



Exploration & Production

GENERAL SPECIFICATION

HVAC

GS EP HVA 202

Air Handling Unit(s) (AHU)

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1. Scope

The purpose of this document is to define the minimum requirements for design and construction of air handling units (*AHU*). This specification is not applicable for spaces requiring asepsis.

The words and expressions in CAPITAL characters and *italic* are defined inside the general specification **GS EP HVA 801**.

When other words require a definition only to be used in the present document, then the definition is given in a dedicated paragraph of the present document and the defined word, when used, is marked in small and *italic* letters.

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of the CONTRACT.

Order of precedence of documents is defined in **GS EP HVA 100**.

Notes:

- In case of discrepancy between documents (whatever the documents and / or whatever origins), the most expensive solution must be quoted by the *BIDDER*. During the studies (Basic Engineering and/or Detailed Engineering) *CONTRACTOR*(s) shall raise the discrepancy noted to the COMPANY's *HVAC* specialist. This last shall review and shall cut short.
- The *HVAC VENDOR* or *CONTRACTOR* may propose proven improvements to the reference documents but must obtain written approval of the COMPANY prior to implementation.
- An International Standard is a good "engineering practice" which shall be recognised and taken into consideration by *VENDOR*, *SUPPLIER*, *MANUFACTURER* and/or *CONTRACTOR*. If required, the translation of the standards must be included into *HVAC* scope.
- The latest revision of Standards, codes, regulations and the published errata if any must be used and applied by *VENDOR*, *SUPPLIER*, *MANUFACTURER* and *CONTRACTOR*.

Standards

Reference	Title
ASTM B 209M	Standard specification for aluminium and aluminium-alloy sheet and plate (metric)
ASTM E 34	Test method for Chemical analysis of aluminium and aluminium base alloys
ASTM E 53	Standard test method for determination of copper in unalloyed copper by gravimetry
EN 779	Particulate air filters for general ventilation - Determination of filtration performance

Reference	Title
EN 1216	Heat exchangers - Forced circulation air-cooling and air-heating coils - Test procedures for establishing the performance
EN 1216-A1	Heat exchangers - Forced circulation air-cooling and air-heating coils - Test procedures for establishing the performance
EN 1751	Ventilation for buildings - Air terminal devices - Aerodynamic testing of dampers and valves
EN 10169 (Parts 1; 2; 3)	Continuously organic coated (coil coated) steel flat products - (Parts 1; 2; 3)
EN 13053	Ventilation for buildings - Air handling units - Rating and performance for units, components and sections
EN ISO 7235	Acoustics - Laboratory measurement procedures for ducted silencers and air-terminal units - Insertion loss, flow noise and total pressure loss
IEC 60034	Rotating electrical machines (All parts)
IEC 60079 (Parts 0; 14)	Explosive atmospheres - (Parts 0; 14)
IEC 61310-1	Safety of machinery - Indication, marking and actuation - Part 1: Requirements for visual, acoustic and tactile
ISO 1940-1	Mechanical vibration - Balance quality requirements for rotors in a constant (rigid) state - Part 1: specification and verification of balance tolerances
ISO 3741	Acoustics - Determination of sound power levels of noise sources using sound pressure - Precision methods for reverberation rooms
ISO 3744	Acoustics. Determination of sound power levels of noise sources using sound pressure. Engineering method in an essentially free field over a reflecting plane
ISO 3746	Acoustics - Determination of sound power levels of noise sources using sound pressure - Survey methods using an enveloping measurement surface over reflecting plane
ISO 4628-3	Paints and varnishes - Evaluation of degradation of coatings - Designation of quantity and size of defects, and of intensity of uniform changes in appearance - Part 3: assessment of degree of rusting
ISO 9614 (Parts 1; 2; 3)	Acoustics - Determination of sound power levels of noise sources using sound intensity - (Parts 1; 2; 3)
ISO 11546 (Parts 1; 2)	Acoustics - Determination of sound insulation performances of enclosures - (Parts 1; 2)
ISO 12499	Industrial fans. Mechanical safety of fans. Guarding
ISO 14001	Environmental management systems - Requirements with guidance for use
ISO 14694	Industrial fans. Specification for balance quality and vibration levels

Reference	Title
NF EN 308	Heat exchangers - Test procedures for establishing performance of air to air and flue gases heat recovery devices
NF EN 1886	Ventilation for buildings - Air handling units - Mechanical performance
NF EN 13463 (Parts 1; 3; 5)	Non-electrical equipment for potentially explosive atmospheres - (Parts 1; 3; 5)
NF EN 14986	Design of fans working in potentially explosive atmospheres
VDI 6022 Part 1	Hygienic requirements for ventilating and air-conditioning systems and air-handling units
VDI 6022 Part 2	Hygienic requirements for ventilation and air-conditioning systems - Measurements procedures and examinations in hygiene check-ups and hygiene inspections

Professional Documents

Reference	Title
ADC	Air Diffusion Institute (All documents)
AFI	American Filtering Institute (All documents)
AGA	American Gas Association (All documents)
AICVF Codes	Association des Ingénieurs de Chauffage - Ventilation Français (All codes)
AMCA	Air Moving and Conditioning Association (All documents)
ARI 410	Air Conditioning and Refrigeration Institute
ASHRAE 52-76	American Society of Heating, Refrigeration and Air Conditioning Engineers
EUROVENT	Certification (All documents concerning that subject)
EUROVENT	Sound attenuator (All documents concerning that subject)
SMACNA	Sheet Metal and Air Conditioning CONTRACTORS National Association (All documents concerning duct construction)



Regulations

Reference	Title
Directive 94/9/EC, referred to a ATEX 100a / 95	Directive of the European parliament and the council on the approximation of the laws of the member states concerning equipment and protective systems intended for use in potentially explosives atmospheres
Directive 97/23/EC dated 29 May 1997	Directive 97/23/EC of the European Parliament and of the Council of 29 May 1997 on the approximation of the laws of the Member States concerning pressure equipment
Directive 98/37/EC dated 27 June 1988	Directive 98/37/EC of the European Parliament and of the Council of 22 June 1998 on the approximation of the laws of the Member States relating to machinery
Directive 1999/92/EC, referred to a ATEX 118 / 137	Directive of the European parliament and the council on minimum requirements for improving the safety and health protection of workers potentially at risk from explosives atmospheres
Directive 2004/108/EC dated 15 December 2004	Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EECText with EEA relevance
Directive 2006/95 dated 12 December 2006	Directive 2006/95/EC of the European Parliament and of the Council of 12 December 2006 on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits

Codes

Statutory by law or recognised professional body approved by COMPANY.

Reference	Title
CODETI	Code Français de Construction des tuyauteries industrielles (All documents related to pipe construction)
ASME B16.5	Pipe flanges and Flanged fittings
ASME B16.20	Gaskets

Other documents

Reference	Title
Not applicable	



Total General Specifications

Reference	Title
GS EP COR 350	External protection of offshore and coastal structures and equipment by painting
GS EP HVA 000	List of HVAC General Specifications
GS EP HVA 100	Basis of design
GS EP HVA 801	Terminology, definitions, abbreviations
GS EP HVA 803	Symbols for P&ID and D&ID + Drawing

3. Construction

In the present specification, "stainless steel" must be understood as stainless steel AISI 316 or AISI 316L.

For the whole unit and components, screws and nuts will be made of stainless steel (nuts AISI 304 and screws AISI 316), equipped with nylon washers. An alternative can be the use of screws protected by Impreglon Delta-MKS.

It is required that the unit can be totally dismantled (panels and components).

3.1 Casing

Construction shall be in accordance with [NF EN 1886](#) standard. The minimum requirements of this standard are supplemented by the present specification.

The following design classes are selected for the design of the *AHU* casing:

- Casing strength: casing class: CEN 1A for airflow up to 25000 m³/hr & CEN 2A above 25000 m³/hr
- Casing air leakage classes of *AHU* (400 Pa negative test pressure): leakage class CEN B (filter class [EN 779](#): F9)
- Units operating under both negative and positive pressure: casing air leakage classes of *AHU* (700 Pa positive test pressure): leakage class: CEN B
- Classification of thermal transmittance U of the casing panel of the air handling unit: T2 Certification to be provided by a third party
- Classification of thermal bridging factor of the casing: (*MANUFACTURER* certification to be provided)
 1. TB3 for indoor installation
 2. TB2 for outdoor installation.

HVAC CONTRACTOR shall provide adequate ventilation around the *AHU* installation area. *HVAC CONTRACTOR* shall also provide additional internal insulation at *AHU* frames & corners after cooling coil section for outdoor installation.

The air handling unit casing shall be built with double face panels. Support parts and casing structure shall be integrated in panels' thickness.

Panels shall be made of sheet metal (minimum thickness: 08/10 mm and 15/10 mm for panels with duct connections (inlet and outlet). A mineral wool cushion shall be used to realise thermal and sound insulation (M0 fire classification in accordance with French regulation or equivalent in accordance with International Standards).

Sheet metal type shall be in accordance with the using conditions indicated in **GS EP HVA 100**:

"Installation type"	Air handling unit outside panel casing	Air handling unit inside panel casing	Complementary protection against corrosion
Indoor	Stainless steel 316L	Stainless steel 316L	-
Outdoor	Stainless steel 316L	Stainless steel 316L	According with GS EP COR 350

Complementary protections against corrosion shall be done after cutting and boring of steel sheet metal & on outer surface of *AHU* panel for outdoor installation.

Panels shall be fixed with AISI 316 stainless steel screws, with interposition for fixation on painted sheet metal of a nylon washer between screw top and panel. An alternative can be using of screws protected by Impreglon Delta-MKS.

The panel arrangement shall allow limitation of thermal bridges and shall be preferred to a frame arrangement (which must be in stainless steel). Joints between panels, which are not subject to a regular dismantling, shall be blocked up with silicone or polyurethane mastic or equivalent.

Therefore, the pressure rating of the casing, withstanding a negative pressure or an overpressure (based on maximum Head of the fan(s)) shall not induce any permanent deformation.

When negative pressure or overpressure duty of the casing shall be superior to value shown in chapter "sizing characteristics", maximum authorised leakage flow, shown in this chapter shall be corrected with the following formula:

$$f_m = f_e \times \left[\frac{\text{overpressure}^*}{700} \right]^{0,65}$$

*: overpressure or negative pressure

f_m : maximum actual leakage flow allowable for overpressure (or negative pressure) in l/s/m²

f_e : maximum leakage flow allowable for overpressure (or negative pressure) nominal (sizing characteristics) in l/s/m²

Some panels shall need to be dismantled to allow access to any component of the unit. The removal of these panels shall not alter the rigidity of the assembly. Each panel must be dismantled independently of other panels.

Air tightness between panels will be assured by resistant joints put on fixed parts, and by another joint put on mobile parts. Contact surfaces shall be free from any roughness.

AHU corner shall be made of stainless steel AISI 316L or composite material in single piece with no sharp edges. For larger units, height more than 2 m, *AHU* corner piece should be die cast aluminium painted (70 micron primer + 70 micron epoxy powder paint).

Casing will be delivered with longitudinal steel supports feet. This structure must be in stainless steel, and protected against corrosion in accordance with **GS EP COR 350** specification.

Insulation of the casing and accessories shall be realised with non-flammable material (M0), 50 mm thick, heat transfer coefficient shall be $0.5 < U \leq 1$ (class T2). The word "Accessories" defines all the components of the casing (i.e. angles profiles, doors, etc.).

The sections of the *AHU* shall be built together on a common base frame made of minimum 6 mm of AISI 316L and protected against corrosion in accordance with **GS EP COR 350** specification, The base frame shall be 20 cm height minimum in order to allow the drainage of condensates.

The fixed base frame shall ensure that the *AHU* can be lifted in one operation and placed into correct place. The above will insure that it will not be required to make alignment and building together on site. This will also ensure that the *AHU* can be tested in the factory, and leakages will be avoided.

Note: An alternative for casing construction may be submitted to COMPANY regarding a construction in several parts. This alternative must provide solutions for casings alignment including convenient alignment devices.

Whether the above alternative arrangement is accepted by COMPANY, the following measures must be taken by *AHU MANUFACTURER* (no deviation will be granted):

- Air tightness to be checked on assembly site, in accordance with **NF EN 1886**
- If accordance with ATEX is required, conformance of *AHU* assembly with ATEX dossier, has to be certified by Notifying Body
- *AHU* installation on assembly site has to be performed by personnel from *MANUFACTURER*.

Minimum Insulation density

	Panel	Frame
Outdoor installation	140 kg/m ³	140 kg/m ³
Indoor installation	28 kg/m ³ minimum	140 kg/m ³

In accordance with the unit size, maintenance areas inside the casing (e.g. fan, filters sections) shall be equipped with a stainless steel flooring withstanding a load between 240 and 400 kg.

The maximum surface temperature, on external part of casing must be less than 50°C and must be 5°C above the dew point of the outside conditions.

Factor of thermal bridge k_b shall be higher than the value shown in chapter "sizing characteristics", with:

$$k_b = \frac{t_{\min}}{t_{\text{air}}}$$

$$t_{\min} = t_i - t_{\max}$$

$$t_{\text{air}} = t_i - t_a \text{ (nearby } 20^\circ\text{C)}$$

t_i = average temperature of air inside the unit (°C)

t_a = average temperature of air outside (°C)

t_{max} = maximum temperature of external area (°C)

For air handling unit section located between fresh air intake up to downstream filters (filters located upstream a heating coil), the floor must be sloping and equipped with drain. The drain must be extended by pipe to the maintenance side of the air handling unit (in order to connect it to siphon - out air handling unit *MANUFACTURER's* scope -). Drain and piping shall be made of stainless steel AISI 316L. All components which require to be removed for replacement or maintenance (except filters), shall be installed on sliding drawers made of stainless steel AISI 316L.

The unit construction shall allow dismantling of any coil (by sliding) by both sides of the unit, whatever the position of coil junctions to hydraulic circuit.

Dismantling of coils must be possible from both sides of the air handling unit, by removal of panels located in line with coil. Position of flanges must allow the sliding of coils, for dismantling, without disconnection of the flanges from headers.

Access doors shall be easy to open and shut. They will be delivered with devices in accordance with [Machines Directive](#).

Access doors must be equipped with devices for the security of personnel:

- When the section of the air handling unit on which the door is located, is at negative pressure (relative to outside of casing), the door must be maintained in open position by a blocking system. The closure of the door shall need a manual operation to unlock the blocking system
- When the section of the air handling unit on which the door is located, is at positive pressure (relative to outside of casing), the door must be blocked in its opening way. This opening shall be limited to an angle of 25°, by the blocking system. The complete opening of the door shall need a manual operation to unlock the blocking system.

Handles must be installed on both sides of access doors. At, least, one external handle, for each door, must be lockable with socket single square or triangular wrench.

The sound absorption through the panels shall be according to [NF EN 1886](#) (acoustic insulation). The sound reduction through the panels required shall confirm to the values below:

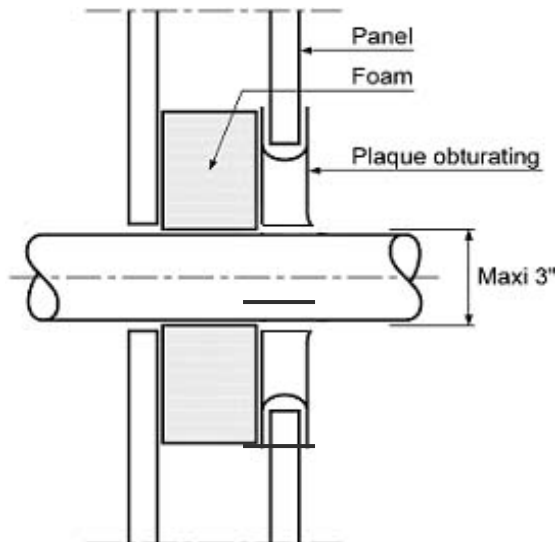
Noise reduction through casing shall be at least:

Frequency (Hz)	125	250	500	1000	2000	4000	8000
Insertion Loss (dB)	18	24	32	31	28	33	37

All AHUs shall be provided with AISI 316L connecting flanges at inlet and outlet for duct connections at site. The AHU panels on such inlet and outlet (with duct connections) shall be provided with additional stiffeners or thicker casing material than the rest of the AHU panel.

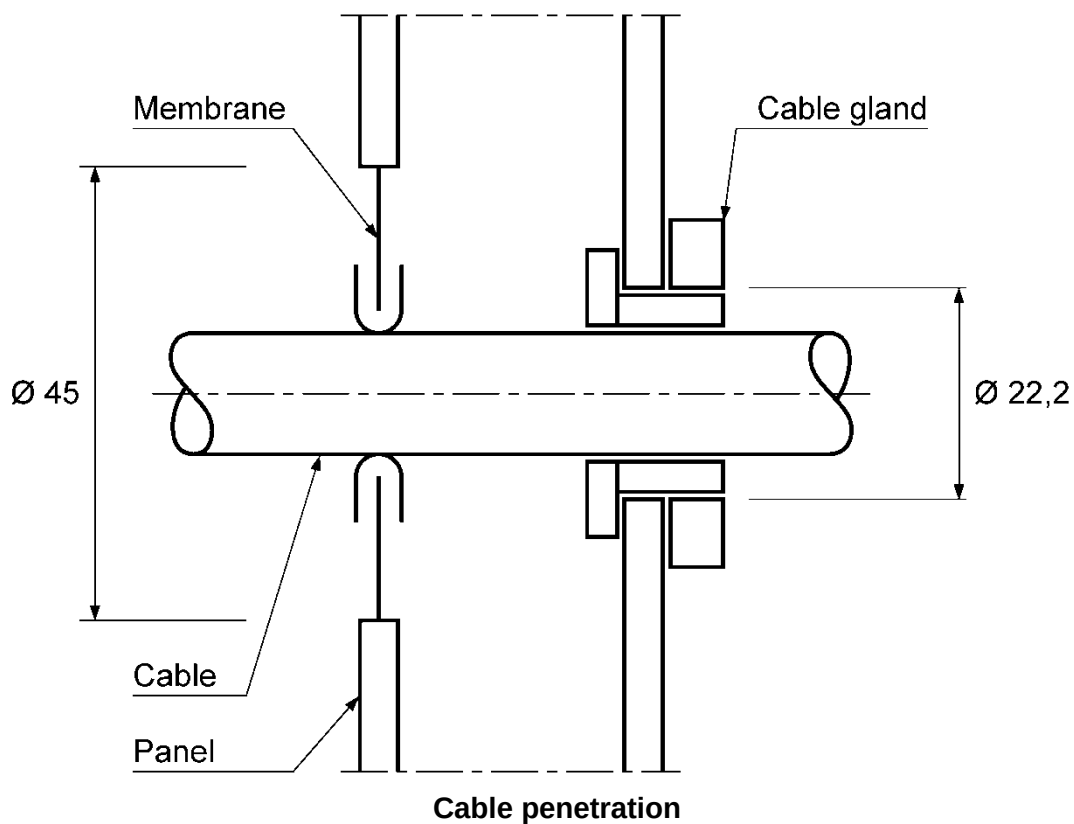
Panels crossed by pipes of heating and cooling coils shall be sealed in order to break thermal bridge (see the following sketch).

Pipe penetration for diameter up to 3"



Cables penetrations

All cable penetrations in the casing shall be carried out in accordance with the following principle:





One separated cable gland shall be supplied per purpose such as:

- Electrical motor power supply, heater, temperature sensor, starter, etc.
- Fire and gas detectors
- Safety switches (near fan motor, interlocking cable for the position switch which control the second door on fan access, etc.)
- Shut-off dampers (motor, heater, etc.)
- Anti-freeze thermostat
- Control devices, etc.

A cable tray shall be supplied in the casing to support the cable between the penetrations and the connecting points on the equipment. They must be made of stainless steel AISI 316L.

Additional penetrations shall be provided for commissioning and maintenance to allow insertion of control equipment. Their minimum diameter will be 22.2 mm and they will be supplied with screwed caps. They will be located at:

- Fresh air casing inlet
- Return air casing inlet
- Humidifier outlet
- Outlet of each coil.

Panels of air handling unit shall be protected by a plastic film, which will be removed during commissioning.

In order to design the face velocity through the components, the minimum actual free area of the components shall be considered instead of the casing section (reduction of air handling unit section is prohibited).

3.2 Marking and tagging of air handling units sections

Pictograms (or symbols) shall be indicated on concerned sections of air handling unit following the **GS EP HVA 803**.

Labels (characters 6 mm height) with equipment numbering as per HVAC equipment numbering rules must be placed:

- On equipment
- On access door or access panel to equipment.

The labels must be engraved on stainless steel nameplates which must be mechanically fixed on doors or panels.

On filters access door, an engraved plate (15 mm height white characters on red background) must be mechanically fixed. It shall be mentioned: "**Fire Risk - Flammables Dirty Filters**".

3.3 General consideration about Air Handling Units

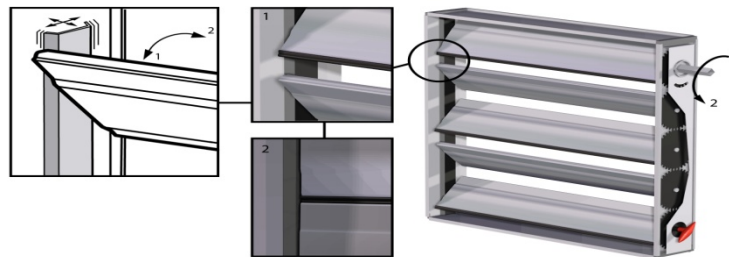
All elements of the unit shall be free of salient or trenchant parts (sheet metal cutting, sharp angles, etc.).

Components described hereafter must be installed, in accordance with *P&ID*, *D&ID* and calculation note results, approved by COMPANY.

3.4 Shut-off damper

Shut off dampers integrated into *AHU* may be in accordance with *MANUFACTURER* standards or be in line with the following requirements.

Each shut off damper shall be equipped with blades (in opposition) composed of double sheet metal (material in accordance with table of chapter "Casing - Air handling unit inside panel "). Blades should be equipped with ethylene-propylene joints. They should be operated by Stainless steel AISI 316L solid drive shafts, with square end. Bearings should be made of nylon and crankshaft of stainless steel, with opposite moving. An indicator of shut-off damper position shall be engraved on end of the damper operating shaft. An interface flanging plate shall allow installation of a motorization.



Opposed blade damper

According to the *AHU* configuration, one shut-off damper (provided by *MANUFACTURER*) must be supplied and installed on each air inlet and located within the casing. It shall be supplied and installed one shut-off damper (provided by *MANUFACTURER*) at *AHU* outlet when the fan is located within the casing.

Fresh air shut-off damper must be located outside of casing, except when fresh air temperature is less than -10°C (winter temperature defined in **GS EP HVA 100** specification). In this case, fresh air shut-off damper must be located inside of casing.

When fresh air temperature is less than -10°C, driving crankcase and bearings crankcase must be equipped with heaters in order to maintain a positive temperature, whatever the fresh air intake temperature is. Safety thermostats with automatic reset must be installed inside crankcases in order to avoid over-heating inside them.

In order to ease the air balancing of the *AHU* (Fresh air Vs Return air), two perforated grilles shall be installed on the fresh air stream (one fixed, one sliding). These two Stainless steel AISI 316L grilles shall be supplied with a fixation device to stop the sliding grille in the adequate position. The balancing dampers shall be located inside the air handling units.

Damper shall be provided with blade position indicator. Damper linkages located outside the casing shall be provided with protection plate to hide the linkage.

3.5 Air filters

Filtration shall be assured by one or several filters. The filters efficiency shall be equal or superior to the one defined in chapter "Sizing characteristics". Filters, when clean, shall be, at least, classified M2 (according to French regulation).

The frame receiving the filter(s) must be Stainless steel AISI 316L.

Easy access to filters shall be provided for maintenance and replacement. Dismantling of filters shall be done on dirty side (i.e. in upstream side of filters). Filters shall never be handled in downstream side relative to the vertical level of filter fixation.

The air tightness between filters and filter holders shall be improved by a joint fixed on the holder, combined with a device allowing a solid contact between the two elements. Filters freely installed into slides are prohibited.

Indicator of pressure loss, (one per filtration stage and one for the whole filtration section: therefore 3 off), shall be installed on the casing (all at the same location) in order to monitor the filter clogging.

The manometer shall be Magnehelic brand.



Piping for pressure measurement on each filtration stage must be "Instrument quality", stainless steel AISI 316L.

In addition, differential pressure transmitters must be installed:

- On each filtration stage
- For the whole filtration section.

Each transmitter shall be connected to the *HVAC PLC* in order to monitor the clogging of filters, air quality and save electrical energy.

When the individual maximum clogging delta-pressure is reached, an alarm is sent to the *HVAC PLC*. When the aggregate delta-pressure is reached, the fan shall be stopped and an *AHU* change over shall be carried out.

The following maximum clogging delta-pressure shall be used:

- Pre-filter: 250 Pa
- Bag pocket filter (hi-flow): 350 Pa or Opakfil rigid pocket filter: 450 Pa
- Aggregate delta-pressure: 600 or 700 Pa.

Variation of clogging-up of filters shall not lead to variation of flow above 4% of the nominal flow of the *AHU*.

Pressure loss of each filtration stage, shall be indicated on an engraved Dilophane label, located under each pressure loss indicator. Pressure tapings shall be integrated into the frame to allow a manometer to be fitted.

Filter materials shall be flame-retardant, incombustible, and non-odorous. Filter efficiency & class should be in accordance with European standard [EN 779](#).

The air by-pass around filters will be limited to the value indicated in chapter "sizing characteristics", according to level type of filtration installed.

The filters shall be composed of two stages:

- Prefilters: F7 as per EN 779 - 2003 opacimetric or Eurovent EU7 or ASHRAE $80 \leq E < 90$
- Bag filters: F9 as per EN 779 - 2003 opacimetric or Eurovent EU9 or ASHRAE $E \geq 95$.

For each filtration stage, *MANUFACTURER* must provide perforated grille(s) in stainless steel AISI 316L. Pressure loss of this grille must be identical to filter(s) pressure loss taken into account for design (see § "Sizing characteristics") with nominal air flow rate. The grille(s) shall be placed instead of filters during pre-commissioning and commissioning. Air tightness between grille(s) and filter(s) frame must be realised.

A chart "Pressure loss Versus Air flow rate" must be supplied by the *MANUFACTURER*, in order to read the air flow rate when the grille(s) is (are) installed.

Use of filter material which can produce illness shall not be used like asbestos, glass fibre class 2B etc. (a certificate shall be issued to certify above requirement). They shall in accordance SMO publication 24 October 2002.

3.6 Cooling coil

The materials of the cooling coil shall be selected taking into account the environment and the operating situation, defined in document [GS EP HVA 100](#):

Tubes	Fins	Coil frame	Protection against corrosion
Copper	Copper	Stainless steel 316L	Heresite Sakaphen

The internal diameter of pipes crossing in the coil frame shall be 0.5 mm larger than the coil pipes diameter. Coil tube thickness should not be less than 0.4 mm, return bend 0.5 mm and fin thickness should not be less than 0.12 mm.

All joints shall be silver brazed. Headers of cooling coil shall be outside the air stream enclosed in a double skin insulated box and shall provide maximum face area. Sealing around cooling coil should be provided to avoid hot air bypass (on the hot air side), refer figure.

Drain pans shall be in stainless steel AISI 316L minimum 1 mm thickness, insulated and should have at least 4 threaded drain outlet, one in each corner and cross connection.

For *AHU* installed onto floating units, the height and slope of the drain pan and the drain pipe shall accommodate the heel and trim of the support during operation of the *AHU*. The drain pan should be also designed to consider the rolling effect. The outlet pipe of the drain pan shall be screwed to allow coupling of a screwed sleeve, and then connected to waste waters circuit. For *AHU* installed onto floating units, it must be foreseen one outlet of drain receiver starboard and port side.

The condensate drain pipe connection through the unit casing shall be insulated from the factory with 12 mm thick closed cell elastomeric foam rubber insulation and sealed with plastic grommet. All connections shall be insulated with closed cell rubber and shall be sealed with a rubber gasket where they pass through the casing.

Cooling coils should be fitted with removable profiled droplet eliminator made of:

- Mineral reinforced polypropylene with 2.5% well dispersed carbon black (density 1500-2000 kg/m³). The material should not burn at less than 160°C, combustion gases of eliminator material should not be hazardous
- Stainless steel AISI 316L.

For AHU installed in hazardous area, the whole droplet eliminator must be made in stainless steel AISI 316L in accordance to [ATEX Directives](#).

Eliminator efficiency should be 100% at 4 m/sec air velocity.

Maximum air velocity across the coil shall be calculated taking into account the free section at the level of the coil rows (thickness of finned tubes and their protection will be considered).

Finned tubes will be crimped with tube expansion. The slotted tubes or with interior finned tubes are prohibited. Headers will be made in copper. They must be equipped with manual venting devices, located inside the casing. A leak test will be realised in a pool, (immersion during 2 hours) with air pressure of 21 bars. Working pressure of coils shall be 16 bars. A proof certificate will be issued at the end of the test.

For unit with height more than 1.2 m, the coil shall be horizontally split (one coil split in two parts). The double section coil shall have intermediate condensate collector tray to reduce condensates carry over. Drains shall be brought to the drain receiver incorporated in the floor of the unit.

After pressure test, a global protection of the coil shall be applied, with Heresite Sakaphen anti-corrosion painting system (application by hot bath in accordance with Sakaphen requirements).

Variation of air velocity across finned tube section, with regard to average air velocity on this section, shall be less than 20%.

Sizing of cooling coil shall take into account heat gains due to air compression during its way through the fan and heat gains due to the motor.

Connection of the coil to hydraulic circuit shall be realised with screwed devices or flanges (see chapter "Sizing characteristics"). In this last case, the nozzle connections on the coils headers shall be realised with a gap allowing the coil and flanges sliding on both sides.

An air vent and a drain shall be supplied for each manifold.

3.7 Heating coil

The materials of the heating coil shall be selected taking into account the environment and the operating situation, defined in document [GS EP HVA 100](#).

Electric Heating Coil

Electric heating coils elements shall be of low surface temperature type (not more than 90 Deg C). The heater will be finned body fitted with stainless steel (AISI 321) tubular heating element. The heating spiral (composition of 80% nickel, 20% chromium) should be protected in a stainless steel casing filled with magnesium oxide to give lower watt/sq cm and therefore longer life.

Minimum distance between tubes shall be 25 mm. The air heater should be fitted with two independent overheating thermostats, one with manual reset and one with automatic reset. The heater shall be asbestos free. The maximum air temperature downstream of air heater must not

exceed 40°C. The power supply to the heater must be interlocked with a flow meter to ensure that air heater will be switched off, should the airflow be lower than permissible value. Heater, up to 4 kW shall be controllable in steps. Heater more than 4 kW shall be controllable by Thyristor.

When a heating section is part of the *AHU* design (with electrical heater), a dedicated damper, closed in normal operation, located above the heating element shall open and then allow the dissipation of the heat in case of unexpected electrical shortage or lack of ventilation.

Water Heating Coil

The internal diameter of pipes crossing in the coil frame shall be 0.5 mm larger than the coil pipes diameter. Coil tube thickness should not be less than 0.4 mm, return bend 0.5 mm & fin thickness should not be less than 0.12 mm.

Maximum air velocity across the coil shall be calculated taking into account the free section at the level of the coil rows (thickness of finned tubes and their protection will be considered).

Finned tubes will be crimped with tube expansion. The slotted tubes or with interior finned tubes are prohibited. Headers will be made off steel or in copper. They must be equipped with manual venting devices, located inside the casing. A leak test will be realised in a pool, (immersion during 2 hours) with air pressure of 16 bars. A proof certificate will be issued at the end of the test.

Sizing of heating coil shall not take into account heat gains due to air compression during its way on the fan and heat gains due to the motor.

When temperature of fluid used for heating is above 90°C (or when an electrical heater is used), an anti-radiation screen must be installed upstream and downstream the heating coil. In addition, dilatation must be taken into account (operating phase and stand-by phase). In all cases, the maximum headers height shall be 1.2 m.

Particular arrangement when a heating section is associated with cooling coils:

- A drain receiver common to all coils is prohibited, a drain receiver shall be dedicated to each cooling coil
- The minimum distance between the heating element and the upstream droplet separator shall be 300 mm.

An air vent and a drain shall be supplied for each manifold.

For maximum fluid temperature of 95°C:

Coils shall be made of copper tube & copper fins. Coils shall be provided with copper headers. The coil shall be fitted with connections for vents and drain which shall be routed outside of the casing. Coil shall be suitable for maximum working pressure of 16 bars.

Tubes	Fins	Coil frame	Protection against corrosion
Copper	Copper	Stainless Steel 316L	Heresite Sakaphen

For fluid temperature between 95 and 200°C:

"Type"	Tubes	Fins	Coil frame	Protection against corrosion
Unit height less than 1.5 m	Copper	Copper	Stainless steel 316L	Heresite Sakaphen
Unit height more than 1.5 m	Carbon steel	Aluminium	Stainless steel 316L	Heresite Sakaphen

Coils shall be provided with copper headers. Unit with a height more than 1500 mm shall have painted steel header.

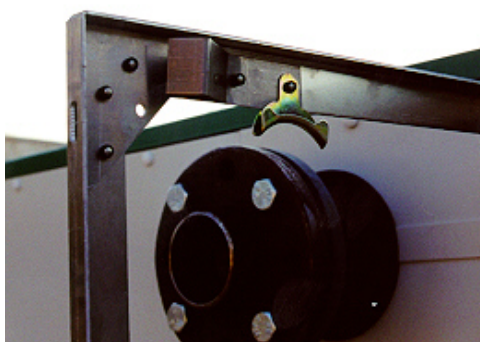
	Height lower than 1500 mm	Height more than 1500 mm
Max working pressure	10 bar	16 bar
Max temperature	185 Deg C	225 Deg C

3.8 Sensor frame section

Downstream the first hot water coil installed in the air handling unit, a sensor frame shall be installed on slides.

This frame shall receive the capillary of antifreeze thermostat equipped with manual reset. Thermostat shall be fixed on a plate part of the frame.

The bent support of the capillary shall be metallic and shall respect the minimum bending radius of the capillary.



For the external unit, the antifreeze thermostat shall be part of supplied equipment and shall be delivered with cable to allow connection to a junction box outside the air handling unit (for external unit, to put the junction box inside the air handling unit). The junction box with IP55 (IP56 when installed on open deck), shall have a cable gland which allows a connection of cable type U 1000 RO2V 3 x 2.5 mm². This cable gland shall be located on lower part of the junction box.

The junction box shall be located on a fixed panel of the air handling unit.



Wiring of antifreeze thermostat shall be "fail safe". Thirty centimetres upstream the antifreeze thermostat (on cable way), a complete plug (male and female, 2 Poles + Earth) shall be installed in order to allow removing of the whole sensor frame section or checking.

3.9 Fan

The fan design shall take into account a filters pressure loss due to a clogging-up of 50%. Fan shall be preferably in-house production of *AHU* manufacturer.

The fan operating point shall be selected on the steeper section of the fan curve approaching a straight vertical line from minimum to maximum static pressures, in order to minimise variation in delivered air volume, due to change in external wind pressure.

The fan shall be backward centrifugal type, simple or double air intake. Driving will be done by blocks and belts. The fan and motorization shall be installed on a same fixed structure (AISI 316L), isolated from the casing by steel or elastomeric flexible mounting (calculation of anti-vibration devices shall be provided).

Heavy duty impeller should be continuously welded to the back-plate and shroud. Every individual fan shall be run before delivery to check bearing condition and vibration.

When a support is installed between the fan motor and the anti-vibration devices (i.e. in order to heighten the fan), bracing must equip the support in order to resist to the torque produced by equipment.

Discharge of fan shall be linked to the casing with a non combustible flexible sleeve (M0 according French regulation or equivalent in accordance with International Standards).

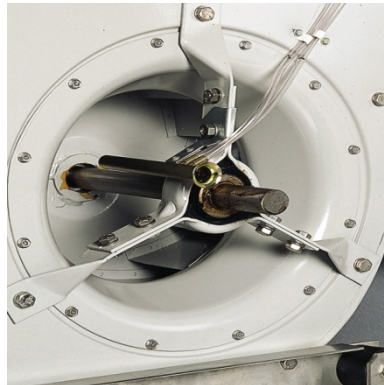
All fans being used in hazardous area shall be provided with approved flexible sleeves in conformance with **ATEX directive**.

The driving shaft of the fan shall be supported with ball-bearing life-lubricated or equipped with lubricators. All bearings should be rated for continuous operation of 40,000 hours at maximum fan speed, with 90% probability.

Driving of fan shall be realised with a minimum of two belts (when applicable). The drive belts shall be selected for appropriate duty (e.g. continuous or intermittent).

The motor shall be installed on a support type (installation of motor on a support fixed on the fan volute is prohibited). An adjustment by central screw shall permit to adjust belts tension without modifying the blocks alignment. A locking screw will stop the adjustment device once in position.

All *AHU* fans shall be provided with airflow meter with overall accuracy of $\pm 7\%$. Air flow meter shall be connected to the digital display mounted outside the casing. Air flow meter shall be compatible for connection to control system (4-20 mA or 0-10 V). All *AHU* fans for "ATEX" installation must be provided with an ATEX certified air flow meter.



Air flow measurement with Q-nozzle sensor

Bulkhead light wired to a switch outside casing, drainage of diffuser shall be provided in fan section.

Anti-spark protection (brass inlet cone) must be provided on fan when *AHU* is designed as per [ATEX Directive](#).

Fans shall be fitted with a proximity speed sensor head & impulse pad permanently attached to fan casing & blade respectively for remote monitoring of rotational speed. A junction box delivered separately shall be mounted on external face of *AHU* casing at site and wired. The sensor shall provide 1 pulse per revolution.

A temperature sensor shall monitor the temperature of the motor frame. Should the temperature rises above the set point given by the *MANUFACTURER*, the motor shall be stopped.

A thermocouple may be attached to the bearing blocks to monitor the temperature and give early warning of inadequate or excessive lubrication.

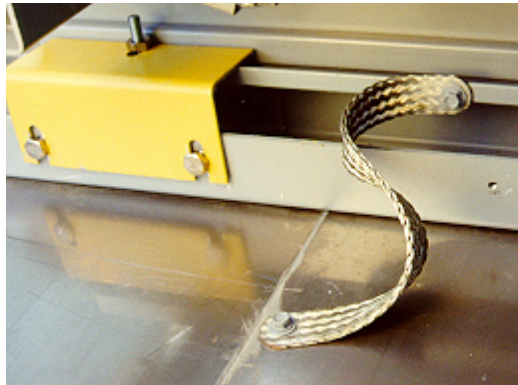
Vibration monitors may be fitted for fan units:

- When absorbed power on fan shaft is equal or higher than 132 kW (outside this range, *MANUFACTURER* must provide maintenance notice indicating the precautions regarding vibration monitoring)
- When fluid is with dust.

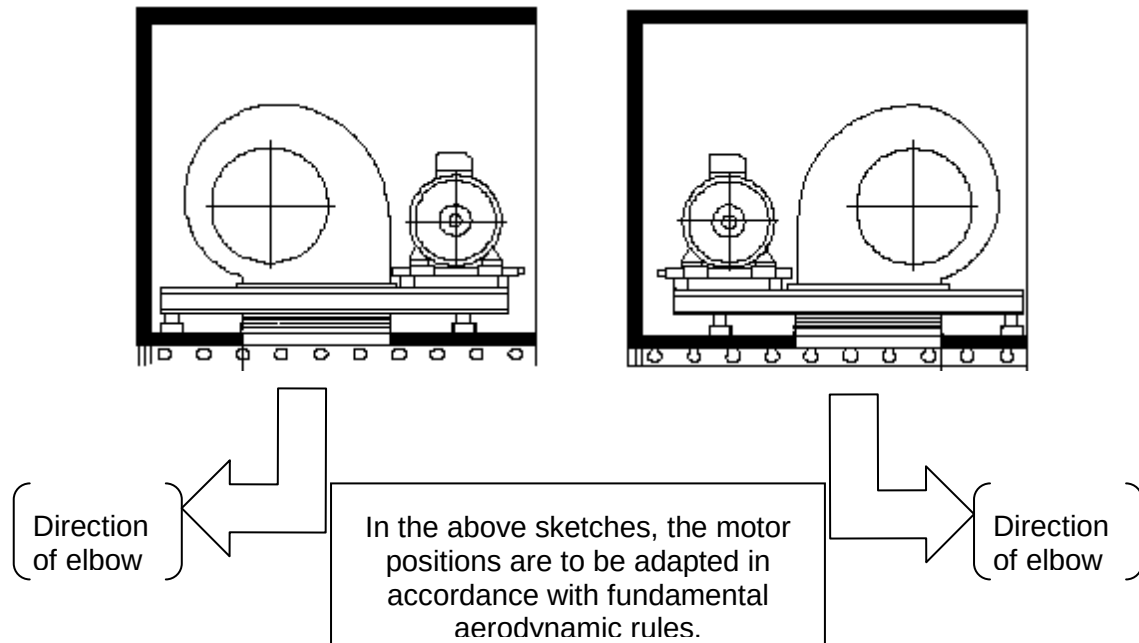
Vibration monitor must detect out-of-balance loads due to build-ups contaminants or damage to the impellers, with alarm and stopping levels.

The fan impeller shall be dynamically balanced. The balancing shall be in accordance with recognised standard such as [ISO 1940-1](#) and [ISO 14694](#). Fans with driver power equal or less than 37 kW (BV-3) shall meet balance quality Grade G 6.3, while fans drivers power higher than 37 kW (BV-4) shall meet balance quality Grade G 2.5. The maximum vibration limits for the assembled fan shall not exceed the peak and RMS values given in clause 8.3 of [ISO 14694](#).

Equipotential connection between frame fan and casing shall be realised with tinned copper braid, as shown on the picture.



The *MANUFACTURER* shall take into account the direction of the duct at discharge of the fan. The mounting arrangement of the fan shall depend on the elbow orientation downstream the outlet of the fan, as shown hereafter:



If the fan is located upstream one or several air handling equipment in the plant, the fan shall be positioned far enough to allow a balanced air flow distribution.

When the fan will be located upstream one or several equipment installed inside the air handling unit, it must be installed a grille of distribution in order to spread out the blown air flow rate on the section located downstream the fan.

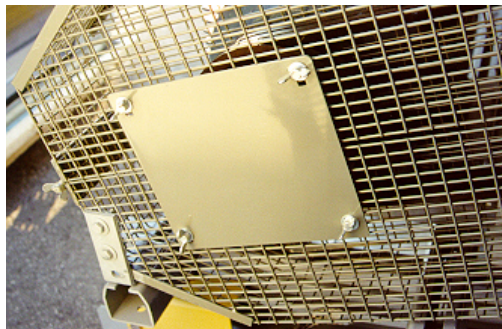
A calculation shall be supplied to validate that above grille of distribution shape.

In addition to the casing fan access door, all rotating parts of the fan and its driver shall be protected by a guard in accordance with [ISO 12499](#). This guard must be done with a metal frame with wire netting (maximum mesh 30 x 30 mm). This guard will be supplied with a door opening from inside to outside. The door shall be fixed and removed without any tools. A change-over limit switch must be installed inside the air handling unit to monitor the opening of the door. The position limit switch will trip the fan motor when the door is opened. An impulse push-button must be installed inside the air handling unit. It will be possible to run temporarily

and manually the fan by action on the push button located inside the casing. In addition, on the guard, an access shall be given allowing to measure rotation speed of the fan, without removing this guard.

The guard construction must be in accordance with the following table:

"Installation type"	Door outside panel casing	Guard inside panel casing	Complementary protection against corrosion
Indoor	Stainless steel	Stainless steel	-
Outdoor	Stainless steel	Stainless steel	According with GS EP COR 350



An emergency push button must be installed close to the fan motor. It will be equipped with an auxiliary contact (voltage free) to remote the switch status.

All push button and switch will be wired by the *CONTRACTOR*.

All fans being used in hazardous areas shall be provided with ant-sparkling rubbing plates and anti-static belts in conformance with **ATEX directives**. For this last application, the fan must be designed according to **EN 14986**.

Fan materials:

For maximum pressure of the fan less or equal to 3000 Pa, **and for both indoor and outdoor installation**, the following materials shall be used:

Fan Type	Fan Casing	Impeller	Frame and support	Belt guard protection
Action Fan (LP)	Hot galvanised steel + painting (*)	Hot galvanised steel + painting (*)	AISI 316L	AISI 316L
Reaction fan (MP/HP) with impeller diameter ≤ 450 mm	Hot galvanised steel + painting (*)	Polyamide loaded with fiber glass	AISI 316L	AISI 316L
Reaction fan (MP/HP) with impeller diameter > 450 mm	Hot galvanised steel + painting (*)	Carbon steel + painting (*)	AISI 316L	AISI 316L
Reaction fan (MP/HP) with impeller diameter > 1200 mm	Carbon steel + painting (*)	Carbon steel + painting (*)	AISI 316L	AISI 316L

(*) Fan casing must be of 250 micron epoxy painted steel and impeller of 100 micron epoxy painted steel. A five years warranty is required for the anti-corrosion painting (with a degree of rusting Ri2 according to [ISO 4628-3](#)).

(*) The fan shaft shall be made of Carbon Steel and protected against corrosion with a varnish.

All metal parts shall be protected against corrosion by same corrosion protection than the fan itself (included screw and nuts).

Beyond a maximum pressure of the fan of 3000 Pa the construction will be industrial and customised for the specific requirement and application.

Fan made of Stainless steel (prohibited in case of chloride (i.e. salt + water):

When using stainless steel fans (in case manufacturer can not match base material specification of fan above) the following specific cares, concerning design, must be implemented:

1. The design operating point of the fan shall be 30% less than the maximum head of the fan
2. In case of system effects from duct network, **MANUFACTURER** must check whether the duct supports are designed to avoid transmission of vibrations to the fan (stresses induced to the fan). In case of constraints on fan from duct network, due to system effects, **MANUFACTURER** must require action from **CONTRACTOR** to avoid/reduce this impact on fan and must include the final resulting constraints on fan selection,



3. Climatic environment study, regarding atmospheric pollutants and process will be carried out by the COMPANY
4. Use of a fan made of stainless steel will be clearly notified to COMPANY.

Fan upstream of coils:

Whenever fan is located upstream of coils, the fan shall be of "plug fan" type equipped with a frequency variator. The variator shall be classified IP54 minimum and located inside a ventilated box (the variator shall be separately provided by installer in control panel).

Fan motors:

Electrical motors shall comply with *COMPANY* electrical specification.

3.10 Humidifier

Evaporative humidifier

The drain tray of humidifier should be made of stainless steel AISI 316L.

Drain tray should be designed for effective flushing and quick drying of tray when the humidifier is not in operation.

The humidifier should be supplied with humidifier fills made of aluminium.

For cleaning purpose, all components should be side removable.

Maximum air temperature upstream of humidifier: 70°C.

Maximum air temperature downstream of the humidifier: 40°C.

The humidifier should be fitted with removable profiled droplet eliminator made of:

- Mineral reinforced polypropylene with 2.5% well dispersed carbon black (density 1500-2000 kg/m³). The material should not burn at less than 160°C, combustion gases of eliminator material should not be hazardous
- Stainless steel AISI 316L.

The humidifier should be equipped with self flushing function that empties the humidifier drain tray every 24 hour to minimise risk of bacterial & algae growth.

The water consumption should consist of the water evaporated and a certain amount of water bleed-off. This bleed off flow is necessary to reduce concentration of salts in the circulated water. If the concentration of salt is too high, salts may be deposited to the humidifier fill, which will have a detrimental effect on the performance and useful life of the humidifier. Hence, continuous bleed off & make up of fresh water is necessary.

90% humidity efficiency should be achieved with dew point control.

Running time per cycle should not be less than 10 minutes.

The pump for circulating water and housing must have IP54 classification.

The pH value of water should not be lower than 5 and should not be higher than 8.5.

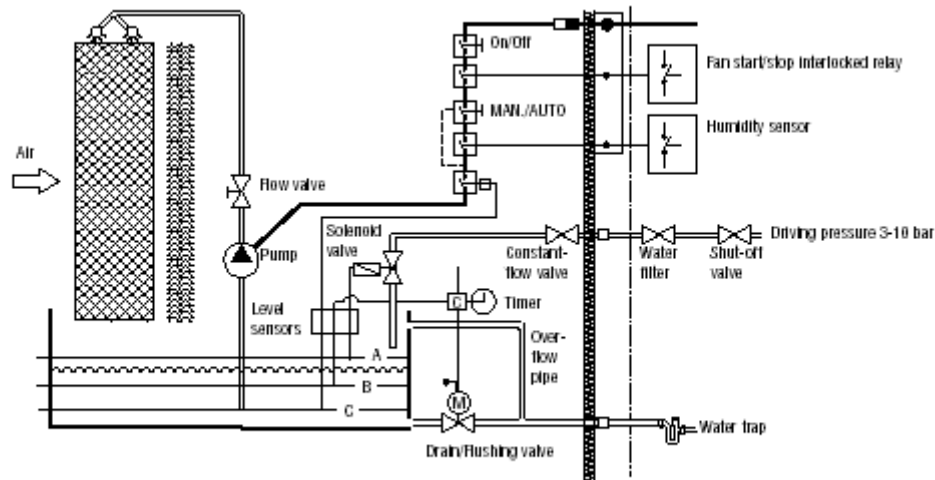


Fig. 1. Humidifier for circulated water

Steam humidifier

The steam humidifier shall consist of an empty section, equipped with sloping drain tray made of stainless steel AISI 316L and a U-profiled section secured at the top for suspending steam lances. An empty section with inspection door shall be installed downstream of the humidifier.

3.11 Equipment safety

Equipment shall be studied and designed taking into account constraints due to ambience in which the air handling unit will be installed.

Whatever the air flow rate, a smoke detector must be installed at *AHU* outlet, downstream the shut-off damper. The smoke detector has to be stand alone type.

In case of smoke detection:

- Signal from detector must be transmitted to *F&G* system
- Trip order (one per *AHU*) must be sent from *F&G* system to the *HVAC* control cabinet
- The fan motor and the electrical heating coil(s) must be tripped (action from *HVAC* control cabinet)
- Shut-off dampers on *AHU* must be closed (action from *HVAC* control cabinet)
- Exchangers must be by-passed (action from *HVAC* control cabinet)
- Major alarm must be indicated on *HVAC* control cabinet and must be transmitted to ICSS (free voltage contact).

3.12 Tropicalisation

Electrical equipment shall withstand their environment (their position in the installation, the psychrometric conditions surrounding the equipment).

3.13 Air Handling Unit roof protection

When installed outdoor, *AHU* shall be protected by a roof against environmental conditions (rain, direct solar radiation, etc.).

The roof shall be provided separately by *MANUFACTURER* made of the same material than external panel of the casing.

The roof shall be larger than the *AHU* outside dimensions of 20 cm.

In order to minimize impact from solar and flare radiations, radiation shield must be supplied and installed by *CONTRACTOR* above *AHU* roof protection.

3.14 Low temperature application

For low ambient temperature application (between -15°C and -50°C), fluid in heating coil shall be oil. The test pressure for coil should be 22 bars; a certificate of test shall be supplied.

Surface temperature of heating section panel should not be more than 60°C . Additional insulation shall be required.

AHU should be installed in an air conditioned area.

Fan bearing and grease used should be able to withstand and be compliant with the minimum design temperature of the site (for cold start).

When necessary, an electrical heater should be installed inside fan section for cold start for oil viscosity compliance.

A special electric heater should be used before fresh air damper for frost control.

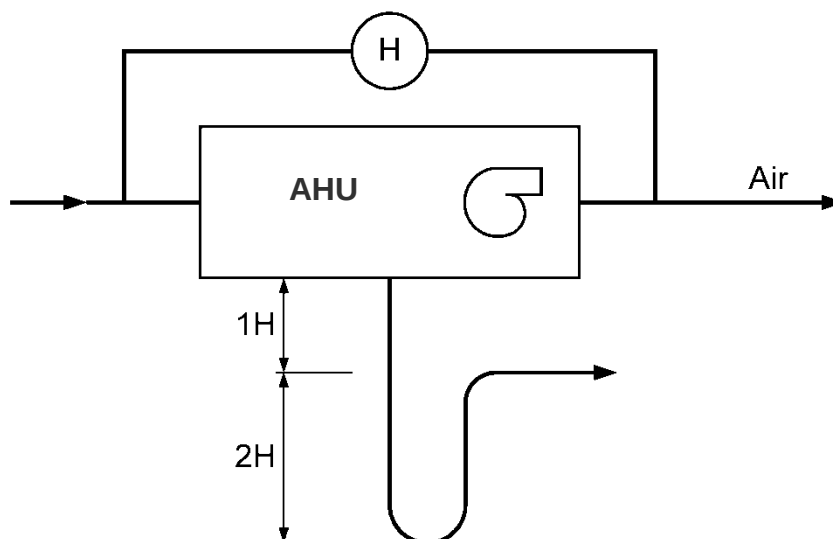
Casing and components must be designed in accordance with a temperature of -50°C .

All components, including fan, must be in Stainless Steel AISI 316L.

Filter should be installed after fan section.

3.15 U-trap for draining

U-trap for draining shall be in accordance with the following principle:



Concerning the above principle, any deviation shall be granted by COMPANY. The base frame height shall be defined in accordance with the above principle. The “H” value shall be calculated and then checked on site.

3.16 Specific requirement for floating installation

For floating support such as *FPU* or *FPSO*, particular attention shall be paid for draining of water from humidifier or condensate water from cooling coils. As most of the time the floating support is operated with a permanent (or during a long period of time for maintenance) trim or heel, drain pan and associated piping shall be designed with a sufficient slope that will prevent water traps which can lead to *AHU* flooding or still water.

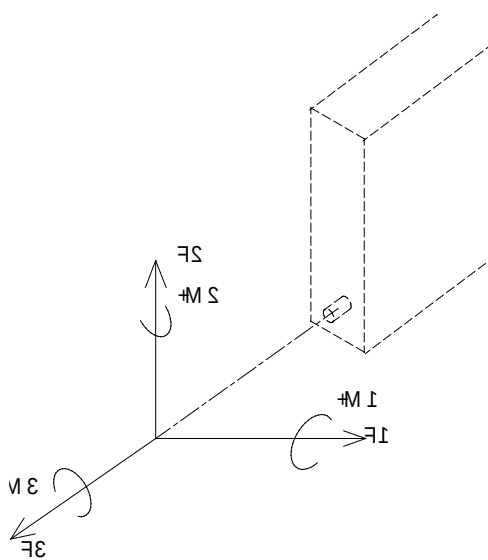
4. Sizing characteristics

4.1 Strength and acceptable moments on the piping (flanges or threaded tubes)

The *MANUFACTURER* of the equipment shall indicate the strength values and acceptable moments on the headers (flanges or screwed tubes) of the coils equipping its air handling unit.

Strength values and acceptable moments can apply at the same time in all directions and with both signs (positive and negative), on each pipe (inlet and outlet).

System of tag used:



If these values cannot be shown by the *MANUFACTURER*, it shall be considered the values defined by **CODETI**, for pumps with horizontal shaft.

4.2 General characteristics

Maximum flexion of the casing cover	Refer to “Casing” section
Positive pressure defining tightness test	Pressure generated by the fan discharge
Negative pressure defining tightness test	Pressure generated by the fan suction
Leakage flow acceptable under overpressure of 700 Pa	Refer to “Casing” section

Leakage flow acceptable under depression of 400 Pa	Refer to "Casing" section
Maximum part of derived flow around filters (according to NF EN 1886 classification) under 400 Pa test pressure:	
F7	2% of nominal flow to filter
F9	0.5% of nominal flow to filter
Maximum heat transmission factor of the air handling unit	Refer to "Casing" section
Heat bridge factor	Refer to "Casing" section
Zinc mass due to galvanisation (when this corrosion protection is accepted)	400 g zinc/m ²
Minimum zinc thickness (when this corrosion protection is accepted)	50 µm
Minimum painting thickness (when requested)	200 µm colour RAL 9002
Structure insulation (except floor)	Refer to "Casing" section
Minimum thickness insulation	50 mm once crushed
Minimum panels sheet metal thickness	Refer to "Casing" section
Maximum shut-off dampers leakage air flow rate (tightness required for overpressure relative to outside conditions)	20 m ³ /h/m ² under 100 Pa
Minimum pressure accepted by the shut-off dampers	2000 Pa for 1 m of shut-off damper length
Filters sizes	According European standards
Pre-filters efficiency	F7 according to EN 779
Pockets filters efficiency	F9 according to EN 779
Maximum front velocity on filters	2.5 m/s
Maximum pressure loss of dirty filters	200 Pa
Fins fouling factor	0.002 m ² .KW
Maximum by-pass factor on coils	5%
Maximum quantity of row per coil	8
Velocity in cooling coils tubes	1 to 1.75 m/s
Minimum fins spacing (including anti-corrosion protection)	2.1 mm for heating coils 2.5 mm for cooling coils

Maximum air velocity on fins: - For heating coil - For cooling coil - For electrical heaters	3 m/s 2.5 m/s 4 m/s
Droplet separator efficiency	100% at 4 m/s
Characteristics of ambient air in unit	
Dry temperature	According to calculation notes
Relative humidity	According to calculation notes
Overdesign	Refer to GS EP HVA 100
Water inlet temperature at heating coil	According to calculation notes
Water outlet temperature at heating coil	According to calculation notes
Water inlet temperature at cooling coil	According to calculation notes
Water outlet temperature at cooling coil	According to calculation notes
Glycol percentage in hot water	According to calculation notes
Glycol percentage in chilled water	According to calculation notes
Maximum water pressure loss in coils	3000 Pa
Connections on heating and cooling coils: - If DN ≤ 50 - If DN > 50	Threaded Flanges PN 16
Coils operating pressure	10 bars
Coils design pressure	16 bars
Fan vibration isolation	> 90%
Minimum fan efficiency	> 80%
Maximum bearings temperature	85°C
Minimum quantity of belts	2
Maximum fan rotation speed	2500 t/min
Supply voltage of electrical motor	400 V 3 phases
Frequency of supply voltage	50 Hz
General protection index	IP55 - IK07
Cable gland sizes: - Lighting equipment supply - Fire detection	12.5 mm 9.3 mm
Position of cable gland for cables	+ 200 mm above bottom of unit

Position of cable gland for measurement equipment	Half height of the casing
Position of manometric plugs	Half height of the casing and maximum 1700 mm from soil taking into account a frame of 200 mm under the lowest part of the unit
Painting colour (when requested)	RAL 9002
Pipe insulation thickness	50 mm (minimum)
Equipment tagging	On stainless steel plate mechanically fixed
Cable gland size	According to motor size
Classification area	Refer to GS EP HVA 100
Blown air temperature (at air handling unit discharge)	According to calculation notes
Maximum pressure loss of coils, on water side	According to calculation notes
Nominal air flow rate to blow, in blowing conditions	According to calculation notes
Available pressure at inlet of the unit	According to calculation notes
Available pressure at outlet of the unit	According to calculation notes (system effect on fan not included)
Sound power level at air handling unit inlet	< 77 dBA
Sound power level at air handling unit outlet	< 90 dBA
Ambient characteristics	Refer to GS EP HVA 100

5. Equipment tagging

The following equipment will have an engraved Stainless steel label, mechanically fixed:

- Air handling unit
- Filters
- Cooling coil
- Fan
- Fan motor
- Fresh air shut-off damper
- Return air shut-off damper
- Blown air shut-off damper
- Fresh air shut-off damper motor
- Return air shut-off damper motor



- Blown air shut-off damper motor
- Differential manometer on filter
- Fire & smoke detection.

The characters to be used for tagging are defined in Project specification.

6. Presentation of calculation results

Detailed calculation notes concerning sizing of the following equipment will be given by the *MANUFACTURER*:

- Cooling and Heating coils
- Number of row(s)
- Number of tubes(s)
- Finned area
- Water pressure loss
- Air velocity in fins
- Selection of fan
- Pressure loss on each air handling unit component
- Available pressure
- Fan discharge area
- Fan discharge area at fan volute
- Heat gain due to the fan
- System effects.

Calculation notes about above topics will be provided with full details, without any reserve. Algorithms and formulas will be provided.

Above information will only be provided to COMPANY and not be disclosed outside.

Calculation notes are considered as an integral part of the air handling unit supply.

"Proprietary information" cannot be claimed in order not to supply any of the requested documents.

7. Equipment certified in accordance with Atex Directives

When **ATEX Directives** are applicable to an *AHU*, requirements indicated in **GS EP HVA 100** must be taken into account by the *MANUFACTURER* and by *HVAC CONTRACTOR*. A certificate must be delivered, for each *AHU*, by *AHU MANUFACTURER* taking into account the operating conditions and environment of *AHU*.

The certificate must be issued for equipment leaving the factory. Whatever the reason of *AHU* dismantling, (transportation, handling, installation, reparation ...), the re-assembly of unit must be realized by the *AHU's* Manufacturer. It is *HVAC CONTRACTOR's* responsibility to purchase

the re-assembly of unit to the *AHU's MANUFACTURER*. It is *HVAC CONTRACTOR's* responsibility to indicate to *MANUFACTURER* that *AHU* must be dismantled.

Installation of a dismantled *AHU* must be supervised by the *AHU MANUFACTURER*. It is *MANUFACTURER's* responsibility to inform *COMPANY* when the above installation requirement is not respected.

8. Factory acceptance tests

Tests will be carried out by *MANUFACTURER* according to listed Standards.

- Test shall be carried out on a complete *AHU* selected by *COMPANY* at the R & D/test bench of *AHU* factory.
- The test will be conducted to verify presented data for airflow, fan pressure, radiated noise level and noise in duct & casing leakage rate/class. Airflow test will be done at room temperature & suitable extrapolation shall be made for design air temperature.
- Tests standards should be in accordance with [EN 13053](#) in pressure chamber.
- Leakage test should be carried out to demonstrate that the casing meets CEN B leakage class. The test should be carried out as per [NF EN 1886](#) standard at a pressure of +700 Pa and -400 Pa
- Tolerances: $\pm 5\%$ including instrument tolerance for airflow & pressure.
- Mandatory instrument: Betz manometer for pressure, [AMCA](#) nozzles & Betz manometer for airflow, frequency analyser & sound intensity meter for noise level, Tachometer for fan speed.
- Calibration certificates should be issued during and after the test so that they are relevant and up to date.
- Witness test results should be printed out at the time of each test and copies should be provided at that time for verification.

Tests shall be realised in the *MANUFACTURER* premises at their own expense. They shall be carried out at least eight days before shipping material on site.

COMPANY can carry out controls to verify the performance and design data listed in chapter "sizing characteristics" and accordance with the present technical specification.

9. Installation acceptance by MANUFACTURER

The *MANUFACTURER* must include in his scope:

- Survey of *AHU* installation (lifting on *CONTRACTOR* site during *AHU* installation phase, laying, assembly, fastening, ...) and issue of an installation acceptance (signed by *MANUFACTURER*)
- Visit on site in order to issue a "ready for precommissioning document". Visit must be held on site fortnight before precommissioning.

10. Documents to be supplied

Requirement disclosed in this paragraph shall not prevail over Project specific requirements.

Documents will consist in:

Due date	Document
With tender	Conformity certificates in accordance with NF EN 1886
At receipt of order	The MANUFACTURER must transmit to COMPANY a copy of the order signed on each page, and possible deviation inquiries which need to be submitted and approved by COMPANY prior signing the order. Note: If the MANUFACTURER do not return to COMPANY the documents listed here above, MANUFACTURER undertake to supply equipment in contractual operating conditions and conform to the contract specifications.
2	AHU drawings (including accesses for maintenance and operation)
2	Detailed calculation notes (thermal, hydraulic, aerodynamic, acoustic, centre of gravity, stress and moments on piping, vibration analysis, etc.)
2	Technical data sheets
3	Installation and support drawings
4	Certificates (Tightness, painting, fire tests, electrical for hazardous area, etc.)
6	Maintenance book
5	Factory Acceptance Tests report
1	Weight and centre of gravity

Due dates:

- 10 days after purchase of order
- 21 days before erection
- 8 days before erection
- 8 days after end of erection
- 3 days after *FAT*
- 8 days before *FAT*

A fortnight will be given to **COMPANY** to control and comment documents. These comments shall be taken into account by the **MANUFACTURER**. They are a contractual element.

All documents shall be provided in at least 4 paper copies and at least 1 electronic copy on CD ROM (Autocad (current release) for drawings and PDF for texts).

Notes:

The transmitted documents shall be specific to the supplied equipment. General documents are not acceptable.



Documents are an integral part of the supply. In case of delay in the issue of documents, the same liquidated damages than for late delivery of equipment may apply.

The transmitted documents between the *MANUFACTURER* or *CONTRACTOR* and the *COMPANY* or Engineering shall be typed. The hand written documents will be refused.

"Proprietary information" cannot be claimed in order not to supply any of the requested documents.

11. Information to be provided with proposal

- A drawing with equipment sizes, weights, centre of gravity of each component and the global centre of gravity.
- Characteristics of each component of the air handling units. The attached data sheets shall be used to describe the proposed air handling unit design and shall be copied as often as necessary if components of a same type are used several times (e.g.: when several heating coils are used).

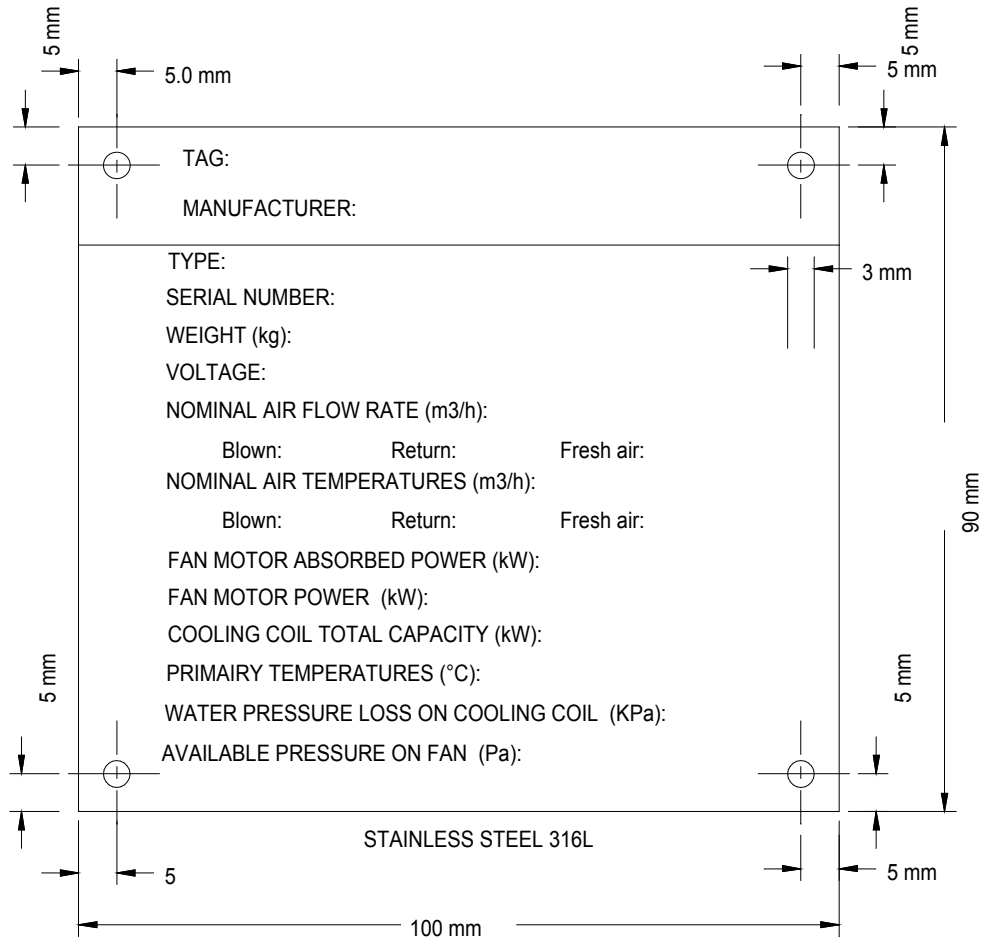
12. Other references

Following documents are applicable:

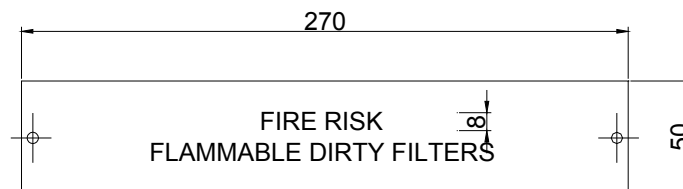
- Standards: [ASTM B 209M](#), [ASTM E 34](#), [ASTM E 53](#), [EN 1216](#), [EN 1216-A1](#), [EN 1751](#), [EN 10169 \(Parts 1; 2; 3\)](#), [EN ISO 7235](#), [IEC 60034](#), [IEC 60079 \(Parts 0; 14\)](#), [IEC 61310-1](#), [ISO 3741](#), [ISO 3744](#), [ISO 3746](#), [ISO 9614 \(Parts 1; 2; 3\)](#), [ISO 11546 \(Parts 1; 2\)](#), [ISO 14001](#), [NF EN 308](#), [NF EN 13463 \(Parts 1; 3; 5\)](#), [VDI 6022 Part 1](#), [VDI 6022 Part 2](#)
- Professional document: [ADC](#), [AFI](#), [AGA](#), [AICVF Codes](#), [AMCA](#), [ARI 410](#), [ASHRAE 52-76](#), [EUROVENT](#), [SMACNA](#)
- Regulations: [Directive 94/9/EC](#), referred to a [ATEX 100a / 95](#), [Directive 97/23/EC](#) dated 29 May 1997, [Directive 98/37/EC](#) dated 27 June 1988, [Directive 1999/92/EC](#), referred to a [ATEX 118 / 137](#), [Directive 2004/108/EC](#) dated 15 December 2004, [Directive 2006/95](#) dated 12 December 2006
- Codes: [ASME B16.5](#), [ASME B16.20](#)
- Total General Specifications: [GS EP HVA 100](#).

Appendix 1 Tagging plate

- Drawing of the tagging plate for each air handling unit, to be fixed on the casing:



- Tagging plate concerning clogging of filters:





Appendix 2 Air Handling Unit(s) – Data Sheet



Exploration & Production

GENERAL SPECIFICATION

HVAC

DS EP HVA 202

Air Handling Unit(s) - Data Sheet

00	10/08	First issue
Revision	Date	Notes



TOTAL

Exploration & Production

HVAC

Air Handling Unit(s) - Data Sheet

Data sheet presentation

This data sheet is composed of the following sheets:

- Air Handling Unit(s) - ("Main" sheet - Pages 1 & 2)
This sheet mentions the main data concerning the air handling unit(s).
Page 1 sums up the common data for the air handling unit(s).
Page 2 mentions the main components of air handling unit(s) and references of their data sheets.
- Entering box - ("Entering box" sheet - Page 3)
This page is only used when air handling unit suction is connected to a recirculation air ducting or to an outside air ducting.
- Mixing box ("Mixing box" sheet)
This page is only used when air handling unit suction is connected to a recirculation air ducting and to an outside air ducting. Page numbering has to be updated (see instructions below).
- Filtration stage ("Filtration stage" sheet) which indicates the characteristics of filters.
Depending on filtration stages on Project, this page can be copied to create the number of requested folios (pre-filtration, filtration,.... Page numbering has to be updated.
- Cooling coil ("Cooling coil" sheet) which indicates the characteristics of each cooling coil.
Depending on number of cooling coils, this page can be copied to create the number of requested folios. Page numbering has to be updated.
- Heating coil ("Heating coil" sheet) which indicates the characteristics of each heating coil.
Depending on number of heating coils, this page can be copied to create the number of requested folios. Page numbering has to be updated.
- Humidifier ("Humidifier" sheet) which indicates the performances of humidifier.
Page numbering has to be updated.
- Fan ("Fan" sheet) which indicates the performances of fan. For fan motor produce a motor data sheet.
Note: measurements indicated in this data sheet have to be issued from model (M) (refer to prEN1886 - 2006) but must be checked during FAT.

Instruction for use of sheets:

Only fields to be filled-in by the *CONTRACTOR* are accessible.

For major part of these fields, contextual help is accessible when roll-over with the mouse.

The contextual help includes a definition of field to avoid misunderstanding.

The "Cover" and "Data sheet presentation" have not to be attached to the data sheet submitted to *COMPANY* for approval.

A "Highlighting" button allows to identify the fields to modify or to fill in for each sheet.



Before printing a sheet, press "Without highlighting" button.

Data sheets approval:

The data sheets have to be fully filled in by *CONTRACTOR*.

The filled data sheet (including all sheets) has to be approved by the *COMPANY*'s Specialist before purchasing the equipment.

Within *HVAC* documents, expression in capital characters and *ITALIC* are defined within the "Terminology, definitions and abbreviations" General Specification.

Within *HVAC* documents, expression in small characters and *italic* are defined within the "Definition" paragraph of the associated specification.

[illegible]



Exploration & Production

General Specification

Date: 01/2012

GS EP HVA 202

Rev: 08

Appendix 2

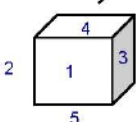
 TOTAL Exploration & Production		COMPANY PROJECT NAME DATA SHEET AIR HANDLING UNIT	0
			Page 2 /
1	Air handling unit components:		
2	Description:	Refer to data sheet:	
3	Shut-off damper on outdoor ducting connection		
4	Shut-off damper on recirculation ducting connection		
5	Shut-off damper on supply ducting connection		
6	Shut-off damper actuator on outdoor ducting connection		
7	Shut-off damper actuator on recirculation ducting connection		
8	Shut-off damper actuator on supply ducting connection		
9	Pump for water recirculation, on humidifier		
10	Fan motor		
11			
12			
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[illegible]

 TOTAL Exploration & Production	COMPANY PROJECT NAME AIR HANDLING UNIT - DATA SHEET MIXING BOX	
Doc. number:	Contractor document N°:	Page 3 /
Equipment location: Tag No: System No: Sub-system No: Supplier: Manufacturer:	Model: Serial No:	
Reason for issue	Rev.	Stat.
Date	By:	Checked by:
Approved by:		

Technical data

Air flow direction



Air inlet positions:

- 1: Front
- 2: Left side
- 3: Right side
- 4: Top
- 5: Bottom

Positions and air category of duct connections:

	Position	Air category
Inlet 1:		
Inlet 2:		

Mixing box is equipped with drain: Yes: ☐ No: ☐

Mixing box is equipped with shut-off dampers: Yes: ☐ No: ☐

Shut-off dampers are located:

Inlet 1: Inside: ☐ Outside: ☐

Inlet 2: Inside: ☐ Outside: ☐

Air inlet 1:

Maximum entering temperature: °C

Relative humidity associated to above temperature: %

Minimum entering temperature: °C

Relative humidity associated to above temperature: %

Mass flow rates:

at maximum entering temperature: kg/h

at minimum entering temperature: kg/h

Air inlet 2:

Maximum entering temperature: °C

Relative humidity associated to above temperature: %

Minimum entering temperature: °C

Relative humidity associated to above temperature: %

Mass flow rates:

at maximum entering temperature: kg/h

at minimum entering temperature: kg/h

Access door is equipped with blocking system in open position: Yes: ☐ No: ☐

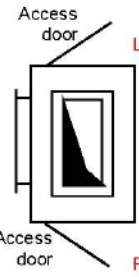
Gaskets are fixed on:

access door: ☐ frame of AHU: ☐

access door and frame of AHU: ☐

Gasket material:

Access for maintenance



Left side

Right side

Air flow direction

Mixing box top view

Note: air inlets can be located at other position as per indicated on left part of this data sheet.

Position of access door:

Right side: ☐

Left side: ☐

[illegible]

 TOTAL Exploration & Production	COMPANY PROJECT NAME AIR HANDLING UNIT - DATA SHEET COOLING COIL																																				
Doc. number: _____ Contractor document N°: _____ Page 5 /																																					
Equipment location: _____ Tag No: _____ Model: _____ System No: _____ Serial No: _____ Sub-system No: _____ Supplier: _____ Manufacturer: _____																																					
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">Reason for issue</td> <td style="width: 11%;">Rev.</td> <td style="width: 11%;">Stat.</td> <td style="width: 11%;">Date</td> <td style="width: 11%;">By:</td> <td style="width: 11%;">Checked by:</td> <td style="width: 11%;">Approved by:</td> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>			Reason for issue	Rev.	Stat.	Date	By:	Checked by:	Approved by:																												
Reason for issue	Rev.	Stat.	Date	By:	Checked by:	Approved by:																															
1 Technical data 2 Cooling medium: 3 Fresh water: ☐ with % glycol 4 Sea water: ☐ 5 Refrigerant: ☐ type: 6 7 Cooling medium temperature (°C): 8 9 10 11 12 13 14 15 16 Air temperature, mass flow, capacities: 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52	53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104																																				

 TOTAL Exploration & Production	COMPANY PROJECT NAME AIR HANDLING UNIT - DATA SHEET HEATING BOX																																											
Doc. number: _____ Contractor document N°: _____ Page 6 / 1																																												
Equipment location: _____ Tag No: _____ Model: _____ System No: _____ Serial No: _____ Sub-system No: _____ Supplier: _____ Manufacturer: _____																																												
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 40%;">Reason for issue</th> <th style="width: 5%;">Rev.</th> <th style="width: 5%;">Stat.</th> <th style="width: 10%;">Date</th> <th style="width: 10%;">By:</th> <th style="width: 10%;">Checked by:</th> <th style="width: 10%;">Approved by:</th> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>			Reason for issue	Rev.	Stat.	Date	By:	Checked by:	Approved by:																																			
Reason for issue	Rev.	Stat.	Date	By:	Checked by:	Approved by:																																						
1 Technical data 2 Heating medium: 3 Fresh water: ☐ with % glycol 4 Oil: ☐ 5 Refrigerant: ☐ type: 6 Steam: ☐ 7 Heating medium temperature (°C): <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th></th> <th>When minimum air inlet temperature</th> <th>When maximum air inlet temperature</th> </tr> <tr><td>8 At exchanger inlet:</td><td></td><td></td></tr> <tr><td>9 At exchanger outlet:</td><td></td><td></td></tr> <tr><td>10 Condensing temp.:</td><td></td><td></td></tr> <tr><td>11 Superheat:</td><td></td><td></td></tr> <tr><td>12 Steam:</td><td></td><td></td></tr> </table> 13 Air temperature, mass flow, capacities: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th></th> <th>When minimum air inlet temperature</th> <th>When maximum air inlet temperature</th> </tr> <tr><td>14 Air inlet temperature (°C)</td><td></td><td></td></tr> <tr><td>15 Air inlet rel. humidity (%)</td><td></td><td></td></tr> <tr><td>16 Air outlet temperat. (°C)</td><td></td><td></td></tr> <tr><td>17 Air outlet rel. humidity (%)</td><td></td><td></td></tr> <tr><td>18 Air mass flow (kg/h)</td><td></td><td></td></tr> <tr><td>19 Heating capacity (kW)</td><td></td><td></td></tr> <tr><td>20 Air velocity between tubes & fins (m/s)</td><td></td><td></td></tr> </table> 21 Number of rows: 22 Number of circuits: 23 Fins spacing: mm 24 Tubes outer diameter: mm 25 Tubes thickness: mm 26 Header outer diameter: mm 27 Header schedule: 28 Heating medium connections sizes: 29 DN inlet: DN outlet: 30 Flanges: Yes: ☐ No: ☐ 31 Number of connections: 32 Inlet: Outlet: 33 Access panel to headers can be removed without to dismantle flanges or nipples: Yes: ☐ No: ☐ 34 Venting pipes are located out of insulation: Yes: ☐ No: ☐ 35 Design pressure: bar 36 Operating pressure: bar 37 Accordance with pressure equipment directive: Yes: ☐ No: ☐ 53 Pressure loss on heating circuit: kPa 54 Pressure loss on air section: Pa 55 Heating medium flow rate: m³/h 56 Heating medium density: kg/m³ 57 Heating medium content: dm³ 58 Heating coil net weight: kg 60 Materials 61 Frame: 62 Tube: 63 Fins: 64 Headers: 66 Protection against corrosion 67 Protection applied to avoid corrosion: 68 On exchanger:				When minimum air inlet temperature	When maximum air inlet temperature	8 At exchanger inlet:			9 At exchanger outlet:			10 Condensing temp.:			11 Superheat:			12 Steam:				When minimum air inlet temperature	When maximum air inlet temperature	14 Air inlet temperature (°C)			15 Air inlet rel. humidity (%)			16 Air outlet temperat. (°C)			17 Air outlet rel. humidity (%)			18 Air mass flow (kg/h)			19 Heating capacity (kW)			20 Air velocity between tubes & fins (m/s)		
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19 Heating capacity (kW)																																												
20 Air velocity between tubes & fins (m/s)																																												

Page 7 /

 TOTAL Exploration & Production	COMPANY PROJECT NAME AIR HANDLING UNIT - DATA SHEET HUMIDIFIER						
Doc. number:		Contractor document N°:					Page 7 /
Equipment location: Tag No: System No: Sub-system No: Supplier: Manufacturer:		Model: Serial No:					
Reason for issue	Rev.	Stat.	Date	By:	Checked by:	Approved by:	

Technical data

Humidifier type:

Water spray:

Vapour:

Other:

▶

▶

type:

Performance:

	When minimum air inlet temperature	When maximum air inlet temperature
Air inlet temperature (°C)		
Air inlet rel. humidity (%)		
Air outlet temperat. (°C)		
Air outlet rel. humidity (%)		
Air mass flow (kg/h)		
Humidification (g/kg)		
Air velocity (m/s)		

When water is used:

Requested water pressure (supply):

Water flow rate (supply):

Drain flow for concentration limitation:

kPa m³/h l/h

When vapour is used:

Requested vapour pressure (supply):

Vapour mass flow (supply):

Drain flow:

kPa m³/h l/h

Piping connection sizes:

Water or vapour supply (DN):

Drain:

mm DN

Connections:

Water supply:

Drain:

DN DN

Design pressure:

Operating pressure:

Conformance to pressure equipment directive:

kPa kPa Yes ☒ No ☒

Materials

Casing:

Drain pan:

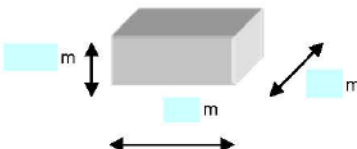
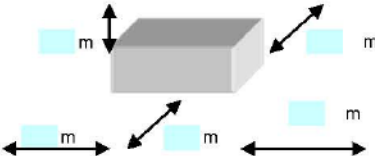
Piping:

Protection against corrosion

Protection applied to avoid corrosion:

Caising:

Drain pan:

 TOTAL Exploration & Production	COMPANY PROJECT NAME AIR HANDLING UNIT - DATA SHEET FAN																																											
Doc. number: _____		Contractor document N°: _____																																										
Equipment location: _____ Tag No: _____ System No: _____ Sub-system No: _____ Supplier: _____ Manufacturer: _____																																												
Model: _____		Serial No: _____																																										
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 35%;">Reason for issue</th> <th style="width: 10%;">Rev.</th> <th style="width: 10%;">Stat.</th> <th style="width: 10%;">Date</th> <th style="width: 10%;">By:</th> <th style="width: 10%;">Checked by:</th> <th style="width: 15%;">Approved by:</th> </tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>			Reason for issue	Rev.	Stat.	Date	By:	Checked by:	Approved by:																																			
Reason for issue	Rev.	Stat.	Date	By:	Checked by:	Approved by:																																						
1 Technical data 2 Air mass flow rate at fan discharge*: _____ kg/s 3 Air temperature at fan suction*: _____ °C 4 Air temperature at fan discharge*: _____ °C 5 Relative humidity at fan suction*: _____ % 6 Suction pressure*: _____ Pa 7 Total pressure of fan*: _____ Pa 8 Static pressure of fan*: _____ Pa 9 Absorbed power on fan shaft*: _____ kW 10 Fan rotation speed*: _____ rpm 11 Motor rotation speed*: _____ rpm 12 Maximum velocity of impeller: _____ rpm 13 Fan efficiency*: _____ % 14 Number of air inlet (1 or 2): _____ 15 Discharge fan surface: _____ m² 16 Discharge volute surface: _____ m² 17 Impeller type: forward ☐ backward ☐ 18 Number of belt(s) : _____ 19 Motor pulley size: _____ 20 Fan pulley size: _____ 21 Belt(s) type: _____ 22 Bearings: auto-lubricated ☐ lubricated ☐ 53 Materials 54 Impeller:: _____ 55 Envelope: _____ 56 Frame: _____ 57 Screws / bolts: _____ 58 Pulleys: _____ General sizes :  Space for maintenance: 																																												
Noise data*: Sound power levels SWL in dB (ref. 10⁻¹²W) Octave band centre frequency (Hz) <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th>#</th> <th>32</th> <th>63</th> <th>125</th> <th>250</th> <th>500</th> <th>1000</th> <th>2000</th> <th>4000</th> <th>8000</th> <th></th> </tr> <tr> <td>Maximum value :</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>dB(A)</td> </tr> </table>			#	32	63	125	250	500	1000	2000	4000	8000		Maximum value :										dB(A)																				
#	32	63	125	250	500	1000	2000	4000	8000																																			
Maximum value :										dB(A)																																		
83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98																																												