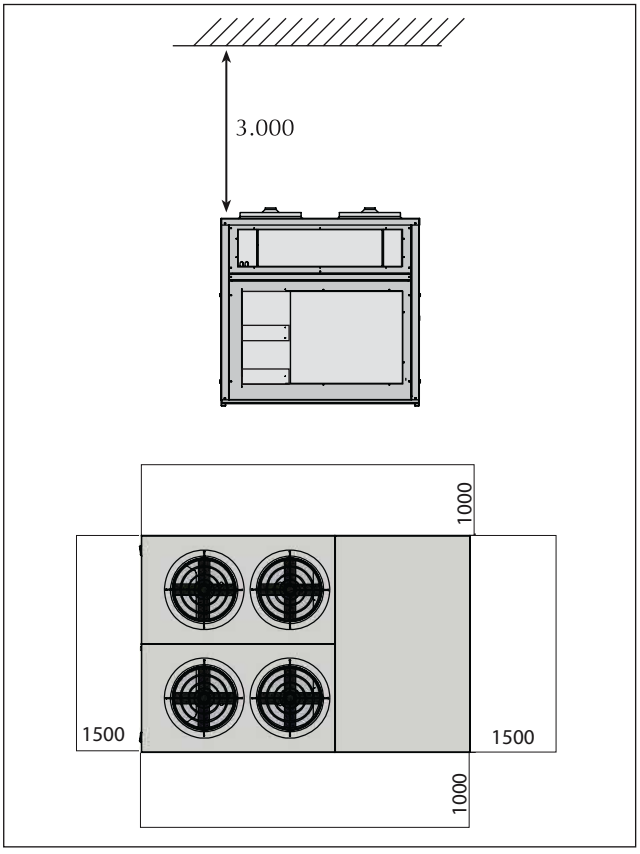
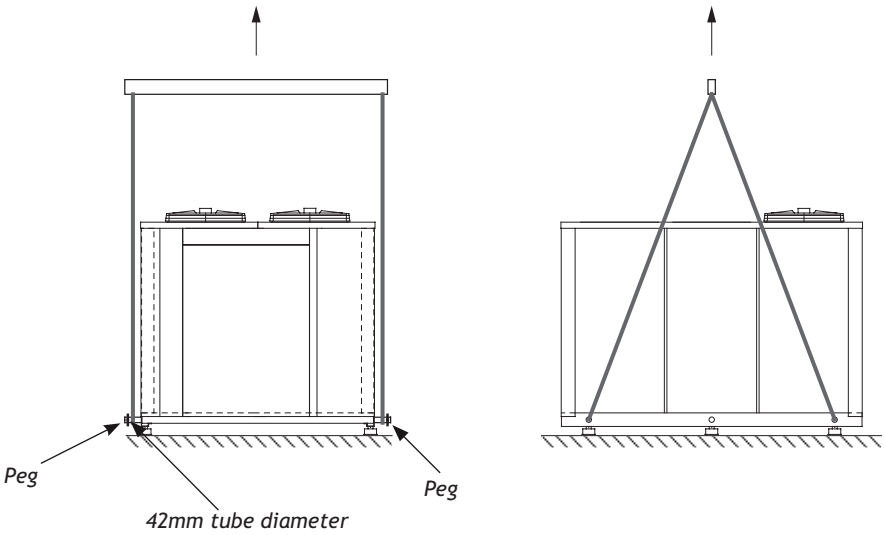


Figure 5 - Minimum operative spaces

Lifting with trolley crane

Lifting must be carried out in accordance with the diagram below following the indicated instructions. Use a lifting beam or bar, cords of suitable capacity (not chains), 42 mm (1" 1/4) diameter tubes that must be inserted into the holes at the base of the machine; block the ends of the tubes with pegs or split pins making sure that the cord does not slip off. Make sure that the unit is securely balanced.



Electrical connections

The unit is completely wired in the factory and to be set in motion it needs to be powered electrically in accordance with the information on the nameplate, intercepted with on-line protection devices.

To access the electric panel and therefore the power supply control board the front upper panel must be dismantled. For the scaling of the power supply line, refer to the power and current values in the electrical diagram which is found inside the compressor compartment along with the other supplied documents.

Particular attention must be given to the following points:

- the electrical connections must be carried out by qualified personnel;
- the power supply cables must be protected upstream by a suitable device in accordance with the present laws against short circuits and overloads;
- the section of the cables must be in line with the upstream safety system setting and must take into account all influencing factors (temperature, type of insulation, length etc.);
- it is very important that the earthing connections are carried out with the maximum care;
- check the type of power supply that could be three-phase or three-phase with neutral.

It is the responsibility of the installation engineer to dimension the power line adequately in accordance with the length, type of cable, input power and current of the unit and the physical deployment.

All the electrical connections must correspond with the regulations currently in force at the moment of installation.

There are two pairs of terminals in the electric panel control board (free contacts): one is for the remote general alarm and the other is for the remote ON-OFF (see electrical layout).

in particular, refer to the supplied electrical layouts for the connections of the condensing unit units to the internal units and the room thermostat.

WARNING:

For installation requirements, please refer to the wiring diagram supplied with the unit.

CAUTION:

Check that all power cables are correctly secured to the terminals when switched on for the first time and after 30 days of use. Then check the tightening of all the power terminals twice a year. Loose terminals could cause the cables and components to overheat.

First start up or start up after prolonged stand still

Preliminary electrical, hydraulic and refrigerating controls must be performed before starting the roof top MFS.

Before starting

Before starting, check that:

– the electrical connections have been carried out correctly;
– the line voltage is within the permitted tolerances (±10% of the nominal value);

WARNING:
If present, the unit must be powered to allow compressors' cover electric heaters to evaporate the refrigerant present in the oil at least 24 hours before starting (or at the end of each prolonged standstill period). If this precaution is not carried out serious damage may be inflicted on the compressor and the guarantee will decay.

Unit start-up

Commissioning the units must be previously agreed on the basis of the timing for the realisation of the installation.
Before the intervention of FAST After Sales Service all the works (aeraulic, hydraulic and electrical connections, loading and blowing out of air from the system) will have to be completed.
For the setting of all the operating parameters and for detailed information regarding the operation of the machine and check list, refer to the control manual.

WARNING:
Make sure that all the indications in the present manual have been carried out before carrying out the controls on the first start-up.

Before starting the roof top, check that:

- the electrical connections have been carried out correctly and that all terminals have been fully tightened;
- the voltage on the terminals is 230 V ± 5% (for units fed with 1 phase) or 400 V ± 5% (for units fed by 3 phases), which can be verified by means of a tester: if the voltage is subject to frequent changes, contact our Technical department for the choice of suitable protections;
- there are no leaks of refrigerant, using a leak detector if necessary.

WARNING:
Before starting, check that all the unit closing panels are in place and fixed with the suitable screws.

System charge/discharge

During the winter period, only in the case of water coils, if the system is left still, the water in the heat exchanger might freeze and damage the heat exchanger irreparably.
To avoid the freezing risk, there are three possible solutions:
1) The complete drainage of the water from the heat exchanger at the end of the season and refilling at the beginning of the next season.
2) Operation with glycol water with a glycole percentage chosen on the basis of the minimum external temperature expected. In this case, due account must be taken of the heating coil performance and pump scaling.
3) Keeping the temperate of the water above 5°C.

Norms covering the use of R407C gas

Rooftop units functioning with refrigerating R407C gas require particular attention at the assembly stage and during maintenance so as to keep them from malfunctioning.
It is therefore necessary:
- To avoid refilling with oil different from the one specified which is already precharged in the compressor.
- If there are gas leaks implying that the rooftop units are even partially empty, do not refill the refrigerant partly but completely drain the machine and after evacuating it completely fill it again with the amount required.
- In the event of replacement of one of the refrigerating circuit parts, do not leave the circuit open for more than 15 minutes.
- In particular, in the case of substitution of the compressor, complete the installation within the above mentioned times after removing the rubber caps.
- Do not power up the compressor if the is no charge; do not compress air inside the compressor.
- If you use R407C gas tanks, please pay attention to the maximum number of withdrawals you can make in order to ensure the correct ratio of the components in the R407C gas mixture.

Preliminary controls - electric parts

Before carrying out the controls in this paragraph, make sure that the power supply line of the unit is disconnected upstream of the unit. Make sure that the disconnecting device is locked or that a suitable notice warning not use is applied to its handle.
All operations must be carried out without voltage as follows:
- remove the front upper panel;
- move the main switch to the "0" position (OFF);
- open the door of the electric panel;
- make sure that the power supply cables are correctly dimensioned;
- make sure that the roof top is earthed;
- make sure that the screws that fix the wires to the electrical components inside the panel are tight so as to guarantee a good contact;
- close the door of the electric panel.

At this point power can be applied to the machine closing the line disconnector and moving the main switch of the machine to the "1" position (ON).
Using a voltmeter, check the phase voltage value supplied to the unit. The power supply voltage should be 400 V ± 10%. Determine the average phase voltage (RS+ST+RT)/3 and the percentage difference between each of the phase voltages and this average voltage. The maximum difference must not be higher than 3%. A greater variation will annul the guarantee.

EXAMPLE:

R-S = 397 V;
S-T = 406V;
R-T = 395 V

- average of the values:
(397+406+395)/3 = 399.3 V

- percentage difference:
(406 - 397) / 399.3 x 100 = 2.25%

(406 - 395) / 399,3 x 100 = 2.75%

(397 - 395) / 399,3 x 100 = 0.5%

Preliminary controls - cooling circuit

Visually control the integrity of the various cooling circuit components.
Make sure that the level of the lubricating oil on the compressors is at approx. halfway on the sight glass.

Plumbing

CONDENSATE DRAIN PAIN
The condensate drain pan has a threaded drain pipe 1" G UNI 338.
The drainage system should feature an adequately sized siphon to:
• allow the free drainage of the condensate;
• prevent the undesired inlet of air in the vacuum systems;
• prevent the undesired air leakage from pressure systems;
• prevent bad smells or insects from infiltrating.

Here below you will find rules to adopt for the dimensioning and creation of syphons in the case of pressure and vacuum tanks (figure 6).
Negative pressure:
H1 = 2P
H2= H1 / 2
Positive pressure:
H1 = 2P
H2= H1 / 2
where P is the internal pressure expressed as mm of a water column (approx. 1 mm = 9.81 Pa). This pressure is indicated in the relevant label near the condensate drainage point. The syphon must be equipped with a plug for the cleaning at the bottom or must anyway allow for fast dismantling for cleaning purposes.

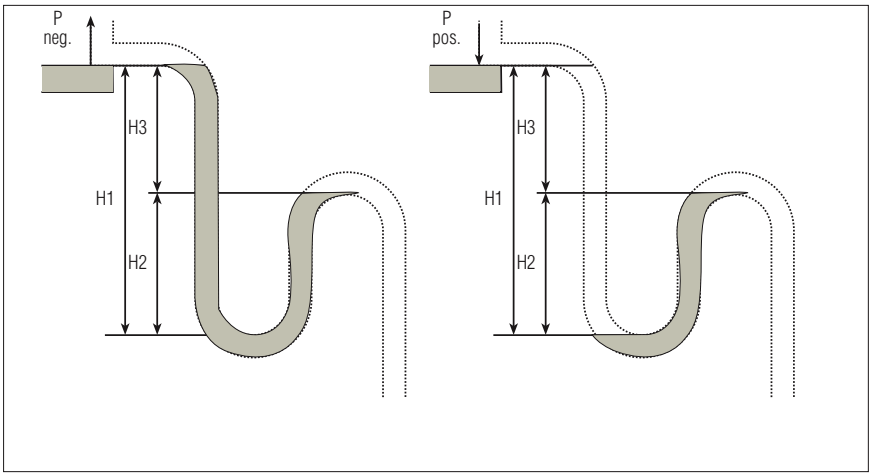


Figure 6 - Plumbing

Air ducts

For the installation of the ducts it is recommended to:

• install adequate brackets to support the ducts so to avoid that their weight burden on the roof top;

• connect the supply and exhaust vents to the ducts by means of antivibration canvases. The antivibration canvas has to be connected to the unit screwing it to the flange or damper, if present. If the flange or the damper are not present, the antivibration canvas has to be screwed to the frame of the unit using drive screws;

• put in place an electrical earthing cable that acts as a bridge over the shock absorber joint to guarantee electrical equipotentiality between the duct and the unit;

• foresee, before bends, branches, curves, angles etc., the supply duct with a straight stretch at least 2.5 times longer than the smaller side of the duct (A) to avoid a fall off in the performance of the fan;

• avoid the ducts from having stretch inclinations that diverge more 7°C.

The progress of the first curve must conform with the orientation of the fan as illustrated in the figure 7 below.

Controls during running

Check the rotation direction of 3 phase compressors: if the intake pressure does not diminish and the outlet pressure does not increase at the normal values, disconnect the power and invert any two of the three phases of the core input cable and reconnect the power to make sure it was not connected incorrectly: never modify the internal electrical connections otherwise the guarantee will decay.

IMPORTANT NOTE: it is very important to check the compressor rotation direction in the scroll unit. If powered with the incorrect phase sequence they will rotate backwards. In this case they are very noisy and could be damaged: invert the phases immediately. To make a more precise control of the rotation direction, connect a pressure gauge unit by means of the appropriate tapping points and check that the pressures are correct.

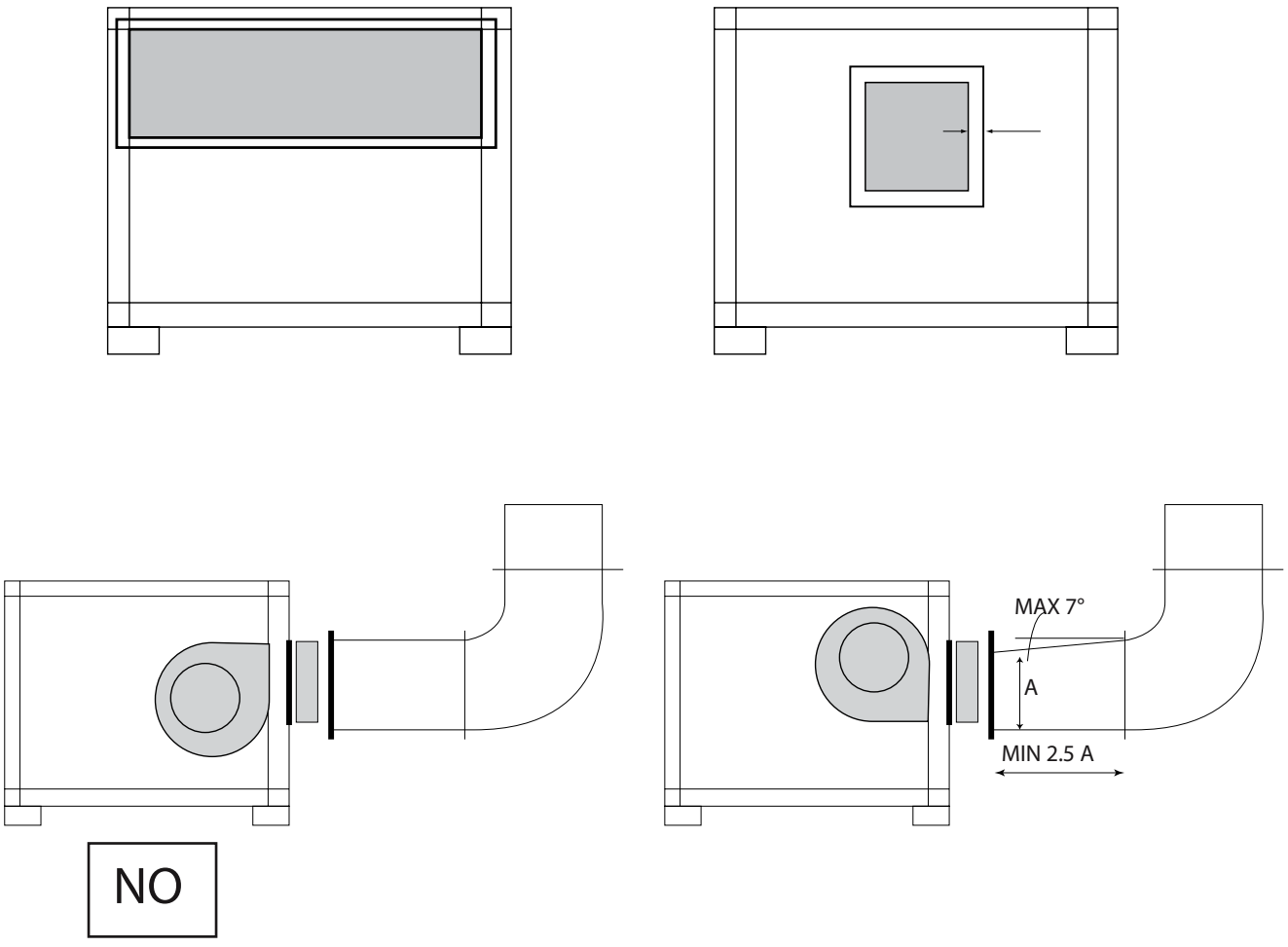


Figure 7 - Air ducts

Unit maintenance

Ordinary maintenance consists of simple operations which should be carried out on a monthly basis, as follows.
The maintenance program must, in any case, be carried out by a qualified technician.

WARNING:
- Use suitable personal protective equipment (PPE) during maintenance operations
- Before accessing the unit for maintenance or cleaning operations, make sure the unit is disconnected from the power supply, that the supply can not be switched on again without the maintenance engineer's knowledge and that the fans are off.
- The upper part of the compressor and the outlet pipes are at high temperatures: take particular care if working close to them.
- Take particular care when working close to finned coils because the fins are particularly cutting.
- Do not remove the fan protection grilles before have previously disconnected the power supply inside the machine; do not introduce foreign objects through the protection grille of the fans.
- After finishing the maintenance operations, make sure that the panels are correctly closed by means of fixing screws.

The table below indicates the monthly maintenance operations of each components indicating the type of control to be carried out. The monthly program is indicative and could vary depending on the working and environmental conditions in which the roof top is operating.

MONTHLY MAINTENANCE PROGRAM	
FANS	• Control the electrical absorption • Control that the fan motors rotate freely and without abnormal noise. Make sure that the bearings do not overheat excessively • Control the screws of fans to fan grille and of grille to the structure
CONDENSING COIL	• Control the condensing coils. In order to grant a correct heat exchange, these have to be clean. It is necessary to remove dirty, if any, which accumulates on their surface due to the air movement. Remove papers, leaves etc. and clean the fins with a jet of air. To avoid damaing the aluminium fins, make sure that the air jet is perpendicular to the coil. The cleaning operation has to be carried out with the utmost care since the fins of the heat exchanger can easily be damaged (aluminium 0,12 mm). In case the fins are damaged, it will be necessary to fix them back with a proper device. Before performing any operation of the heat exchangers if it necessary to wear protection gloves, as the accidental contact with the fins may cause cutting wounds.
REFRIGERATING CIRCUIT	• Control the condensate and evaporation pressures (by a refrigeration expert). It is necessary to remove compressor cabinet panels and connect manometers on the suitable pressure sockets in the refrigerating circuit • Control the compressor current absorption, the outlet temperature and the presence of any strange noises • Control the correct quantity of refrigerant by means of the liquid indicator • Control the calibration of the thermostatic valve (superheating 5 ÷ 8°C) • Check that the oil level indicated in the compressor indicator is not below the minimum • Check that the safety devices are activate (pressure switches)
ELECTRICAL CIRCUIT	• Check the electric power supply on all phases • Make sure that the electrical connections are sufficiently tightened • Make sure that the supply electric cable does not show alterations which might compromise its insulation; • Check the correct torque of the screws fixing the conducers to the electric components present in the control board, so as to guarantee a correct electrical connection; same for the earthing connections.
CONTROL	• Check that the control equipment, LEDs and display are functioning

Improper use

The equipment is designed and constructed to guarantee the maximum security in the immediate proximity as well as to resist atmospheric agents. The fans are protected from undesired intrusion of bodies by protection grilles.
The accidental opening of the electrical panel with working machine is prevented by the door lock sectioning device .
Avoid laying tools or heavy objects on the side heat exchanger coils to avoid ruining the fin pack.

DO NOT introduce objects or allow them to fall through the grilles of the fan motors.

DO NOT rest on the heat exchanger coils: sharp surfaces.

IMPORTANT SAFETY INFORMATION
The machine must not exceed the pressure and temperature limits indicated in the table shown in the "Operating limits" section.
Correct functioning is not guaranteed after a fire; before starting up the machine again, contact an authorised after sales centre.

The machine is provided with safety valves that in the case of excessive pressure may discharge hot gases into the atmosphere.

Wind, earthquakes and other natural phenomena of exceptional intensity are not taken into consideration.
If the unit is used in aggressive atmosphere or with aggressive water please consult the head office.

After extraordinary maintenance carried out on refrigeration circuits, with the replacement of components, carry out the following operations before starting the machine again:
1. pay the greatest attention when replacing refrigerant charge indicated on the machine nameplate;
2. open all the taps on the refrigerating circuit;
3. correctly connect the electrical power and the grounding;
4. check the hydraulic connections;
5. check that the condenser coils are not dirty or clogged;
6. Check the proper rotation of the fans.

Unit disposal

The MFS series machines have been designed to guarantee continual use. The duration of some main components, such as the fan and compressor, depend on the maintenance they have undergone.
If the unit is to be disposed of, the operation must be carried out by specialised refrigeration personnel. The MFS series units must be disposed of in accordance with the present laws at the end of their useful working life.

If the unit is to be disposed of, the operation must be carried out by specialised refrigeration personnel.

The main materials that make up the MFS series units are:

- galvanised sheet steel (panels, fans);
- copper (pipes, coils, winding of the electric motors);
- the refrigerating gas is recovered by specialised personnel and sent to a collection centre in accordance with the laws in your country;
- the compressors' lubrication oil is also recovered by specialised personnel and sent to a collection centre in accordance with the laws in your country.

Diagnosis and troubleshooting

PROBLEM	CAUSE	SYMPTOM	REMEDY
1. AIR OUTLET TEMPERATURRE UNDER THE SET VALUE	1. Excessive thermal load	- Air outlet temperature is higher the foreseen value	- Reduce thermal load, reducing either the air flow rate, or air inlet temperature
	2. Excessive ambient temperature	See 2.1.	- Avoid air ricirculation on the condenser coil. Improve the flow of fresh air.
	3. Condenser coil fins blocked	See 1.1.	- Clean condenser fins
	4. Condenser coil front surface blocked	See 1.1.	- Free the front surface of the condenser coil that is blocked
	5. The fan rotates in the wrong direction	See 1.1.	- Invert the position of two of the three phases of the fan
	6. Lack of refrigerant in the refrigerating circuit	- Low evaporating pressure - Bubbles in the liquid sight glass	- Check for refrigerant leaks and liminate them (carried out by a technician) - Fill the circuit again (carried out by a technician)
2. INSUFFICIENT COOLING CAPACITY	1. Lack of refrigerant in the refrigerating circuit	- The refrigerating circuit works correctly, but with insufficient capacity	See 1.6.
	2. Excessive ambient temperature	See 2.1.	- Avoid air ricirculation on the condenser coil. Improve the flow of fresh air.
3. ABNORMAL NOISE	1. Vibrations throughout the piping	- The roof top noise is higher than normal	- Suitably brace the piping
	2. Noisy compressor	See 3.1.	- Check and replace if necessary
	3. Noisy thermostatic valve	See 3.1.	- Check. Add refrigerant if necessary. Replace if necessary.
4. ACTIVATION OF THE LOW PRESSURE SWITCH	1. Pressure switch out of service	- The compressor stops	- Check and replace the pressure switch
	2. Roof top completely empty of refrigerant	See 4.1.	See 1.6.
	3. Refrigerant filter blocked	See 4.1.	- Check and replace the filter
	4. Thermostatic valve doesn't work correctly	See 4.1.	- Check, clean and if necessary replace it
	5. Ambient temperature too low	See 4.1.	- Install thelow temperature device DPCR

continue...

PROBLEM	CAUSE	SYMPTOM	REMEDY
5. ACTIVATION OF THE HIGH PRESSURE SWITCH	1. One or moere fans did not start	- The compressor stops - Activation of the general alarm relay	- Repair or replace the fan/s
	2. Pressure switch out of service	See 5.1.	- Check and replace the pressure switch
	3. Excessive refrigerant charge	See 5.1.	- Discharge the excess gas
	4. Presence of non condensable gas in the refrigerating circuit	See 5.1.	- Fill the circuit again, after having emptied the system and created the vacuum
	5. Insufficient air flow to the condenser coil	See 5.1.	- See 1.2, 1.4, 1.5
	6. Refrigerant filter blocked	See 5.1.	- Check and replace filter
	7. Excessive ambient temperature	See 5.1.	- Avoid air ricirculation on the condenser coil. Improve the flow of fresh air.
	8. Hot air ricirculation due to wrong installation	- Condenser coil air outlet temperature over maximum values	- Elimitate causes of recirculation, repsecting the maximum distances from a wall as indicated in the dimensional drawings or prevent the condenser coils from coming into contact with hot air
6. FAULT IN COMPRESSOR WORKING	1. Faulty compressor	- The compressor does not start	- Replace the compressor
	2. Lack of consent of a safety device	See 6.1.	- See point 5 and 6
	3. Faulty connection or open contacts	See 6.1.	- Check the voltage and close the contacts
	4. Power circuit open	See 6.1.	- Check the cause of safety devices intervention, close the automatic of the compressor
	5. Compressor's solenoid starter de-energized	See 6.1.	- Check the voltage at the safety devices terminals. Close the automatic of the compressor
	6. Faulty compressor's solenoid starter	- The compressor starts and stops	- Check and replace if necessary
6. FAULT IN THERMOSTATIC VALVE WORKING	1. Thermostatic expansion valve too closed: excessive gas superheating at evaporator outlet	- Compressor too hot	- Open the thermostatic valve to reduce superheating
	2. Thermostatic expansion valve too open: the system works with a too low superheating. Return of liquid to the compressor	- Compressor too cold and noisy	- Close the thermostatic valve to increase superheating
	3. Faulty thermostatic valve: empty bulb or stem blocked	- Low evaporation pressure	- Replace the thermostatic valve
6. FAULT IN DRIER WORKING	1. Drier chocked	- Compressot inlet piping frosted - Bubbles in the flow indicator - Liquid piping colder at the druer outlet	- Clean or replace the filter

Notes

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The technical data in the following documentation are not binding.
FAST reserves the right to make all the modifications considered necessary for improving the product at any time.

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