

## GENERAL SPECIFICATION

### HVAC

#### GS EP HVA 206

***Air Conditioning Unit(s) (ACU) and Associated Air Cooled Condenser(s) (ACC)***

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|------|---------|-------------------------|
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## 1. Scope

The purpose of this document is to define the minimum requirements for the design, the construction and the operability of *air conditioning unit(s) (ACU)* and associated *air cooled condenser(s) (ACC)*. The choice / use of an *air conditioning unit (ACU)* and associated *air cooled condenser (ACC)* shall be submitted to COMPANY HVAC SPECIALIST approval.

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.

### External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the effective date of this document.

| Reference                                    | Title                                                                                                                                                                                                                                             |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ADC                                          | Air Diffusion Institute (All documents in accordance with equipment or part of HVAC installation designed)                                                                                                                                        |
| AFI                                          | American Filtering Institute (All documents in accordance with equipment or part of HVAC installation designed)                                                                                                                                   |
| AGA                                          | American Gas Association (All documents in accordance with equipment or part of HVAC installation designed)                                                                                                                                       |
| AICVF Codes                                  | Association des Ingénieurs de Chauffage, Ventilation Français (All codes in accordance with equipment or part of HVAC installation designed)                                                                                                      |
| AMCA                                         | Air Moving and Conditioning Institute (All documents in accordance with equipment or part of HVAC installation designed)                                                                                                                          |
| ARI                                          | Air Conditioning and Refrigeration Institute (All documents in accordance with equipment or part of HVAC installation designed)                                                                                                                   |
| ASHRAE                                       | American Society of Heating, Refrigeration and Air Conditioning Engineers (All documents in accordance with equipment or part of HVAC installation designed)                                                                                      |
| 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 |

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| Directive 2006/42/EC dated 17 May 2006          | Directive 2006/42/EC of the European parliament and of the council on machinery, and amending Directive 95/16/EC                                                                                                         |
| 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 |
| 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                                                             |
| EUROVENT                                        | Certification (All documents concerning that subject)                                                                                                                                                                    |
| IEC 60947-4-1                                   | Low-voltage switchgear and controlgear – Part 4-1: Contactors and motor-starters – Electromechanical contactors and motor-starters                                                                                       |
| IEC 60034 (All parts)                           | Rotating electrical machines - All parts                                                                                                                                                                                 |
| IEC 60079 (Parts 0; 14)                         | Explosive atmospheres - Parts 0; 14                                                                                                                                                                                      |
| IEC 60079-14                                    | Explosive atmospheres - Part 14: Electrical installations design, selection and erection                                                                                                                                 |
| IEC 61310-1                                     | Safety of machinery - Indication, marking and actuation - Part 1: Requirements for visual, acoustic and tactile                                                                                                          |
| NF EN 10169 (Parts 1; 2; 3)                     | Continuously organic coated (coil coated) steel flat products – Parts 1; 2; 3                                                                                                                                            |
| NF EN 1216                                      | Heat exchangers - Forced circulation air-cooling and air-heating coils - Test procedures for establishing the performance                                                                                                |
| NF EN 12735 (Parts 1;2)                         | Copper and copper alloys - Seamless, round copper tubes for air conditioning and refrigeration – Parts 1; 2                                                                                                              |
| NF EN 13463 (Parts 1; 3; 5)                     | Non-electrical equipment for potentially explosive atmospheres - Part 1; 3; 5                                                                                                                                            |
| NF EN 14986                                     | Design of fans working in potentially explosive atmospheres                                                                                                                                                              |
| NF EN 1886                                      | Ventilation for buildings - Air handling units - Mechanical performance                                                                                                                                                  |

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| NF EN 308                      | Heat exchangers - Test procedures for establishing performance of air to air and flue gases heat recovery devices                                                                                          |
| NF EN 378 (Parts 1; 2; 3; 4)   | Refrigerating systems and heat pumps - Safety and environmental requirements – Parts 1; 2; 3; 4                                                                                                            |
| NF EN 779                      | Particulate air filters for general ventilation - Determination of the filtration performance                                                                                                              |
| NF EN ISO 11546-1 (Parts 1; 2) | Acoustics - Determination of sound insulation performances of enclosures - Parts 1; 2                                                                                                                      |
| NF EN ISO 14001                | Environmental management systems - Requirements with guidance for use                                                                                                                                      |
| NF EN 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 ISO 3741                 | Acoustics - Determination of sound power levels of noise sources using sound pressure - Precision methods for reverberation rooms                                                                          |
| NF EN 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                                              |
| NF EN ISO 3746                 | Acoustics - Determination of sound power levels of noise sources using sound pressure - Survey methods using an enveloping measurement surface over reflecting plane                                       |
| NF EN 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    |
| NF EN ISO 9614 (Parts 1; 2; 3) | Acoustics. Determination of sound power levels of noise sources using sound intensity - Parts 1; 2; 3                                                                                                      |
| VDI 6022 Part 1                | Ventilation and indoor-air quality – Hygiene requirements for ventilation and air-conditioning systems and units (VDI Ventilation Code of Practice)                                                        |
| VDI 6022 Part 1.1 :            | Ventilation and indoor-air quality – Hygiene requirements for ventilation and air-conditioning systems and units – Checking of ventilation and air-conditioning systems (VDI Ventilation Code of Practice) |

Note: NF EN 378 shall be only read and applicable according to the **GS EP HVA 301**.

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### Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published in the applicable yearly collection.

| Reference     | Title                                                                            |
|---------------|----------------------------------------------------------------------------------|
| GS EP COR 350 | External protection of offshore and coastal structures and equipment by painting |
| GS EP ELE 011 | Electrical requirements for packaged units                                       |
| GS EP ELE 031 | Design of earthing and bonding systems                                           |
| GS EP ELE 079 | Electrical apparatus for potentially explosive gas atmospheres                   |
| GS EP ELE 111 | Induction motors                                                                 |
| GS EP ELE 137 | Distribution boards                                                              |
| 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 205 | FAN UNIT(s)                                                                      |
| GS EP HVA 220 | Shut-off Dampers                                                                 |
| GS EP HVA 290 | Shut-off Damper Electrical Actuator(s)                                           |
| GS EP HVA 301 | HVAC Plant Room(s)                                                               |
| GS EP HVA 462 | HVAC equipment numbering rules                                                   |
| GS EP HVA 801 | Terminology, Definitions, Abbreviations                                          |
| GS EP INS 102 | Instrumentation identification                                                   |
| GS EP INS 107 | Design and installation of instrumentation links                                 |

### 3. Definitions

*Air conditioning unit (ACU)*: vertical *AIR HANDLING UNIT* which can include electrical cabinet(s) (*HVAC MCC* and / or *HVAC CC*), and built in accordance with the present specification.

Note: **GS EP HVA 202** is not applicable for construction of *ACU*.

*Air cooled condenser (ACC)*: outdoor casing which contains condenser coil(s), *FAN UNIT(s)*, instruments, electrical devices.

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## 4. Limit of Use

The *ACUs* can be used under the following conditions:

- The total cooling capacity (sensible and latent capacity) does not exceed 50 kW
- The *OUTDOOR* air quantity of *HVAC* system does not exceed 25% of the *SUPPLY* air of *HVAC* system
- *ACUs* are only accepted for technical rooms, temporary refuge
- The number of rooms served by an *ACU* is limited to three rooms
- The total number of *ACUs* installed for a building shall not exceed four (4) units.

*ACUs* cannot be installed outside a safe area.

## 5. System Design

The system is used in order to filter, to cool, to heat, to humidify and to dehumidify air of room(s) and *OUTDOOR AIR* when required.

In case of *ACU* is equipped with a chilled water cooling coil, the requirements for *ACC* shall not apply.

In case of *ACU* is equipped with a direct expansion coil, an *ACC* shall be associated to the *ACU*. Both units shall be provided by the same *VENDOR*.

The *ACU* and the *ACC* shall be connected together by means of piping network, instruments and electrical cables.

The design of the *ACU* shall take into account the ducting arrangement / air distribution (raised floor,..) defined by the *HVAC ENGINEERING*.

For information, a minimum free space of 300 mm high shall be provided (main *CONTRACTOR*) to allow a correct air distribution through the raised floor.

The units shall be designed according to the life time required by the project.

## 6. Air Conditioning Unit (ACU)

### 6.1 Construction

The construction shall be of a self-supporting type enabling lift handling. Two procedures for handling are accepted:

- Single-point lift from pad eyes installed at top of unit
- Handling from bottom of the unit, with spreader bars (3.2 certified spreader bars shall be provided by the *ACU MANUFACTURER*).

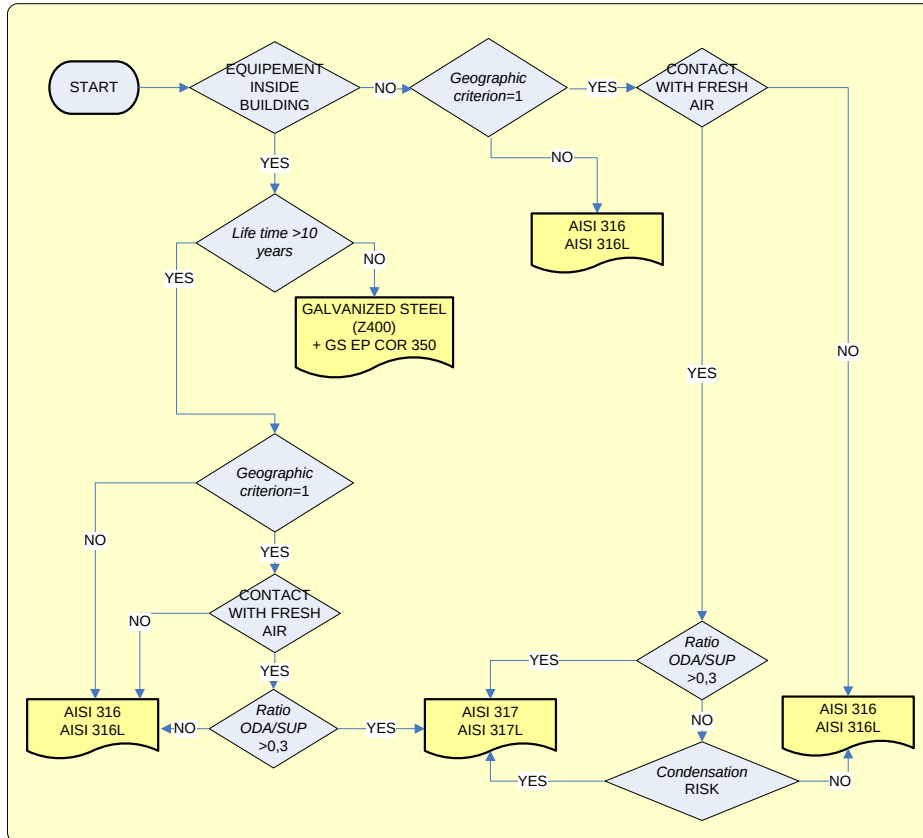
The *ACU* casing material shall be compliant with the following figure:

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### 6.1.1 Casing

Strength of casing structure shall be sufficient to enable the removal of any access panel without any deformation.

Casing shall be built in three separate sections: the air handling section, the refrigeration section (in case of direct expansion ACU) and the power & control section. The power & control section shall be physically segregated from the air handling section and from refrigeration section.

The whole ACU casing, including the internal partitions, shall be thermally and acoustically insulated and with double face panels. Panels metallurgy shall be identical to the metallurgy of the casing.

The panel thickness shall be defined in order to fulfill the [NF EN 1886](#) strength requirements. Nevertheless thickness shall not be less than 15/10 mm for panels equipped with duct connections (inlet and outlet) and 08/10 mm for other panels.

A mineral wool cushion shall be used to realize thermal and sound insulation with a density of 45 kg/m<sup>3</sup> as minimum. The mineral wool shall be non-combustible. Frame and doors shall also be insulated in order to reach the expected thermal performances defined in section "Air handling section – Casing".

The surface temperature of the casing (structure, panels, doors) shall be less than 50°C and shall be 5°C above the dew point of the ambient conditions.

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### 6.1.2 Removable Panels and Access Doors

The casing shall be equipped with removable panels and access doors. Access doors shall be provided for regularly maintenance (filter access, power & control section, belt tension...). Removable panels shall be used for curative maintenance (compressor replacement, exchanger replacement, heater, *FAN* replacement...).

Access doors shall be equipped with hinges, two kickstands and quarter turn handles (heavy duty corrosion resistant). Power & control section shall be key lockable.

Removable panels shall be fixed with screw or quarter turn devices. Removable panels shall be equipped with handles to facilitate panel removal.

For assembly of panels made of dissimilar material, it shall be used a Teflon washer between screws head and panel. An alternative can be the use of screws protected by Impreglon Delta-MKS.

Air tightness of panels shall be provided by resistant gasket secured on the frame and running on the entire perimeter.

For access doors:

- A gasket shall mechanically fixed on the door, without additional fixing system. The installation and the removal of the gasket shall be feasible without tools
- The removable gasket, placed on the periphery of the door, shall be compressed by door closure
- The compression of the gasket shall not exceed 20% of the initial thickness, after 24 hours, between 20°C and 25°C.

The external faces of panels and doors of the *ACU* shall be protected by a plastic film, which will be removed during *COMMISSIONING*.

The removal of panel or the opening of the door, dedicated to the *FAN UNITS* section of *ACU*, shall automatically stop the operation of *FAN UNIT(s)*.

## 6.1 Battery Limit

The external battery limit of the *ACU* shall be:

- The inlet and outlet *SHUT-OFF DAMPERS* duct connection
- The screw connection of the condensate drain pipe; the battery limit shall be located outside the *ACU* casing
- The Multi-Cable Transit (MCT or similar) for interfacing (piping and cables) with the *ACC*, the main power supply, and any plant instrument or control system.

## 6.2 Air Handling Section

The air handling section and the refrigerating compartment shall be equipped with *REFRIGERANT* leak detector (detection level of 5 gram / year), in case the unit is equipped with a refrigerating circuit (use of *REFRIGERANT*).

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### 6.2.1 General

The air handling section is mainly composed of the following equipment:

- Inlet actuated *SHUT-OFF DAMPER*
- Pre-filters
- Filters
- *FAN UNIT*
- Outlet actuated *SHUT-OFF DAMPER*.

According to the air treatment process, the one or several of the following components shall be provided:

- Heat exchanger (direct expansion coil, heating and cooling coil)
- Droplet eliminator
- Drain pan
- Electrical heater
- Steam humidifier.

### 6.2.2 Casing

The air handling section shall conform to the enforcing of the following requirement:

- Casing strength: D2, as per [NF EN 1886](#)
- Casing air leakage: L2, as per [NF EN 1886](#) (measurement on *real unit (R)*)
- Filter bypass leakage: according to filter class as defined in [NF EN 779](#)
- Thermal transmittance U of the casing: T2 as per [NF EN 1886](#)
- Thermal bridging factor of the casing: TB3 for indoor installation, TB2 for outdoor installation as per [NF EN 1886](#).

The design pressure of the casing (negative or positive pressure (based on maximum head of the *FAN(s)*)) shall not induce any permanent deformation.

### 6.2.3 Filtration

The filtration shall be composed of two stages and be at least of the following performance level according to [NF EN 779](#):

- Pre-filters: G4
- Filters: F7.

Each filtration stage shall be composed of one or several filters.

All filters shall be of disposable type and of standard size and brand (refer to *HVAC VENDORS* list). Customized filters dimensions are not accepted.

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All filters media and seals shall be flame retardant, non-smoking, non-hygroscopic, inert and chemicals resistant to all types of atmospheric pollutants that can be met in the plant environment.

The filter(s) holder (support of the filter) shall be made of stainless steel AISI 316L. Filters installed into slides shall be prohibited.

The filter(s) frame shall be made of plastic material.

Easy access to filters shall be provided for maintenance and replacement. Removal of filters shall be made only from the front face of the casing and shall not require the removal or the dismantling of any other part / component of the unit.

The air tightness between filters and filter supports shall be improved by a gasket fixed on the filter(s) holder. The filter(s) holder shall be provided with a fixing device enabling a compression of the gasket.

Pressure tapings shall be placed upstream and downstream the filter(s) holder, in order to connect a differential pressure gauge and a differential pressure sensor. Instrument piping between tapings and instruments shall be made of vinyl or stainless steel tube but this tubing shall be made of stainless steel in case the unit is located outside a building.

Stainless steel nipples shall be provided and accessible from outside the casing in order to enable connection for instrument zero adjustment and setting. The nipples shall be equipped with threaded caps.

**Figure 1 - Example of nipples for instrument zero setting**



Differential pressure loss indicator (Magnehelic), (one per filtration stage), shall be installed on the casing in order to monitor the filter clogging. It shall be readable from outside.

**Figure 2 - Example of differential pressure gauge**



Each filtration stage shall be equipped with:

- A differential pressure gauge

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- A differential pressure transmitter
- A set of treaded nipples, with associated threaded plugs
- Associated tubing.

Each transmitter shall be connected to the *ACU PLC* in order to monitor the clogging level of the filters.

The following maximum clogging delta-pressure shall be used:

- Pre-filter: 250 Pa;
- Filter: 350 Pa;

The variation of clogging of filters shall not lead to a variation of more than 4% of the nominal flow of the *ACU*.

The maximum clogging pressure losses of each filtration stage shall be indicated on the pressure gauges.

For each differential pressure gauge, the tree followings name plates shall be fixed under the differential pressure gauge:

- The instrument tag number
- The maximum pressure loss on the filter(s)
- The safety tag: "FIRE RISK – FLAMMABLE DIRTY FILTERS".

**Figure 3 – Names plates under the differential pressure gauge**



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## 6.2.4 Cooling Coil

The cooling coil material shall be as per the following table:

| "Building type"<br>(Refer to<br>GS EP HVA 100)           | Ratio $\frac{ODA}{SUP}$ | Frame                   | Tubes    | Fins      | Complementary protection against corrosion for the whole cooling coil |
|----------------------------------------------------------|-------------------------|-------------------------|----------|-----------|-----------------------------------------------------------------------|
| RU                                                       | -                       | Galvanized Carbon steel | Copper   | Aluminium | No additional protection                                              |
| IN or INT                                                | <0,3                    | Carbon steel            | Copper   | Aluminium | 2 epoxy baths, minimum total thickness of 30μ                         |
| IN or INT                                                | ≥ 0,3                   | Carbon steel            | Copper   | Aluminium | Heresite Sakaphen or Blygold                                          |
| MA or MAT                                                | -                       | Stainless steel 1.4404  | Copper   | Copper    | Heresite Sakaphen or Blygold                                          |
| All building types with sea water used as cooling medium |                         | Titanium                | Titanium | Titanium  | No additional protection                                              |

Corrosion protection coating can be avoided in some specific operating cases related to air quality. Non application of the corrosion protection coating shall only be granted by a COMPANY HVAC SPECIALIST.

Air by-pass between the cooling coil and the ACU casing is not permitted.

The cooling coil shall be provided with a maximum of 10 fins per 25,4 mm of coil (10 fins / inch). AIR VELOCITY across the cooling coil shall be 3 m/s maximum.

AIR VELOCITY calculation:

The AIR VELOCITY through the coil shall be calculated with the following method:

$$v = \frac{D}{(w \times h) - n_t \times (o_d \times w) - n_f \times (f_t \times h) + (o_d \times f_t \times n_f \times n_t)}$$

Where:

- $D$  = air flow rate at outlet of the coil (m<sup>3</sup>/s)
- $w$  = inner width of the coil frame (m)
- $h$  = inner height of the coil frame (m)
- $n_t$  = number of tubes on the last row of the coil
- $o_d$  = outside diameter of the tubes (m)
- $n_f$  = number of fins on the coil
- $f_t$  = fin thickness (m)

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The sizing of the cooling coil shall include the re-heating of the air across the fan.

For direct expansion coil:

- Tubes shall conform to the requirements of the [EN 12735-1](#). Tube enhancement by means of internal grooves is allowed.
- *REFRIGERANT* liquid distributor shall be vertically installed, with distributor inlet at the top. The refrigerant supply and the outlet header of the direct expansion coil shall be out of the air stream, shall be insulated and enclosed in an accessible compartment.
- Two separate imbricated *REFRIGERANT* circuits shall be provided.

The whole coil shall be pressure tested before application of the anti-corrosion coating. In case of direct expansion coil, the *REFRIGERANT* distributor shall be brazed with capillary tubes to coil before testing.

The general arrangement of the unit shall enable an easy access to the cooling coil, for cleaning, maintenance and replacement. Removal of cooling coil shall not require the removal or the dismantling of any other part or component (piping, cabling, structure of the unit...).

#### 6.2.5 Droplet eliminator

A droplet eliminator shall be installed to prevent water carry-over of condensate. It shall be made of stainless steel. Polypropylene can be used in case of electrical heater is not located below the droplet eliminator.

The droplet eliminator efficiency shall be 100% at 4 m/s.

The droplet eliminator shall be easily removable without dismantling any other part or component of the *ACU*.

#### 6.2.6 Condensate drain pan

The condensate drain pan shall collect the condensate water from the cooling coil and from the droplet eliminator.

It shall be made of stainless steel and be built with two separated threaded drain outlet routed outside the casing.

In case the unit is installed on a floating unit, the casing shape shall be designed to prevent the condensate water to overflow due to the motion of the unit.

Both the pan and the pipe shall be insulated with Armaflex M0. All insulation parts shall be properly glued together as well as the insulation on the pipe and on the pan in order to prevent condensation.

The draining pipe shall include a serviceable water trap(s) and shall be easily accessible. It shall be designed to withstand a negative pressure of 1,5 times the pressure loss of the all pieces of equipment (*ACU* and *RECIRCULATION AIR / OUTDOOR AIR* ducting) upstream the drain pan. The traps height shall also take into account 1,5 times the *FAN* head.

#### 6.2.7 Electrical heater

When required, an electrical heater can be a part of the *ACU* design and shall be installed in a dedicated section.

| General Specification                                                              |                         | GS EP HVA 206  |
|------------------------------------------------------------------------------------|-------------------------|----------------|
| <i>Air Conditioning Unit(s) (ACU) and Associated Air Cooled Condenser(s) (ACC)</i> |                         |                |
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The maximum air velocity across the electrical heater shall be 4 m/s.

The surface temperature of the heating element shall not exceed 90°C while operational in all configurations.

The electrical elements shall be black heat type. The tubular elements shall be stainless steel packed with magnesium oxide. Other stainless steel grade than those specified in **GS EP HVA 010** shall be submitted to COMPANY HVAC SPECIALIST for approval.

Dilatation shall be considered for integration within the electrical heater support.

An anti-radiation shield shall be installed to prevent temperature increase of surrounding components.

The electrical elements shall be installed so that they can be easily dismantled for cleaning or maintenance without ACU casing dismantling. Electrical connections of all components shall be easy to access but shall be located within a connection box to prevent any contact with energized parts.

The electrical heaters power shall be controlled from the ACU UCP by thyristor(s).

In case the ACU is normally stopped, a post ventilation period shall be ensured (minimum 1 minute). In case of uncontrolled shutdown of the ACU, the air stream temperature into the heater section shall not exceed 50°C.

#### 6.2.8 Humidifier

When required, a humidifier shall be part of the ACU design and shall be installed in a dedicated section.

Only stand-alone steam humidifier shall be installed.

The steam humidifier shall consist of an empty section, equipped with slopping drain tray made of stainless steel AISI 316L and a U-profiled section for suspending steam ramps.

Depending on the water mineralization, steam shall be produced either by electrodes or by heating elements.

The steam humidifier components shall be installed so that they can be easily dismantled for cleaning or maintenance without ACU casing dismantling. All connections of all components shall be easy to access.

#### 6.2.9 FAN

The FAN shall be preferably of double inlet centrifugal.

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

The selection of the FAN shall also take into account the noise impact of the FAN in the HVAC SYSTEM in order to not compromise the final HVAC noise target.

In case of belt-driven type FAN, two belts as minimum with fixed wheel shall be used. The assembly shall be equipped with an adjustable belt tension device which enables a belt tension adjustment without modification of the belts alignment. A locking device shall secure the belt tensioning.

| General Specification                                                              |                         | GS EP HVA 206  |
|------------------------------------------------------------------------------------|-------------------------|----------------|
| <i>Air Conditioning Unit(s) (ACU) and Associated Air Cooled Condenser(s) (ACC)</i> |                         |                |
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The *FAN* and its motor shall be installed on a common stainless support frame (installation of the motor support on the *FAN* volute is prohibited).

The block and belt assembly shall enable the adjustment of the flow rate in a range of 20%. This shall be made by means of adjustable blocks. The adjustment shall not need to re-align the motor with the *FAN*. The support frame shall be installed on resilient pads in order to prevent vibration transmission to the *ACU* casing. The outlet of the *FAN*, shall be connected to the casing by means of a flexible flange.

Alternatively, the *FAN* can be of direct-driven type with an electrical motor and a variable frequency drive in order to adjust the flow rate.

The motor shall conform to the **GS EP ELE 111**. It shall be selected based on 115% of the rated shaft power of the fan, refer also to the **GS EP HVA 205**.

The *MANUFACTURER* shall select the *ACU FAN* subsequent to ascertaining system static pressure, in accordance with pressure drop calculations and considering system effects, upon approval of the *COMPANY HVAC SPECIALIST*.

### 6.3 Temperature Switches

The electrical heater shall be provided with the following temperature switches:

- A "Very high" temperature switch (TSHH) with manual reset shall be installed in order to trip the relay supplying the heater in case the surface temperature of the heating elements exceeds 100°C.
- A "High" temperature switch (TSH) with automatic reset shall be installed in order to trip the relay supplying the heater in case the surface temperature of the heating elements exceeds 90°C.

#### Notes:

- Action for power tripping, from TSH and TSHH, via a *PLC*, is not permitted
- Temperature fault shall be monitored and shown on *HVAC CC* HMI or *HVAC CC* front panel (LED).

### 6.4 Airflow Switch

The electrical heater shall be provided with an airflow switch (differential pressure switch). In case of air flow shortage, this air flow switch shall automatically trip the relay supplying the heater.

#### Notes:

- Action for power tripping, from air flow switch, via a *PLC*, is not permitted
- Airflow fault shall be monitored and shown on *HVAC CC* HMI or *HVAC CC* front panel (LED).

### 6.5 Water Leak Detection

A water leak detector (sensor cable and detector) shall be provided (whatever the type of *ACU*, direct-expansion or chilled water coil) by the *ACU MANUFACTURER*.

| General Specification                                                              |                         | GS EP HVA 206  |
|------------------------------------------------------------------------------------|-------------------------|----------------|
| <i>Air Conditioning Unit(s) (ACU) and Associated Air Cooled Condenser(s) (ACC)</i> |                         |                |
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The water leak detection system shall be selected in the range of Raychem TraceTek products. The leak controller shall be installed inside the electrical section of the *ACU*. The TraceTek water sensing cable shall be installed by the *HVAC CONTRACTOR* below the *ACU* to monitor any water leakage. The water leak controller shall be connected to the *ACU PLC* for alarm.

## 6.6 SHUT-OFF DAMPER(s)

They shall be integrated within the air handling section or as an alternative be installed directly on the casing limit.

They shall be operated by the *ACU PLC* and actuated by means of an electric actuator. The actuator shall comply with the **GS EP HVA 290**.

They shall conform to the requirement listed in the **GS EP HVA 220**.

Their design and size shall not prevent an even air distribution of the air flow.

Their closing time shall be set-up in line with the run-down time of the *FAN*.

The position status shall be monitored by the *ACU PLC* and shall be repeated to the *HPLC*.

## 7. Refrigeration Circuit

### 7.1 General

The refrigeration circuit shall include all necessary equipment and components to provide a fully operating system in terms of operation, monitoring, safety and maintenance. The refrigeration section shall provide a fully functioning package in conjunction with the external *ACC (Air Cooled Condenser)*.

It shall be designed to operate in all site conditions (weather conditions and internal operating conditions).

The refrigerating components will be installed in a separate compartment of the *ACU*, apart from the main air handling section. This section will be sound attenuated. It shall be paid attention to the air tightness property of the adjacent air handling section for the design of the intermediate bulkhead. The refrigeration compartment shall be also physically segregated to the *ACU* unit control panel.

This compartment may require to be ventilated to prevent a temperature increase due to compressor heat dissipation. An alternative solution could be proposed by the *MANUFACTURER* with *COMPANY HVAC SPECIALIST* approval.

### 7.2 REFRIGERANT Gas and Lubricating Oil

For selection of *REFRIGERANT*, refer to **GS EP HVA 100**.

Oil and *REFRIGERANT* gas charges shall be closely recorded in a dedicated data sheet. The sheet shall be initiated since the first charge and shall be filled at each stage such as factory test, before transportation, at final installation in the plant, *COMMISSIONING*, start-up and fine tuning.

| General Specification                                                              |                         | GS EP HVA 206  |
|------------------------------------------------------------------------------------|-------------------------|----------------|
| <i>Air Conditioning Unit(s) (ACU) and Associated Air Cooled Condenser(s) (ACC)</i> |                         |                |
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It is indeed a strong requirement from COMPANY to closely apply the environmental rules with regards to the storage, the filling, the recovery and the recycling of the *REFRIGERANT* gas and lubricating oil.

If the unit is stored or not started for a period of time exceeding 6 months, the oil shall be changed before the re-start.

In case the *REFRIGERANT* circuit is emptied from *REFRIGERANT* gas, it shall be pressurized at 2 bars minimum with dry nitrogen gas.

### 7.3 Capacity Reduction

The refrigeration "process" shall be made of two separated circuits in order to comply with the cooling requirement varying all along a year without running in an "On-Off" cycling mode. The two circuits will have the same design and the same capacity.

Alternatively and with the COMPANY HVAC SPECIALIST approval, a single circuit may be proposed providing that the minimum capacity of the circuit corresponds to the minimum cooling requirement of the HVAC system (and that a stand-by equipment provides *REDUNDANCY* in case of breakdown).

The capacity reduction, based on a field proven solution, shall preferably be realized by means of an energy efficient system. Capacity reduction shall be made by means of variable speed of compressor (with confirmation of the compressor's *MANUFACTURER*), cylinder unloading, or hot gas injection (energy efficient). Any other alternate proposal could be proposed with COMPANY HVAC SPECIALIST approval.

The minimum cooling capacity reduction shall be demonstrated with regard to refrigeration capacity, oil circulation, running continuity (i.e. no cycling) of the compressor, etc...The minimum capacity requirement shall be based on the plant HVAC system calculation note.

### 7.4 Compressor

The *REFRIGERANT* gas compressor shall be either reciprocating, screw or scroll, semi-hermetic or hermetic type depending on the unit capacity.

Each compressor shall be installed with anti-vibration pads and be equipped with flexible pipe connections.

An electric crankcase heater controlled shall be installed on each compressor; this crankcase heater shall be energized only when the compressor is stopped.

When required by the compressor type, the compressor shall be equipped with a positive displacement automatically reversible oil pump. Oil coming from the crankcase shall be protected by a 20 microns filter and oil pressure controller located within each compressor.

Temperature of compressor motor shall be protected with a high temperature safety switch.

The compressor shall only be started at its minimum capacity.

In order to enable maintenance, testing and to keep the *REFRIGERANT* gas charge, the compressors shall be equipped with isolating valves with service valve at both suction and discharge.

| General Specification                                                              |                         | GS EP HVA 206  |
|------------------------------------------------------------------------------------|-------------------------|----------------|
| <i>Air Conditioning Unit(s) (ACU) and Associated Air Cooled Condenser(s) (ACC)</i> |                         |                |
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## 7.5 Liquid Receiver

A liquid receiver shall be provided and sized to contain the full circuit *REFRIGERANT* charge. The vessel shall be equipped with inlet and outlet isolation valves.

The liquid receiver shall comply with the Directives 97/23/EC.

## 7.6 Expansion Valve

The expansion valve shall be of thermostatic type with an external pressure equalization and interchangeable orifice. The capacity and the number of expansion valves shall take into account the whole system capacity range.

When cooling capacity reduction is provided by means of hot gas by-pass, the expansion valve selection shall be designed accordingly.

## 7.7 Solenoid Valve

Upstream the expansion valve, it shall be installed an electrically actuated solenoid valve.

## 7.8 Filter Drier

The refrigeration circuit shall be equipped with a filter drier with an exchangeable core and the assembly shall be fitted with inlet and outlet isolating valves.

The filter housing shall be supplied with a 3/8" Schraeder service valve with isolating manual valve to allow the *REFRIGERANT* gas filling in liquid phase.

## 7.9 Sight Glass

An hygroscopic sight glass shall be fitted on the liquid line. The sight glass body shall be brazed onto the pipe. The sight glass shall be easily visible for maintenance activities.

## 7.10 Pressure Gauges

Dual scale pressure gauges (pressure and saturated temperature) shall be provided to display the circuit pressure at compressors (suction and discharge), and the oil when applicable. Any other part of the circuit where needed to enable a correct monitoring.

Each gauge shall be oil-filled, and shall be scaled for the selected *REFRIGERANT* gas. The scale shall cover the pressure range of expected pressure and 20% beyond.

These pressure gauges shall be easily visible and accessible for maintenance activities.

## 7.11 Safety Pressure Switches

One low pressure switch and one high pressure switch shall be installed on each *REFRIGERANT* compressor.

The safety high pressure switch shall be fitted with manual reset.

Alarms shall be monitored to the *ACU PLC*.

| General Specification                                                              |                         | GS EP HVA 206  |
|------------------------------------------------------------------------------------|-------------------------|----------------|
| <i>Air Conditioning Unit(s) (ACU) and Associated Air Cooled Condenser(s) (ACC)</i> |                         |                |
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## 7.12 Pressure Safety Valves

Twin pressure safety valves shall be provided, installed downstream a three-way valve enabling the selection of the operating pressure safety valve and operation of one valve while the other is serviced. Each pressure safety valve discharge shall be routed outdoor independently.

One set of pressure safety valve shall be connected onto the high pressure *REFRIGERANT* side and one set shall be connected to the low pressure *REFRIGERANT* side for each *REFRIGERANT* circuit.

## 7.13 Service Valves (Schraeder)

Services valves shall be installed anywhere needed for manifold connection.

The service valves (Shraeder) for high pressure side shall be fitted with isolating manual.

## 7.14 Piping and Accessories

### 7.14.1 Piping

For the site installation, interconnection of the system and on the package itself, all copper *REFRIGERANT* pipe work shall conform to [EN 12735-1](#) and [EN 12735-2](#).

All brazed joints will be realized using a dry nitrogen back purging of the pipe work to eliminate scaling.

The brazing rods used will have a minimum of 25% silver content, with appropriate flux. All pipe work jointing is to be prepared and installed by qualified refrigeration technicians, using the correct tools, and purged of contaminants.

The cutting of pipe work is to be done with a proper rotary pipe cutter. Pipe cutting by hacksaw is not allowed, to eliminate metallic swarf entering the system.

Varnish shall be applied on pipes after dry nitrogen test pressure of piping has been completed.

A double riser may be required where height difference between the *ACU* and the *ACC*, or when the *REFRIGERANT* flow at low load does not allow the carry-over of oil in the circuit. This shall be confirmed with a calculation note.

The *REFRIGERANT* piping is to be supported on "Stauff" or equivalent clamps. The maximum distance between supports will be 1 meter, U bolts and rubber clamps are not acceptable as supports.

The pipe routing shall prevent excessive pressure loss. It shall also prevent oil retention and enable oil return to the compressor by means of adequate pipe slopes on the suction line.

All pipe work and equipment is to be capped and closed to eliminate moisture entry into the unit, and if left sealed for preservation.

Piping shall be preserved at any stage with dry nitrogen or *REFRIGERANT* gas overpressure to a minimum of 2 bars in order to prevent internal pollution of *REFRIGERANT* circuit.

Signs and barriers are to be used to indicate that the system is under pressure.

| General Specification                                                              |                         | GS EP HVA 206  |
|------------------------------------------------------------------------------------|-------------------------|----------------|
| <i>Air Conditioning Unit(s) (ACU) and Associated Air Cooled Condenser(s) (ACC)</i> |                         |                |
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All piping and associated piping accessories exposed to shocks shall be mechanically protected. The protection shall consist of stainless steel metal jacketing assembled by means of metallic bands.

Any piping having a temperature above 50°C shall be protected to prevent direct contact with personnel.

After completion of all pipe work and the final interconnection to the *ACU* and *ACC*, a vacuum and pressure test with dry nitrogen shall be performed and recorded as part of the inspection and test report for mechanical completion. This test method statement shall be validated by *COMPANY HVAC SPECIALIST* before the performance of the test.

*ACU/ACC MANUFACTURER* shall provide to *HVAC CONTRACTOR* an interconnection study for the interconnection of the *ACU* and the *ACC*. It shall provide the piping design including diameter, piping isometric, brazing requirement, etc. *ACU/ACC MANUFACTURER* shall realize or at least witness the piping interconnection on yard in order to provide the warranty on the refrigeration circuit. Prior to connect the units, the pipe network is to be blown through completely and this final purging is to be done with dry nitrogen.

The refrigeration pipe work routing shall be as orthogonal as possible, within the units and interconnections between the *ACU / ACC*.

In case the condenser shall be installed above the compressor:

- The pipe connection to the condenser shall be routed correctly (goose neck) to avoid the liquid return to the compressor;
- Oil trap(s) shall be installed on the *REFRIGERANT* discharge line (maximum distance between two oil traps: 2,5 m);
- A double discharge line shall be installed in case of capacity reduction of the refrigerating circuit.

#### 7.14.2 Pipe insulation

Any piping sections which exposition or location may downgrade the refrigeration circuit performance or lead to air condensation shall be insulated.

The insulation shall be made with foamed Armaflex M0 EPDM Rubber and a UV-resistant coating when required. All insulation parts shall be properly glued together as well as the insulation on the pipe in order to prevent air condensation.

The condensate water drain pipe shall also be insulated as above.

Any insulated piping exposed to shocks shall be mechanically protected. The protection shall consist of stainless steel metal jacketing assembled by means of metallic bands.

## 8. Air Cooled Condenser (ACC)

### 8.1 General

The outdoor *air-cooled condenser (ACC)* shall be delivered as a complete unit, comprising the frame, the coils, the *FANs* and motors to form a fully functional unit.

The *ACC* shall be ready to be connected (piping and electrical) to the associated *ACU*.

| General Specification                                                              |                         | GS EP HVA 206  |
|------------------------------------------------------------------------------------|-------------------------|----------------|
| <i>Air Conditioning Unit(s) (ACU) and Associated Air Cooled Condenser(s) (ACC)</i> |                         |                |
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The design of the condenser shall take into account the place where it will be installed considering the best air flow path for air exchange and prevent airflow impairment due to vicinity with a *WALL* or any other obstacle. The air flow direction can be either vertical or horizontal, and shall take into account the prevailing wind direction.

The whole assembly shall be designed in accordance with the outdoor area classification. When an ATEX certification is required, it shall be issued by a Notified Body (self-certification by *MANUFACTURER* is not accepted).

The *air cooled condenser* (ACC) shall be equipped with an accessible (once installed in its final position) key-lockable emergency stop push button.

The tagging plate of the ACC shall also be visible once installed in its final position.

## 8.2 Construction

The unit material shall be compliant with the environment where it will be installed. If some parts of the ACC are made of stainless steel, they shall be conforming to the requirement of the **GS EP HVA 010**.

The ACC shall be of a self-supported frame type. Whatever the design, the ACC shall be strong enough to be single-point lifted and to be skidded.

The condenser coil shall be mechanically protected with wire netting.

The ACC shall be designed to prevent any human contact with parts at a temperature above 60°C and to any rotating part.

The whole assembly shall be designed to enable the bonding of elements.

Two earth plates of the frame shall enable the earthing to main structure or to the equipotential bonding system.

The ACC shall be designed in order to take into account the solar loads or flare exposure loads that may impair efficiency.

The ACC shall be equipped with condensation pressure gauge located on the casing of the ACC.

**Figure 4 – Example of condensation pressure gauge**



| General Specification                                                              |                         | GS EP HVA 206  |
|------------------------------------------------------------------------------------|-------------------------|----------------|
| <i>Air Conditioning Unit(s) (ACU) and Associated Air Cooled Condenser(s) (ACC)</i> |                         |                |
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### 8.3 Condenser Coil

The condenser coil(s) shall be made of seamless copper tubes and copper fins protected by means of Heresite Sakaphen (applied by bath). The minimum gap between fins (including the corrosion coating) shall be 2.0mm.

| "Building type"<br>(Refer to<br>GS EP HVA 100) | Frame + feet               | Tubes  | Fins      | Complementary<br>protection against<br>corrosion                                                              |
|------------------------------------------------|----------------------------|--------|-----------|---------------------------------------------------------------------------------------------------------------|
| RU                                             | Galvanized<br>carbon steel | Copper | Aluminium | GS EP COR 350 on the<br>frame, feet and motors                                                                |
| IN or INT                                      | Galvanized<br>carbon steel | Copper | Aluminium | 2 epoxy baths, minimum<br>total thickness of 30μ on<br>the coil +<br>GS EP COR 350 on the<br>frame and motors |
| MA or MAT                                      | Stainless<br>steel 1.4404  | Copper | Copper    | Heresite Sakaphen or<br>Blygold on the coil +<br>GS EP COR 350 on the<br>frame, feet and motors               |

Cooper tubes shall conform to the requirements of the [EN 12735-1](#).

One inlet and one outlet manual isolating valve with a Schraeder valve shall be installed on each circuit.

### 8.4 ACC FAN

The condenser *FAN*(s) shall be of axial-flow type. It shall be direct-driven propeller type using a COMPANY approved electrical motor compliant with the [GS EP ELE 079](#) and the [GS EP ELE 111](#).

They shall be equipped with a control of the condensing pressure. The controls of the condensing pressure can be with variable frequency drive or with pressure step controller.

The *FAN* shall be equipped with safety guard to protect personnel.

| General Specification                                                              |                         | GS EP HVA 206  |
|------------------------------------------------------------------------------------|-------------------------|----------------|
| <i>Air Conditioning Unit(s) (ACU) and Associated Air Cooled Condenser(s) (ACC)</i> |                         |                |
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**Figure 5 – Example of safety guard**



## 9. Power & Control System

A Power and Control section shall be housed in the *ACU* envelop. It shall contain all equipment to enable the unit to operate in a stand-alone mode.

The compartment shall be located in a separated section from the air handling section and shall be physically segregated from the *REFRIGERANT* section.

The panel shall be designed in order to ease operation and to enable access to internal features (from the front face of the *ACU*). The internal layout of panels and cabinets shall provide easy access to all electronic modules, power distribution, circuit breakers, terminals and cable termination areas while maintaining safe working practices.

A stand shall enable to keep the access panel door open.

Power and control sections shall be physically segregated to eliminate electrical hazards. All power sections and terminations shall be identified with applicable safety warning signs properly located.

All components and wiring shall be clearly labeled and tagged.

Outgoing terminations to each field component shall be from dedicated outgoing wiring terminal blocks (segregation between power and control) and not directly connected to the components connections.

The *ACU* will be provided with either a factory fitted cable gland plates or MCTs, They shall be dedicated to electrical and instrument connections.

The cables shall be run in separate containment to enable the segregation.

Each section (power and control) will be designed to include 20% spare capacity.

All cable penetrations in the *ACU* casing will be water and air tight.

Separate equipotential earthing and earth connection rails shall be provided on electrical and instrument equipment.

The *ACU's* *PLC* & power section shall remote any *ACC* functions. The power supply of the *ACC* shall be from the *ACU*.

| General Specification                                                              |                         | GS EP HVA 206  |
|------------------------------------------------------------------------------------|-------------------------|----------------|
| <i>Air Conditioning Unit(s) (ACU) and Associated Air Cooled Condenser(s) (ACC)</i> |                         |                |
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An Emergency Stop Push Button shall be installed on the front face *ACU*. It shall be of key-lockable type.

The *ACU* front panel shall require the selector's switches, individual power supply availability lights, a general alarm light and the HMI as minimum. All these features shall be located at an adequate position on the front face of the *ACU* to enable the control and monitoring.

The HMI functions shall be made by means of a touch screen (12" diagonal size minimum) which shall be positioned at least 1,5m from the floor where the *ACU* will be laid. In case of breakdown of the touch screen, it shall be possible to control the unit from a laptop which will contain a copy of the *ACU* software control.

The HMI shall enable to monitor the system data by means of various system displays and tables.

The compartment shall be ventilated to prevent a temperature increase due to internal heat dissipation and heat gains from adjacent sections. The temperature into the power & control system shall not exceed 35°C.

## 9.1 Power Section

Each *ACU* shall contain its own power distribution.

The power distribution design shall be as per **GS EP ELE 137** except specific requirement mentioned below.

It shall be supplied by a single feeder coming from the plant switchboard.

The auxiliary voltages shall be made internally from the main feeder.

The *ACU* power section shall contain all electrical equipment such as switch isolators, circuit breakers, starters and variable speed drives required for a stand-alone mode operation.

No provision shall be required for electrical equipment, except 10% of spare terminals at the end of *FCT*.

All LV motors shall be provided with a motor thermal magnetic circuit breaker (according to [IEC 60947-4-1](#)).

## 9.2 Control Section

The aim of the control is to have a stand-alone controlled unit. Interface with *HVAC* system shall be limited to the minimum and dedicated instruments may be provided to enable the stand-alone capacity of the unit.

The *ACU* shall include a *PLC* based system to control all functionalities of the units. It shall control the power capacity of the *ACU/ACC* system, all monitoring and alarm instruments as well as the inputs and outputs with plant *HVAC PLC*.

The *ACU PLC* will be factory wired and designed to be interconnected to the *HVAC CC* system for supervisory control and monitoring.

The *ACU* controls section will include:

- A microprocessor based *PLC*, including the proprietary *PLC* controls, software and associated I/O hardware

| General Specification                                                              |                         | GS EP HVA 206  |
|------------------------------------------------------------------------------------|-------------------------|----------------|
| <i>Air Conditioning Unit(s) (ACU) and Associated Air Cooled Condenser(s) (ACC)</i> |                         |                |
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- Human Machine Interface (HMI) access touch screen
- On / Off selector
- All other components necessary for the functionality of the system (alarm reset push button).

As a minimum the system control section will be capable of performing the following functions:

- Self test and safety parameter verification, including monitoring of all safety functionality, such as high pressure or high temperature trip

(Note: Safety features wiring to the PLC is only allowed for the indication, but not the trip action. This shall be directly wired to the source of electrical power)

- Automatic start and stop facilities from the HMI
- Automatic start, stop and local selector switch
- Alarm acknowledgement from the HMI alarm table
- Display module (HMI) will be capable of displaying set points, system status (including temperatures, pressures, run times and percentage loading), and any alarm or alert conditions
- Power load status and other information available for ACU and ACC
- To operate the inlet and outlet ACU shut-off dampers
- The control will have the facility to automatically regulate the compressors and condenser running hours and the number of start ups
- Parameters, set points and PID regulation for variable speed drives controller
- Stopping, starting, and control of the refrigeration compressor(s), ACC FAN(s)
- Refrigeration cooling production and associated capacity control
- Default status reporting and unit / compressors, fans, heaters, humidifiers trip alarms
- The ACU unit fault changeover shall be generated , but not limited to:
  - Loss of REFRIGERANT charge, by low gas pressure readings
  - Low evaporating temperature
  - High pressure
  - Reverse rotation on compressor motor
  - Low oil pressure
  - Current imbalance
  - Thermal overload
  - Shut off damper discrepancy
  - Condensate water leakage
  - One of the filter stage fault

| General Specification                                                              |                         | GS EP HVA 206  |
|------------------------------------------------------------------------------------|-------------------------|----------------|
| <i>Air Conditioning Unit(s) (ACU) and Associated Air Cooled Condenser(s) (ACC)</i> |                         |                |
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- Components electrical faults
- Loss of phase
- Compressor, heater, humidifier, *ACU FAN*, *ACC FAN* faults.
- Monitoring, controlling, alarming and historical trending automatically by interconnection to the *HPLC*.

Any abnormalities on the unit are to be indicated on the *ACU PLC*, which will generate an *HVAC CC (HPLC)* general alarm. The following critical commands as the fault changeover, will be controlled directly from the main *HPLC*, based *HVAC CC*, not made by *ACU*.

When the delta-pressure is reached, the duty *ACU* change over shall be carried out to the stand-by *ACU*. If the stand-by *ACU* is also reached as filter alarm, the stand-by unit shall be maintained in operation.

Interfaces with the *HVAC PLC* are mainly limited to the following information:

- Inputs: permissive to start, *HVAC* system temperature(s) and relative humidity(ies)
- Outputs: minor alarm, major alarm, running status.

The minor alarms are those for which it is not necessary in a short period of time to stop the unit and to changeover to the redundant one (e.g. filter clogging level, one compressor stopped without reaching an high temperature at air outlet).

The major alarm is triggered when an event in the units requires a unit change-over (e.g. compressors failed and high temperature at air outlet is reached, no air flow in the *ACU*).

The HMI shall enable to input parameters for the system adjustment. Access to HMI shall be protected by codes or key. Three different access levels will be granted limiting access to the *PLC* program: Monitoring, Supervision, Programming (Supervision and Programming levels shall be protected by password).

Access to the program shall only be allowed by means of a laptop PC using the convenient softwares.

Note: the password levels shall be only provided to the COMPANY *HVAC SPECIALIST* by the MANUFACTURER.

In case of ESD0 ("black-out") activation, the *ACU HPLC* and the HMI shall be de-energized.

Cables and cabinet design are depicted in **GS EP INS 107** which shall be used as a guide line for *ACU* and *ACC* design.

## 10. Alternative *ACU* Chilled Water Configuration

Alternatively, chilled water *ACU* could be required instead of direct-expansion *ACU* when *ACU* is connected to a chilled water network or a *CHILLED WATER UNIT*.

In this configuration, the "refrigeration circuit" section of the present document shall not apply. The *ACU* cooling coil identified in the "cooling coil" section of the present specification shall be replaced by a chilled water cooling coil (instead of direct expansion cooling coil).

In that case, the chilled water production shall be separate from the *ACU*.

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The chilled water cooling coil shall be provided with the appropriate three-ways valve, balancing valve on three-ways valves by-pass. The piping shall be routed from the cooling coil up to the tie-in located outside the casing. Insulation (Armaflex type) shall be provided on the chilled water piping.

A differential pressure gauge, installed on the five-ways manifold shall be installed between inlet and outlet of the coil.

## 11. Equipment Tagging

Every piece of equipment requiring maintenance, monitoring, setting or being actuated by the *ACU PLC* shall be tagged. The tagging method for equipment and units shall comply with the **GS EP HVA 462** for equipment.

They shall be equipped with stainless steel tagging plates, mechanically fixed onto them.

The tag numbers shall be provided by the main *CONTRACTOR* (if the *MANUFACTURER* is *SUBCONTRACTOR* from main *CONTRACTOR*) or by *COMPANY* if the purchase order issued from *COMPANY*.

### 11.1 Main tagging of ACU

A main name plate shall be installed on the *ACU*. Information shall be engraved on a stainless steel 316L plate, fixed outside the casing.

The main name plate shall indicate the following data:

| Information                               | Unit | Comment (not indicated on name plate)   |
|-------------------------------------------|------|-----------------------------------------|
| Project name:                             | -    |                                         |
| Equipment designation on the project:     | -    | Example: <i>NON ESSENTIAL</i> unit      |
| Air conditioning unit tag number:         | -    |                                         |
| Name of the <i>MANUFACTURER</i> :         | -    |                                         |
| Address of the <i>MANUFACTURER</i> :      | -    |                                         |
| Phone number of the <i>MANUFACTURER</i> : | -    |                                         |
| Air conditioning unit type:               | -    | As per <i>MANUFACTURER</i> codification |
| Air conditioning unit serial number:      | -    |                                         |
| Purchase order number:                    | -    |                                         |
| Delivery date:                            | -    |                                         |
| Voltage:                                  | V    |                                         |
| Phase(s):                                 | -    |                                         |
| Nominal absorbed power:                   | kW   |                                         |

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| Information                                             | Unit | Comment (not indicated on name plate)                                                                              |
|---------------------------------------------------------|------|--------------------------------------------------------------------------------------------------------------------|
| <i>SUPPLY</i> air flow mass:                            | kg/h | Mass of nominal air flow rate at outlet of the unit.                                                               |
| <i>RECIRCULATION</i> air flow mass:                     | kg/h | Mass of nominal air flow rate at outlet of the unit.                                                               |
| <i>OUTDOOR</i> air flow mass:                           | kg/h | Mass of nominal air flow rate at outlet of the unit.                                                               |
| Nominal <i>SUPPLY AIR</i> temperatures (db / wb)        | °C   | Nominal dry and wet bulb temperatures of <i>SUPPLY AIR</i> . <sup>1</sup>                                          |
| Nominal <i>RECIRCULATION AIR</i> temperatures (db / wb) | °C   | Nominal dry and wet bulb temperatures of <i>RECIRCULATION AIR</i> . <sup>2</sup>                                   |
| Nominal <i>OUTDOOR AIR</i> temperatures (db / wb)       | °C   | Nominal dry and wet bulb temperatures of <i>OUTDOOR AIR</i> . <sup>3</sup>                                         |
| Available static pressure:                              | Pa   |                                                                                                                    |
| Maximum pressure loss on each filter stage:             | Pa   | The maximum pressure loss shall be indicated for each filter stage.                                                |
| Cooling medium:                                         | -    | In case of direct expansion coil, the <i>REFRIGERANT</i> designation shall be indicated.                           |
| Refrigerant charge:                                     | kg   | The refrigerant charge shall be indicated for the complete system, per circuit.                                    |
| Cooling medium entering and leaving temperatures:       | °C   | Nominal operating conditions.<br>In case of direct expansion coil, the evaporating temperature shall be indicated. |
| Total and sensible cooling capacity:                    | kW   | Nominal operating conditions.                                                                                      |
| Cooling medium operating pressure:                      | kPa  |                                                                                                                    |
| Cooling medium design pressure:                         | kPa  |                                                                                                                    |
| Heating medium:                                         | -    | In case of electrical heater, heating medium is "Electricity"                                                      |
| Heating medium entering and leaving temperatures:       | °C   |                                                                                                                    |

<sup>1</sup> In case of winter and summer conditions are different, the marking shall be: "Winter: xx/xx Summer: yy/yy"

<sup>2</sup> In case of winter and summer conditions are different, the marking shall be: "Winter: xx/xx Summer: yy/yy"

<sup>3</sup> In case of winter and summer conditions are different, the marking shall be: "Winter: xx/xx Summer: yy/yy"

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| Information                        | Unit | Comment (not indicated on name plate)       |
|------------------------------------|------|---------------------------------------------|
| Heating capacity:                  | kW   |                                             |
| Heating medium operating pressure: | kPa  |                                             |
| Heating medium design pressure:    | kPa  |                                             |
| Humidifier capacity:               | kW   |                                             |
| Humidifier piping design pressure: | kPa  |                                             |
| Net mass:                          | kg   |                                             |
| ATEX certification marking:        | -    | When ATEX certification marking is required |

## 11.2 Main tagging of ACC

A main name plate shall be installed on the ACC. Information shall be engraved on a stainless steel 316L plate, fixed outside the casing.

The main name plate shall indicate the following data:

| Information                               | Unit | Comment (not indicated on name plate)   |
|-------------------------------------------|------|-----------------------------------------|
| Project name:                             | -    |                                         |
| Equipment designation on the project:     | -    | Example: <i>NON ESSENTIAL</i> unit      |
| Air-cooled condenser:                     | -    |                                         |
| Name of the <i>MANUFACTURER</i> :         | -    |                                         |
| Address of the <i>MANUFACTURER</i> :      | -    |                                         |
| Phone number of the <i>MANUFACTURER</i> : | -    |                                         |
| Air-cooled condenser type:                | -    | As per <i>MANUFACTURER</i> codification |
| Air-cooled condenser serial number:       | -    |                                         |
| Purchase order number:                    | -    |                                         |
| Delivery date:                            | -    |                                         |
| Voltage:                                  | V    |                                         |
| Phase(s):                                 | -    |                                         |
| Nominal absorbed power:                   | kW   |                                         |
| Refrigerant:                              |      |                                         |
| Total air flow mass:                      | kg/h | Mass of nominal air flow rate at        |

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| Information                                    | Unit | Comment (not indicated on name plate)                                                        |
|------------------------------------------------|------|----------------------------------------------------------------------------------------------|
|                                                |      | outlet of the unit.                                                                          |
| Nominal air entering and leaving temperatures: | °C   | Nominal dry air temperatures at entering of the condenser air at discharge of the condenser. |
| Nominal condensing temperature:                | °C   |                                                                                              |
| Heat rejection capacity:                       | kW   | Nominal operating conditions.                                                                |
| Net mass:                                      | kg   |                                                                                              |
| ATEX certification marking:                    | -    | When ATEX certification marking is required                                                  |

### 11.3 Others

Instruments, selectors, push buttons or indication lights shall also be tagged when installed on the casing of the units.

All labels shall also be mounted on a visible position.

In addition to the labels related to electrical and mechanical hazards, a safety sign related to risk due to filters shall be installed on filtering section (refer to Filters section). The safety labels related to the *FANs* as required in the [EN 1886](#) shall also be installed.

## 12. Tests

The tests performed in the *MANUFACTURER* factory shall be described in a *FACTORY COMPLIANCE TEST (FCT)* procedure to be submitted to *COMPANY* for validation. The tests shall not be carried out until the procedure has not been validated by *COMPANY*.

This procedure shall explain the way of the performance and the functionalities will be demonstrated and shall depict the test bench. The tests sheets developed by the *MANUFACTURER* shall clearly indicate the target values of performance expected including the tolerances mentioned in the standards and/or those accepted by *COMPANY*.

For each type of test, when an anomaly or an inconsistency has been noted, it shall be clearly listed in a punch list system for future resolution and clearance.

### 12.1 Test NF EN 1886

The *ACU* shall be tested (real unit (R) and be compliant with the performance test as mentioned in the [EN 1886](#).

The tests carried out shall cover the mechanical strength, the air leakage, filter bypass leakage.

Note: the casing surface to be taken into account for determination of leakage air flow rate of the real unit (R) shall not include the area of the blanked inlet(s) and outlet(s) of airflow apertures (requirement from [NF EN 1886](#) regarding that topic shall be not considered).

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## 12.2 Full Load Test

A full load test shall be carried out in the *MANUFACTURER* factory in order to validate the capacities of the units. The aim is to verify whether the system is compliant with *COMPANY* requirements. In addition to the full load and low load capacities, the following capacities shall be demonstrated:

- *FAN*(s) flows
- Cooling capacity and capacity reduction
- Dehumidification capacity
- Heating capacity, when applicable
- Humidifier capacity, when applicable
- Noise measurement.

The two parts of the unit shall be assembled on a test bench in order to simulate the site conditions (temperature, *RELATIVE HUMIDITY*, pressure losses at *ACU* air handling inlet/outlet, pipe connection between *ACU* and *ACC*).

Specific operating conditions can be implemented in order to simulate the site conditions.

During the full load test, all adjustment and settings shall be noted within an adjustment sheet developed by the *MANUFACTURER*. These settings are for instance the variable speed drive set points, the initial pressure losses in filters, the superheat at evaporator outlet, etc.

## 12.3 Functional Tests

A functional test shall be carried out during the *FACTORY COMPLIANCE TEST (FCT)*. It shall demonstrate that all automation is operating. Monitoring and alarm sensors, alarm and consecutive sequences, information exchanges with plant *HVAC* Control System shall be verified if available.

Compliance with block diagrams, D&ID, safety logics, functional analysis, Cause & effect chart, etc. developed in the various control documents shall be verified.

## 12.4 Maintainability Test

During the factory test, it shall be demonstrated the maintainability of the unit. The test shall be included in the *FACTORY COMPLIANCE TEST* and shall be depicted in the *FCT* procedure.

It concerns the replacement of consumables, the free access of all devices for operation, monitoring and possible replacement and the withdrawal of the main pieces of equipment (e.g. evaporator, *FAN*, motor, compressor(s), actuator(s), refrigerating components, etc.) using the required lifting aids or special tools the units may require. This test shall also consider the final location of the *ACU* and *ACC* in the plant and the vicinity of *WALL*(s), cabinets, equipment below, above and around the units. The availability of the lifting means of the plant shall also be part of the rehearsal.

## 12.5 Compliance with Documentation

Further to the capacity and functionality of the units, compliance with Project specification (*HVAC* basis of design, General Specifications, etc.), Project documents (*D&IDs*, *P&IDs*,

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dimensions, arrangements, names plates, tags, position of battery limits, positions of fixation points, drawings, cable list, I/O list, etc.) and certificates examination (ATEX when required, materials, pressure tests, etc.) shall be verified.

## 12.6 Transportation

After the test and before transportation between the *MANUFACTURER* premises and the site, the refrigerant circuits shall be emptied of *REFRIGERANT* gas. The inlets/outlets of the units (*ACU* and *ACC*) shall be capped, vacuum tested and pressurized with dry nitrogen at 2 bar(g). A service valve shall be installed in order to control regularly the nitrogen pressure.

Signs shall be installed to indicate that the system is under pressure and shall indicate the value of the preservation pressure.

The necessary sea fastening shall be performed for transportation and handling of the units.

## 13. Inspection and Maintenance

Inspection and the maintenance of the *ACU* shall be only made from the front panel. Withdrawal of the components shall be proven feasible from the front face without moving or de-assembling the frame/casing.

Operability monitoring or inspection of the unit functionality like filter pressure loss, *REFRIGERANT* gas pressures, temperatures shall be easily accessible from the HMI without dismantling any other parts of the unit.

Replacement of consumables (filters, driers, oil, *REFRIGERANT* gas, etc.) shall not require the removal of any part of the unit except maintenance unit panels or the openings of the access doors.

Accessibility shall also be demonstrated the regular inspection or the replacement of devices such as instrumentation, valves.

Withdrawal of main pieces of equipment such as compressors, *FANs*, motors shall be demonstrated without taking apart structural elements of the casing, piping or cabling. When a piece of equipment heavier than 25kg needs to be withdrawn, a lifting aid or special tool (drawer, guide, jack, lifting points, trolley etc...) shall be provided by the *MANUFACTURER* unless a handling equipment of the plant is available and enable the lifting. This shall be tested during the *FCT* as indicated in Paragraph 12.4.

### 13.1 Specific Tools

When specific tools are required for the adjustment or the maintenance of the equipment, they shall be identified and provided by the *MANUFACTURER*.

Any instrument and software required for the maintenance, the configuration or the test of the *HVAC PLC* shall be considered as a specific tool and shall be supplied as well as all required official licenses for the said softwares.

### 13.2 Spare Parts List

A spare part list for commissioning, start-up and two years maintenance shall be provided by the *MANUFACTURER*.

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The spare parts list shall be filled on a form in accordance with the project documents.

The *MANUFACTURER* shall provide exhaustive equipment spare parts list including the designation and reference of each component, as mentioned in the catalogue of the originator *MANUFACTURER* of this component.

However, the spare part for commissioning & start-up shall be provided from the *MANUFACTURER*.

## 14. Construction

Once the units are installed on the plant construction site, they will be interconnected by either the *MANUFACTURER* or a yard *SUBCONTRACTOR*. The interconnection pipework (refrigeration pipework, condensate pipework) shall be made or at least supervised by the *MANUFACTURER*. The interconnection pipework includes the pipe sizing and design, routing, supporting, insulation and mechanical protection as well as the *REFRIGERANT* gas filling and the preservation procedure in case of the units will not operate for a long period of time.

The interconnection work also comprise electrical and instrumentation links.

When interconnection work is completed, it shall be validated by the *MANUFACTURER* preventing any future argument regarding the warranty of the unit. The interconnection work shall be compliant with the instruction provided by the *ACU/ACC MANUFACTURER*.

The requirements for refrigerating pipes applied for construction of *ACU* and *ACC* shall also be applied for refrigerating circuit between the two units.

## 15. Start-up and Fine Tuning

After completion of the interconnection work, units shall be started and fine tuned. Adjustment and setting points as per the *FCT* shall be the baseline of the final setting. These adjustments shall be carried out either on the plant construction site and/or the production site.

They will be part of the *PRE-COMMISSIONING* and *COMMISSIONING* activity of the whole plant.

## 16. Warranty

The warranty period shall only start according once the units have been started on site and when all Punch list are cleared and in accordance with the Project contract requirement.

## 17. Other references

Following documents are applicable:

- External Documents : [ADC](#), [AFI](#), [AGA](#), [AICVF Codes](#), [AMCA](#), [ARI](#), [ASHRAE](#), Directives [94/9/EC](#) referred to a [ATEX 100a/95](#), [97/23/EC](#) dated 29 May 1997, [98/37/EC](#) dated 27 June 1988, [2004/108/EC](#) dated 15 December 2004, [2006/42/EC](#) dated 17 May 2006, [2006/95](#) dated 12 December 2006, [EUROVENT](#), [NF EN 1216](#), [NF EN 10169](#) (Parts 1; 2; 3), [IEC 60034](#), [IEC 60079](#) (Parts 0; 14), [IEC 61310-1](#), [NF EN ISO 1940-1](#), [NF EN ISO 3741](#), [NF EN ISO 3744](#), [NF EN ISO 3746](#), [NF EN ISO 4628-3](#), [NF EN ISO 9614](#) (Parts 1; 2; 3), [NF EN ISO 11546](#) (Parts 1; 2), [NF EN ISO 14001](#), [NF EN 308](#), [NF EN 13463](#) (Parts 1; 3; 5), [NF EN 14986](#), [VDI 6022](#).



| General Specification                                                              |                         | GS EP HVA 206  |
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