



Exploration & Production

GENERAL SPECIFICATION

HVAC

GS EP HVA 205

FAN UNIT(s)

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1. Scope

The purpose of this document is to define the minimum requirements for design and construction of *FAN(s)* and *FAN UNIT(s)* used for onshore and offshore *HVAC* installations.

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* characters.

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.

Equipment and installations shall be in accordance with (by order of precedence):

1. The country local regulations where equipment and/or installations shall be operated ;
2. Total General Specifications as listed in **GS EP HVA 000** ;
3. The International Standards ;
4. The French Regulation (when Country local regulation does not exist).

International System of Units (SI) shall be used.

Notes:

- In case of discrepancy between documents (whatever the documents and / or whatever origins), the most expensive solution must be quoted by *BIDDER*. During the studies (Basic Engineering and / or Detailed Engineering) *CONTRACTOR(s)* shall raise the discrepancy in question to COMPANY's *HVAC SPECIALIST* who will then review and advise which document(s) is (are) to be specified for the project.
- *HVAC VENDOR* or *CONTRACTOR* may propose proven improvements to the reference documents but must obtain written approval of 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*.

All pictures and figures within this specification are indicated for illustration and example purposes only.



Standards

Reference	Title
ISO 1940-1	Mechanical vibration – Balance quality requirements for rotors in a constant (rigid) state – Part 1: Specification and verification of balance tolerances
NF EN 1127-1	Explosion prevention and protection, basic concepts and Methodology – Part 1: Basic concepts and methodology.
NF EN 13053	Ventilation for buildings – Air handling units – Rating and performance for units, components and sections.
NF EN 13463 (Parts 1; 5)	Non-electrical equipment for potentially explosive atmospheres. Basic method and requirements – (Parts 1; 5)
NF EN 14986	Design of fans working in potentially explosive atmospheres
NF EN 60034-30	Rotating electrical machines – - Part 30: efficiency classes of single-speed, three-phase, cage-induction motors (IE-code)
NF EN ISO 12499	Industrial fans – Mechanical safety of fans – Guarding
NF EN ISO 13349	Fans – Vocabulary and definitions of categories
NF EN ISO 4628	Evaluation of degradation of coatings – Designation of quantity and size of defects, and of intensity of uniform changes in appearance
NF ISO 14694	Industrial Fans – Specifications for balance quality and vibration levels

Professional Documents

Reference	Title
ASHRAE	2008 ASHRAE Handbook
CEMEP	European committee of manufacturers of electrical machines and power electronics.
Fan Manufacturers Association	Position statement on fans intended for use in potentially explosive atmospheres – Conformity with the ATEX Directive 94/9/EC – 3rd edition – 04/07/2003.

**Regulations**

Reference	Title
Directive 2005/32/EC	Directive of the European Parliament and of the Council with regard to ecodesign requirements for electric motors
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 explosive atmospheres.

Codes

Reference	Title
Not applicable	

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 ELE 031	Design of earthing and bonding systems
GS EP ELE 111	Induction motors
GS EP HVA 000	List of HVAC specifications
GS EP HVA 010	Selection of stainless steel grade for HVAC Equipment
GS EP HVA 100	HVAC Basis of design
GS EP HVA 202	Air handling unit(s) (AHU)
GS EP HVA 223	Kitchen Hood(s)
GS EP HVA 301	HVAC plant room
GS EP HVA 400	Ducts and accessories for HVAC systems
GS EP HVA 410	HVAC Equipment equipment FACTORY COMPLIANCE TESTS
GS EP HVA 801	Terminology, definitions, abbreviations
GS EP HVA 830	Typicals HVAC P&ID – D&ID

3. Definitions and abbreviations

Definitions of the two following terms, *FAN(s)* and *FAN UNIT(s)* are indicated within **GS EP HVA 801**.

Definitions of verbs "shall", "should", "may", "can" and "must" are indicated within **GS EP HVA 801**.

Additional definitions for type and associated components of *FAN(s)* and *FAN UNIT(s)* are indicated within **NF EN ISO 13349**.

Note: The term "casing" written in *italic* character shall be understood as the *FAN casing* (volute), whereas casing (not in *italic* character) shall be understood as the *AHU casing*.

4. Remark concerning *AHU* casing

A *FAN UNIT* included within a casing shall be considered as an *AIR HANDLING UNIT*, as per definition in **GS EP HVA 801**, and hence, this *AIR HANDLING UNIT* shall be compliant with **GS EP HVA 202**.

All *FAN UNITs* shall be included within a casing, except the following cases which may be considered, after written agreement from COMPANY HVAC SPECIALIST:

- *FAN UNIT* equipped with a single inlet centrifugal *FAN* installed directly inside ducting
- *FAN UNIT* equipped with an axial *FAN*.

Note: Section 3.9 "Fan" of **GS EP HVA 202** shall be cancelled and is replaced by the present specification.

A *FAN UNIT* installed in a casing working as an *EXHAUST* system, shall be so called *EXHAUST* air *AHU* (refer to **GS EP HVA 801** and **GS EP HVA 830**).

A *FAN UNIT* installed without a casing working as an *EXHAUST* system, shall be so called *EXHAUST* air *FAN UNIT* (refer to **GS EP HVA 801** and **GS EP HVA 830**).

A *FAN UNIT* installed in a casing working as a *SUPPLY* system, shall be so called *SUPPLY* air *AHU* (refer to **GS EP HVA 801** and **GS EP HVA 830**).

A *FAN UNIT* installed without a casing working as a *SUPPLY* system, shall be so called *SUPPLY* air *FAN UNIT* (refer to **GS EP HVA 801** and **GS EP HVA 830**).

A *FAN UNIT* installed in a casing working as a *RECIRCULATION* system, shall be so called *RECIRCULATION* air *AHU* (refer to **GS EP HVA 801** and **GS EP HVA 830**).

A *FAN UNIT* installed without a casing working as a *RECIRCULATION* system, shall be so called *RECIRCULATION* air *FAN UNIT* (refer to **GS EP HVA 801** and **GS EP HVA 830**).

5. *FAN UNIT(s)*

Note: the term "*FAN UNIT*" within this section includes the three following types of *FAN UNIT*: *EXHAUST* air *FAN UNIT*, *SUPPLY* air *FAN UNIT* and *RECIRCULATION* air *FAN UNIT*.

All sub-sections of the section 6 "*FAN UNIT(s)* for *AHU(s)*" are applicable. However, the requirements dedicated to double air inlets *FAN(s)* are not applicable.

It shall be noted that only direct driven *FAN(s)* are acceptable for *FAN UNIT(s)* installed without casing.

6. FAN UNIT(s) for AHU(s)

Note: the term "AHU" within this section includes the three following types of AHUs: *EXHAUST* air AHU, *SUPPLY* air AHU and *RECIRCULATION* air AHU.

6.1 Selection

FAN shall be backward or forward centrifugal type, simple or double air inlet.

Selection of *FAN* type shall take into account the performance characteristics and the applications of *FAN*.

FAN shall be selected to operate on the steep part of their pressure/volume curve to enable a minimum volume variation due adverse wind conditions and/or variation in duct operating conditions.

FAN calculations, including operating margins, shall be clearly indicated within the *CONTRACTOR* calculations note.

FAN operating point shall be selected based on the following principle:

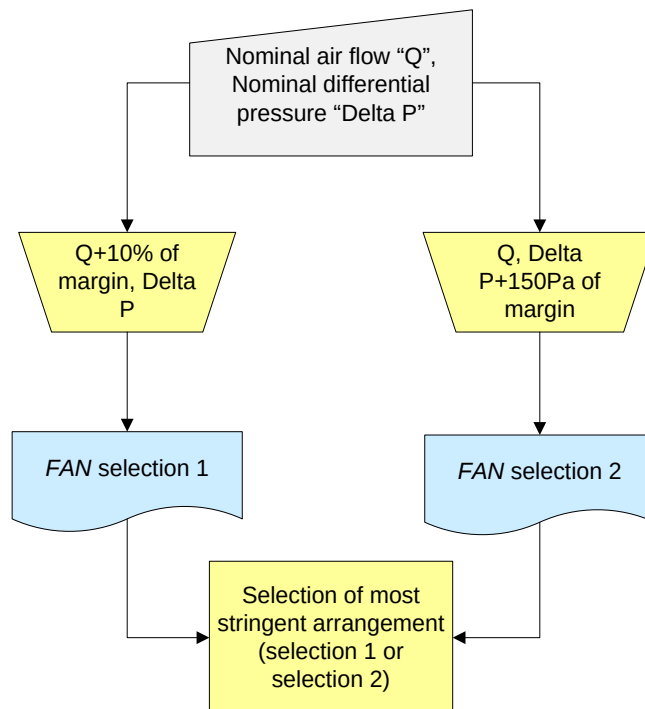


Figure 1 - FAN selection principle

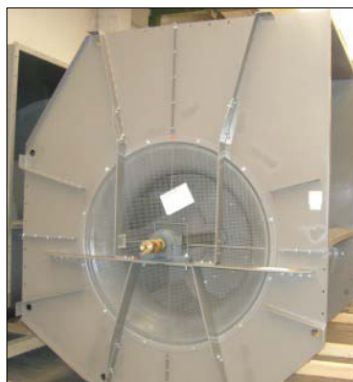
Note: 150 Pa is an arbitrary value which takes into account potential increase of pressure drop in aeraulic network on which *FAN UNIT* is connected, in case of modification of network during construction.

6.2 Construction

FAN UNIT for AHU shall be preferably in-house production of *AHU MANUFACTURER*.

In case the dimensions of the *FAN UNIT* do not permit to enter or remove one or several components of the *FAN UNIT* (particularly the *FAN*) inside or outside the building, where *FAN*

UNIT is installed, the design of the *FAN UNIT* shall enable its dismantling into parts (e.g. *FAN casing*, as per Pictures 1 and 2) for these purposes.



Pictures 1 and 2 - Principle of *FAN casing* which can be dismantled (*FAN casing* in several parts with flanges)

6.3 Material

FAN UNIT material shall be selected based on building type and in accordance with location where *FAN UNIT* is installed, as per criteria defined in **GS EP HVA 100**. These criteria (industrial environment, marine environment, etc.) are defined within project specification.

Table 1 – *FAN UNIT* material

	RU	IN	INT	MA	MAT
<i>Casing</i>	Carbon steel + painting	Galvanized steel + painting	Galvanized steel	Stainless steel	Stainless steel
<i>Impeller</i>	Carbon steel + painting	Galvanized steel + painting	Galvanized steel	Stainless steel	Stainless steel
<i>Base frame</i>	Carbon steel + painting	Galvanized steel + painting	Galvanized steel	Stainless steel	Stainless steel
<i>Motor Support / Slide rails</i>	Carbon steel + painting	Carbon steel + painting	Carbon steel	Carbon steel	Carbon steel
<i>Guarding</i>	Carbon steel + painting	Galvanized steel + painting	Galvanized steel	Stainless steel	Stainless steel
<i>FAN shaft</i>	Carbon steel	Galvanized steel	Galvanized steel	Stainless steel	Stainless steel
<i>Motor shaft</i>	Carbon steel	Carbon steel	Carbon steel	Carbon steel	Carbon steel
<i>Bolts and nuts</i>	Carbon steel	Galvanized steel	Galvanized steel	Stainless steel ¹	Stainless steel ²

The use of a *FAN* made of stainless steel shall be clearly notified to COMPANY. Selection of stainless steel shall be in accordance with **GS EP HVA 010**.

¹ Stainless steel grades for nuts and bolts shall be different.

² Stainless steel grades for nuts and bolts shall be different.

In case of system effects from duct network, *MANUFACTURER* shall 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* shall require action from *CONTRACTOR* to avoid/reduce this impact on *FAN* and *MANUFACTURER* shall include the final resulting constraints on *FAN* selection.

6.4 Painting

Painting system / protection against corrosion shall be in accordance with **GS EP COR 350**. *FAN MANUFACTURER* can apply alternative equivalent solutions for painting / protection against corrosion, which requires a written agreement of *COMPANY HVAC SPECIALIST*.

6.5 Drive arrangement

Drive arrangement of *FAN* shall be direct drive or belt drive and shall follow one of the arrangements indicated in **NF EN ISO 13349**, section 5.4. Type of arrangement (for example, arrangement n°7: Single-inlet *FAN* for coupling drive) shall be indicated on *FAN UNIT* datasheet. Arrangements n°14 and n°19 of table 4 indicated in **NF EN ISO 13349** are forbidden.

FAN UNIT with direct drive arrangement shall be equipped with variable frequency drive.

In case of a drive belt arrangement, a minimum of two belts shall be installed. Pulley with variable diameter technology is forbidden.

Access to the belts, for belt tension verifications, shall be possible by dismantling the upper part of the belt guarding.



Picture 3 – Principle of access to the belts by dismantling of the upper part of the belt guarding

For belt tension adjustment, the following solutions are acceptable:

- An omega shape sliding support plate for motor with a central screw, as Picture 3, can be proposed by *MANUFACTURER*. Central screw shall permit to adjust belts tension without modifying the pulley alignment. Screws shall block the adjustment device once in position.



Picture 4 - Principle of omega sliding shape

- An independent motor support with screws adjustment on the longitudinal direction (action on the feet of motor), as per Picture 4, can be proposed by *MANUFACTURER*.



Picture 5 - Principle of screws adjustment

FAN and motor shall be installed on a same structure, isolated from the *AHU* casing by steel or elastomeric flexible mountings. Calculation of anti-vibration devices shall be provided by *FAN UNIT MANUFACTURER*.

Installation of motor on a support fixed on the *FAN* volute is forbidden.

The driving shaft of the *FAN* shall be supported with ball-bearings life-lubricated or equipped with lubricators. All bearings should be rated for continuous operation of 40 000 hours at maximum *FAN* speed.

In case of belt driven *FAN*, *FAN UNIT* motor rotational speed shall be selected (2 or 4 poles) in order to optimize size of pulley.

6.6 Requirements regarding other *AHU* equipment

FAN UNIT selection shall take into account pressure loss due to *AHU* filters clogging of 50%. *FAN* selection shall take into account the progressive filter clogging to ensure air flow stability as per requirement from **GS EP HVA 202**.

In case variable frequency drive is installed on *FAN UNIT* motor to compensate filter(s) clogging, attention shall be paid to selection of *FAN* in order to avoid *FAN MANUFACTURER* forbidden zone on *FAN* air flow / pressure curve when *FAN* rotational speed will increase to compensate filter(s) clogging.

When electrical heater(s) is (are) installed in the *AHU* casing; heater(s) shall operate only if air flow control of *FAN* confirms that nominal air flow is delivered by the *FAN*. Devices for air flow control shall be included in the *FAN* design and supply.

When *FAN UNIT* is located upstream one or several equipment installed inside *AHU*, a grille of air distribution or any aeraulic mean shall be installed to spread out the delivered air flow on the section located downstream the *FAN*. A calculation note should be supplied to COMPANY to validate the shape of the grille of air distribution or any aeraulic mean.



Picture 6 - Principle of grille of air distribution

FAN UNIT installation shall take into account the direction of the ductwork at discharge of *FAN*. The arrangement of *FAN* shall depend on the elbow orientation downstream the outlet of *FAN*. *FAN UNIT* motor position shall be adapted in accordance with fundamental aeraulic rules.

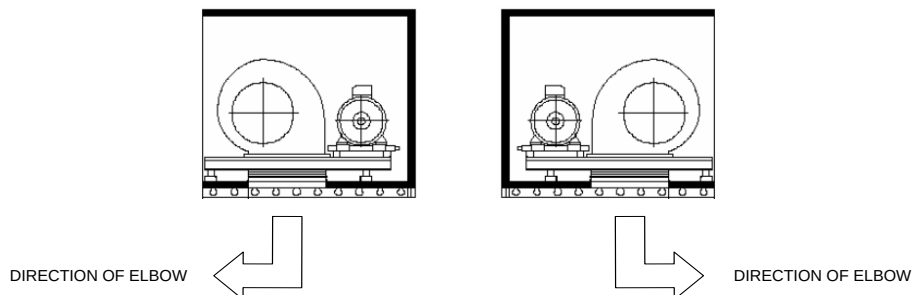


Figure 2 - Principle of rules for *FAN* installation

FAN UNIT MANUFACTURER shall indicate the run-down time of *FAN* due to its inertia after the tripping of the power supply. This time will be supplied to *CONTRACTOR* for the interlock of *FAN UNIT* with other equipment (*SHUT-OFF DAMPER*, heater, etc.).

6.7 Motor

FAN UNIT motor selection shall include a power margin, called f_p .

The power reserve of the motor corresponds to the following ratio:

The following minimum power margin values shall be provided, depending on the *FAN* type and P_w :

Table 2 – f_p values

<i>FAN</i> type	P_w	f_p
Backward curved impellers	$0 \text{ kW} \leq P_w < 0,84 \text{ kW}$	1,5
	$0,84 \text{ kW} \leq P_w < 1,76 \text{ kW}$	1,4
	$1,76 \text{ kW} \leq P_w < 4,58 \text{ kW}$	1,2
	$4,58 \text{ kW} \leq P_w < 9,57 \text{ kW}$	1,15
	$9,57 \text{ kW} \leq P_w < 40 \text{ kW}$	1,125
	$40 \text{ kW} \leq P_w < 227 \text{ kW}$	1,1
Forward curved impellers	$0 \text{ kW} \leq P_w < 1,69 \text{ kW}$	1,3
	$1,69 \text{ kW} \leq P_w < 4,4 \text{ kW}$	1,25
	$4,4 \text{ kW} \leq P_w < 9,17 \text{ kW}$	1,2
	$9,17 \text{ kW} \leq P_w < 227 \text{ kW}$	1,15

In case the *MANUFACTURER* considers that the above values are not sufficient, an additional factor (>1) shall be taken into account. The motor power rating shall be equal or superior to the following product:

For efficiency class, according to **CEMEP** – Standard, 2 and 4 poles motors from 0.75 to 345 kW are classified in three efficiency classes IE1, IE2 and IE3. According to **Directive 2005/32/EC**, motors which are included in the scope of **Directive 2005/32/EC**, shall have the maximum efficiency, as defined in Annex I of this directive.

HVAC CONTRACTOR shall indicate the calculation result of acceleration time (t_A), when *FAN* motor is started. In case t_A exceeds the motor *MANUFACTURER*'s recommendation, a larger rated motor or high-torque machine shall be selected. In case of t_A exceeds the trip time of the starting gear, a longer delay shall be used.

For *FAN* motor rated from 22 kW and above, temperature motor sensor shall monitor the temperature of the motor. In case of the motor temperature rises above the set point given by the *MANUFACTURER*, the motor shall be stopped.

Note: In case of several *FAN UNITS* are running simultaneously to achieve 100% of nominal airflow (e.g. 2 x 50%, 3 x 33%, etc.) in a *HVAC* system, each *FAN UNIT* shall be equipped with temperature motor sensor, whatever the motor rating.

In case a variable frequency drive is used, the sizing of the motor shall be made along with the variable frequency drive criteria and its whole operating range.

6.8 Air flow control and monitoring

Air flow control and monitoring shall be installed for *FAN UNIT* by means of:

- The measure of the differential pressure between upstream and downstream *FAN* and/or a pressure reducing orifice (e.g. filters of *AHU*) ;
- The measure of air flow in *FAN* casing.

The airflow control shall be started with a time delay after motor start-up.

Note: It is forbidden to control the *FAN* air flow with a control of *FAN UNIT* motor frequency variations.

6.8.1 Use of air flow control and monitoring

Air flow control and monitoring shall be used every time that the *HVAC* system including the *FAN* shall be connected to a room(s) for which the pressurization is essential (*ESSENTIAL* room(s)).

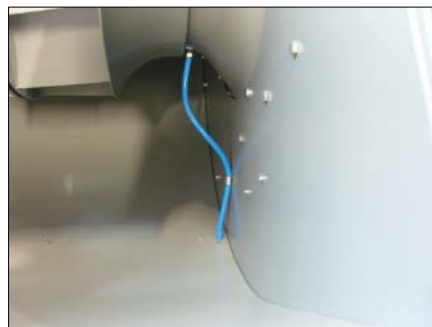
6.8.2 Technology

The principle of air flow measurement shall be based on the measure of the differential pressure between the ambient (or the suction section of an *AHU*) and orifice(s) located at *FAN* air inlet. A pressure tapping, at a predetermined position on the inlet cone of the fan, shall be provided whereby the differential pressure, in relation to the static pressure is measured in front of the inlet cone, in a static atmosphere.



Picture 7 – Pressure measurement orifice in *FAN* air inlet (external view)

The orifice (pressure tapping) shall be linked to the differential pressure sensor with plastic tubing (halogen free) passing inside the *FAN* casing, then through the *FAN* casing.



Picture 8 – Piping connection (in blue) to the pressure orifice located at *FAN* air inlet.

A connector shall be provided outside the *FAN* casing, in order to be linked to the connection to the differential pressure sensor.



Picture 9 – Fixation of plastic tubing (in blue) and connector, outside the *FAN* casing

The plastic tubing shall be fixed to the *FAN* casing with metallic clamps (stainless steel or galvanized steel, according to the *FAN* metallurgy).

FAN UNIT shall be provided with an air flow monitoring facility with a maximal 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). Air flow monitoring shall be provided at the *HVAC CC* (Control Cabinet).



Picture 10 - Principle of air flow digital mounted measurement and display and signal transmission

Note regarding the battery limit: In case of the *FAN* is not included within a casing (*EXHAUST*, *SUPPLY* or *RECIRCULATION* air *FAN UNIT*), the differential pressure sensor, the differential pressure transmitter, their support and the plastic piping shall be provided by the *FAN MANUFACTURER*.

6.9 Rotational speed monitoring

Note: Rotational speed *FAN* shaft control can be used for airflow control only if *HVAC* system including the *FAN* is not connected to a room(s) for which the pressurization is essential (*ESSENTIAL* room(s)).

FAN UNIT shall be fitted with a proximity sensor (head and impulse pad, permanently attached to *FAN casing* and blade respectively) for the remote monitoring of the rotational speed. A junction box shall be mounted and wired. The sensor shall provide one pulse per revolution.



Pictures 11 and 12 - Principle of direct drive *FAN* proximity sensor – Front and back views



Pictures 13 and 14 - Principle of pulley and belt drive *FAN* proximity sensor – Inside and outside views

6.10 Vibration monitoring

Vibration monitoring shall be provided for *FAN UNIT* when:

- Absorbed power on *FAN* shaft is equal or higher than 22 kW (outside this range, *MANUFACTURER* shall provide maintenance notice indicating the precautions regarding vibration monitoring).
- Handled air contains dust (except when air is F7 pre-filtered and F9 filtered as per **GS EP HVA 202**).

MANUFACTURER of *FAN UNIT* shall provide the vibration monitoring. Installation of sensor on the *FAN UNIT* is in charge of *FAN UNIT MANUFACTURER*. Installation of controller is in charge of *AHU MANUFACTURER*.

Vibration monitoring shall detect out-of-balance loads due to building up of contaminants or damage to the impellers, bearings, etc. with alarm levels and stopping.

6.11 Anti-vibration mountings

FAN and *FAN* motor shall be isolated from the structure of the *FAN UNIT* by anti-vibration mountings. A minimum of 95% isolation efficiency shall be achieved by the anti-vibration mountings.



Picture 15: Principle of anti-vibration mounting

When a support is installed between the *FAN UNIT* motor and the anti-vibration mountings (i.e. in order to heighten the *FAN*), bracing shall strengthen the support in order to resist to the torque produced by equipment.

FAN UNIT MANUFACTURER shall provide a blocking system for each vibration mounts for transportation.

6.12 Emergency push button

An emergency push button shall be installed close to the *FAN UNIT* motor as per [NF EN ISO 12499](#). It shall be equipped with an auxiliary contact (voltage free) to remote the switch status. Emergency push button and switch shall be wired by *CONTRACTOR*.



Picture 16 - Principle of *FAN UNIT* emergency push button

6.13 Earthing and bonding

Earthing and bonding shall be in accordance with [GS EP ELE 031](#). Earthing and bonding contacts shall be installed on *FAN UNIT* by *FAN UNIT MANUFACTURER*.



Picture 17 - Principle of earthing and bonding contact

Bonding connections shall be installed on *FAN UNIT* between components of *FAN UNIT* by *FAN UNIT MANUFACTURER*.

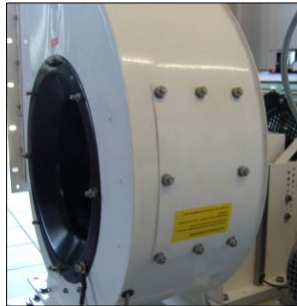
Bonding connections between frame of *FAN UNIT* and *AHU* casing shall be installed by *AHU MANUFACTURER*.

6.14 Casing drain

In case of *FAN* / *FAN UNIT* is installed in building classified IN or MA (building type), *casing* drain of ½" shall be installed on *FAN UNIT*. A drain boss shall be welded on the *FAN casing* and provided with threaded plug.

6.15 Access panel to *FAN casing*

An access panel shall be installed on *FAN casing*.



Picture 18 - Principle of access panel on *FAN casing*

6.16 Flexible sleeve

Discharge of *FAN* shall be linked to the casing of *AHU* with an industrial heavy duty non-combustible type flanged flexible sleeve (M0 according French regulation or equivalent in accordance with International Standards). Flexible sleeve shall be designed for the operating pressure range of the *FAN*.

6.17 Impeller

Heavy duty impeller shall be made of blades continuously welded to the back-plate and the shroud.

Blades of *FAN* shall be continuously welded for MA and MAT environments and/or if *OUTDOOR/SUPPLY* air ratio is superior to 0.3 as per **GS EP HVA 010**.

FAN impeller shall be dynamically balanced. The balancing shall be in accordance with **ISO 1940-1** and **NF ISO 14694**.

FAN with driver power equal or less than 37 kW (*FAN* application category BV-3) shall meet balance quality grade G 6.3.

FAN with driver power higher than 37 kW (*FAN* application category BV-4) shall meet balance quality grade G 2.5.

6.18 Vibration limits

The maximum vibration limits for the assembled *FAN UNIT* shall not exceed the peak and RMS (Root Mean Square) values given in clause 8.3 of **NF ISO 14694**.

FAN UNIT shall be run before delivery by *FAN UNIT MANUFACTURER* to check bearing conditions and vibrations.

6.19 Noise limits

FAN impeller blade passing frequency shall be calculated and indicated by *HVAC CONTRACTOR* within *FAN UNIT* data sheet.

For *FAN UNIT* with a noise level greater than 60 dB(A), an acoustic protection shall be installed in accordance with **GS EP HVA 400**.

6.20 Guarding

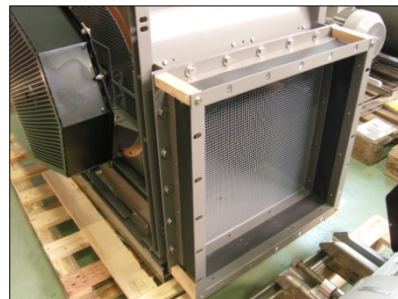
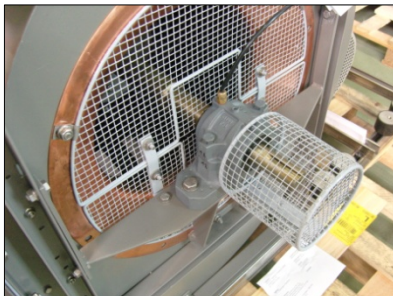
All rotating parts of the *FAN UNIT* shall be protected by a guard in accordance with **NF EN ISO 12499**. This guard shall be done with a metal frame with wire netting (maximum mesh 30 x 30 mm). Guards shall be installed on both side of *FAN casing*. An access point shall be made on the guard enabling to measure rotation speed of the *FAN*, without removing the guard.



Picture 19 - Principle of *FAN UNIT* equipped with a belt guard

The following additional guards shall be provided:

- Inlet guard at each *FAN* air inlet
- At the free end of shaft, in case of double inlet centrifugal *FAN*,
- At the discharge of the *FAN*.



Picture 20 and picture 21 – Additional guard at air inlet, on free end of a shaft and at discharge

The additional guards shall be galvanized and painted according the protection against corrosion indicated within the present document or in accordance with **GS EP COR 350**.

6.21 REDUNDANCY

In case of *REDUNDANCY* of *FAN UNITS* installed for a system, the changeover from duty *FAN UNIT* to stand-by *FAN UNIT* shall be automatic. In case of fault on duty *FAN UNIT*, stand-by unit shall be started automatically.

6.22 Air temperature rise across *FAN*

FAN MANUFACTURER shall calculate the temperature rise of the air handled by the *FAN* due to pressure elevation through the *FAN*.

Formula as per **GS EP HVA 100** shall be used to calculate this air temperature rise across *FAN*.

7. Additional requirements for *FAN UNIT* installed in special rooms

7.1 HVAC PLANT ROOM

FAN UNIT dedicated to *HVAC PLANT ROOM* shall be designed in accordance with the present specification and **GS EP HVA 301**.

7.2 Kitchen

FAN UNIT dedicated to exhaust air from kitchen shall be designed for a temperature of 400°C during two (2) hours. Kitchen hood shall be designed as per **GS EP HVA 223**.

FAN UNIT dedicated to kitchen shall be provided with both start/stop, with run indication, and with high/low speed control operated from a selector switch in the kitchen.

7.3 Battery room or battery exhaust

FAN UNIT installed in battery room shall be hydrogen explosion proof and ATEX certified.

7.4 Laboratory

FAN UNIT installed for laboratory shall be explosion proof and ATEX certified when design for extract of explosive gas or extract of combination of explosive gas. Classification of explosion proof shall be defined based on products present in the laboratory.

8. *FAN UNIT* installed outdoor and exposed to low temperature

8.1 *FAN UNIT* installed outdoor

FAN UNIT installed outdoor shall withstand their environment (in operation and in storage scenarios), in terms of:

- Minimal and maximal temperature
- Minimal and maximal humidity
- Wind
- Pollutant (if any).



8.2 *FAN UNIT* exposed to low temperature

This section is dedicated to *FAN UNIT* which can be exposed to outdoor low temperature (e.g. from below 0°C to -60°C) and hence, can transport low temperature fluid.

As part of a *winterization* study, the following items (list hereafter is non-exhaustive) shall be carefully studied and checked by *FAN UNIT MANUFACTURER* regarding the construction and the installation of *FAN UNIT*:

- Metallurgy
- Painting
- Grease
- Anti-sparkling
- Electrical motor and electrical connections
- Power cable
- Instrumentation
- Flexible sleeve
- Fixing.

Note: *Winterization* is the action to prepare personnel and equipment of an installation to be protected from low temperature.

8.2.1 Metallurgy

High resilience steel at low temperature (e.g. 40J at -38°C) shall be used. Limit of elasticity shall be defined in accordance with the minimal external air temperature.

8.2.2 Painting

Painting with high elasticity at the minimal external air temperature shall be used. With low temperature, painting can be sensitive to shocks and scratches. Moreover, painting adhesion shall be carefully studied.

8.2.3 Lubrification

Lubrication used for *FAN UNIT* components shall not contain element (e.g. waste paraffin) which can congeal at minimal external air temperature.

8.2.4 Anti-sparkling

Anti-sparkling shall be performed by copper elements fixed on steel pieces by bolting, riveting or brazing.

8.2.5 Electrical power

Electrical power absorbed by *FAN UNIT* changes with the air density. Therefore, *FAN UNIT* motor shall be selected taking into account the minimal external air temperature, which corresponds to the higher air density.

To ensure a correct starting with minimal external air temperature (especially for stand-by units), heating of windings shall be provided.

9. ATEX certified *FAN UNIT*

When ATEX [Directive 94/9/EC](#) is applicable to *FAN UNIT*, requirements regarding ATEX indicated in [GS EP HVA 100](#) must be taken into account by *MANUFACTURER* and by *HVAC CONTRACTOR*.

ATEX certification must be issued for equipment leaving the *MANUFACTURER* factory. Whatever the reason of *FAN UNIT* dismantling, (transportation, handling, installation, reparation, etc.), the re-assembly of unit must be realized by the *FAN UNIT*'s *MANUFACTURER*. It is *HVAC CONTRACTOR*'s responsibility to purchase the re-assembly of unit to the *FAN UNIT*'s *MANUFACTURER*. It is *HVAC CONTRACTOR*'s responsibility to indicate to *MANUFACTURER* that *FAN UNIT* must be dismantled.

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

ATEX-certified *FAN UNIT* shall be:

- *FAN UNIT* must be designed according to [NF EN 14986](#)
- Provided with anti-spark devices, which shall include brass rubbing rings and plates fitted to casing, guard, impeller and anti-static belts in conformance with [ATEX Directive](#)
- Provided with approved flexible sleeves in conformance with [ATEX Directive](#)
- Provided with an ATEX-certified air flow meter.

Note: When equipment have to be in accordance with [ATEX Directive](#), only certification by Notified Body is accepted by *COMPANY* (self-certification is not allowed, even when this self-certification is recorded by Notified Body). Notified Body shall be recognized by *COMPANY*.

10. Equipment tagging and marking

Nameplate shall be fixed permanently and indicate:

- Name and address of the *MANUFACTURER*
- Year of construction
- Designation
- Type of *FAN*
- Serial or identification number
- Casing pressure, temperature, flow rate
- Greasing data.

11. FACTORY COMPLIANCE TEST

Administrative requirements from [GS EP HVA 410](#) are applicable.

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

Test shall be carried out on a complete *FAN UNIT* selected by *COMPANY* at the R&D test bench of *FAN UNIT* factory.



The test will be conducted to verify design data for airflow, fan pressure, radiated noise level and noise in duct & casing leakage rate/class. Airflow test will be done at final operating site temperature & suitable extrapolation shall be made for design air temperature.

Tests standards should be in accordance with [NF EN 13053](#) in pressure chamber.

Tolerances shall be $\pm 5\%$ including instrument tolerance for airflow & pressure.

Mandatory instruments are: 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. *COMPANY* can carry out controls to verify the performance and design data listed in chapter "sizing characteristics" and compliance with the present technical specification.

12. Installation acceptance by *MANUFACTURER*

MANUFACTURER shall include in his scope:

- Survey of *FAN UNIT* installation (lifting on *CONTRACTOR* site during *FAN UNIT* installation phase, assembly, fastening, etc.) and issue of an installation acceptance (signed by *MANUFACTURER*)
- Visit on site in order to issue a "ready for *PRE-COMMISSIONING* document". Visit shall be held on site fortnight before *PRE-COMMISSIONING*.

13. Documents to be supplied

Requirement indicated in this paragraph shall prevail over Project specific requirements. Documents will consist in:



Due date #	Document
At receipt of order	The <i>MANUFACTURER</i> must issue 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 <i>MANUFACTURER</i> does not issue to COMPANY the documents listed here above, <i>MANUFACTURER</i> undertake to supply equipment in contractual operating conditions and conform to the contract specifications.
#2	<i>FAN UNIT</i> drawings (including accesses for maintenance and operation)
#2	Detailed calculation notes (aeraulic, acoustic, centre of gravity, 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	<i>FACTORY COMPLIANCE TESTS</i> report
#1	Weight and centre of gravity

Due dates:

- #1: 10 days after purchase of order
- #2: 21 days before assembly
- #3: 8 days before assembly
- #4: 8 days after end of assembly
- #5: 3 days after FCT
- #6: 8 days before FCT.

A fortnight will be given to COMPANY to control and comment documents. These comments shall be implemented by *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 (DWG (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.



14. Information to be provided with proposal

- A drawing with equipment dimensions, weight, centre of gravity of each component and the global centre of gravity.
- Characteristics of each component of the *FAN UNIT*.

15. Other references

Following documents are applicable:

- Standards: [NF EN 1127-1](#), [NF EN 13463 \(Parts 1; 5\)](#), [NF EN 60034-50](#), [NF EN ISO 468](#)
- Professional Documents: [ASHRAE](#), [Fan Manufacturers Association](#)
- Total General Specifications: [GS EP ELE 111](#).