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A. DESCRIPTIVE AND JUSTIFICATIVE MEMORY

#### 1. PURPOSE

THE PURPOSE OF THIS SPECIFICATION IS TO PRESENT THE HEATING, VENTILATION AND AIR CONDITIONING PROJECT RELATED TO THE STORAGE OF MEDICINES, IN THE CITY OF BEIRA.

THE BUILDING HAS BEEN EQUIPPED WITH A SET OF FACILITIES, WHICH GUARANTEE ADEQUATE AIR CONDITIONING CONDITIONS FOR THE FUNCTION OF THE SPACES TO WHICH THEY ARE INTENDED, ALLOWING FOR OPTIMIZED DRIVING AND EXPLORATION CONDITIONS.

IN THIS STUDY, WE WILL PRESENT THE TECHNICAL SOLUTIONS DESIGNED, ALWAYS BEARING IN MIND THE EQUILIBRIUM POINT INHERENT TO THE BINOMIAL MECHANICAL RELIABILITY VERSUS THE COSTS INVOLVED AND THE DESIRED LEVEL OF COMFORT.

THE ARCHITECTURAL DESIGN OF THE BUILDING AND THE PURPOSE OF THE VARIOUS SPACES TO BE TREATED, AS WELL AS THE DIFFERENT WAY OF ITS USES, WERE FACTORS ALWAYS PRESENT IN THE DEVELOPMENT OF THE VARIOUS SOLUTIONS PRESENTED.

#### 2. BUILDING CHARACTERIZATION

The medicine warehouse is characterized by 3 buildings with several distinct areas:

- Guardhouse, storage, filing rooms;
- Flammable warehouse;
- Warehouses 1 and 2, for medicines;
- · Loading and unloading zone;
- · Laboratory, Reagents and Psychotropics;
- Offices and social zones.

#### 3. CONDITIONS OF COMFORT AND SIZING

THIS PROJECT IS INTENDED TO GUARANTEE THE CONDITIONS OF CLIMATIZATION OF THE SPACES CONSTITUTING THE BUILDING. THE CALCULATION PARAMETERS ADOPTED FOR AIR CONDITIONING AND VENTILATION ARE PRESENTED.

The technical solutions presented will seek to provide an efficient response in order to obtain the desirable ambient conditions, taking into account the variables that influence them, which are:

- The temperature;
- Humidity;
- The noise level;
- Air speed.

In the development of this project, regulations, standards and various experimental values were consulted, which define parameters and clear intervals for some of the variables defined above. It should be noted that consultation with DL. No. 79/2006 of the Portuguese Republic, appears in the context of consultation and not as an obligation.

This study took into account, among others, the following documents:

- RECS Energy Regulation for Trade and Services;
- ASHRAE specifications;
- CARRIER specifications;
- SMACNA standards.

This project also took into account the experience and common sense acquired in similar projects.

As a result, the basic design conditions adopted in the present study are as follows:

## 3.1. EXTERIOR THERMO-HYGROMETRIC CHARACTERISTICS

## 3.1.1. SUMMER SITUATION

TEMPERATURE (DRY BULB)	35 [°C]
TEMPERATURE (WET BULB)	33.5 [°C]

#### 3.1.2. WINTER SITUATION

•	Temperature (Dry Bulb)	15 [°C]
•	Temperature (Wet Bulb)	13 [ºC]

#### 3.2. INTERIOR THERMO-HYGROMETRIC CHARACTERISTICS

#### 3.2.1. SUMMER SITUATION

- TEMPERATURE (DRY BULB)  $24 \pm 2$  [°C]
- Uncontrolled Relative humidity

#### WINTER SITUATION 3.2.2.

Relative humidity

- TEMPERATURE (DRY BULB)  $22\pm2$  [°C] Uncontrolled
- Note: Although the indoor relative humidity is not controlled, the values are typically between 30 to 70%.

## 3.3. GLOBAL THERMAL TRANSMISSION COEFFICIENTS

In this project, the global thermal transmission coefficients of the physical elements of the building envelope were considered based on the elements provided by Architecture.

- Coefficient allowed for exterior and interior walls: U = 2 [W / m2 K];
- Characteristics of glazed spans: U = 6,500 [W / m2 K], Solar Factor g = 0.85;
- Coefficient allowed for coverage: U = 1.3 [W / m2 K].

## 3.4. CONDUCT SIZING

In the design of ducts in general, the method of constant head loss was considered, given the following unit values, head loss:

 Insufflation, Return and Extraction Pcu = 0.06 [mmca / m]

#### 3.5. DIMENSIONING OF THE TERMINAL DIFFUSION AND AIR CAPTURE ELEMENTS

In general, the following principles will be adopted:

The air flow rates to be inflated and extracted are obtained through diffusers, grids and valves and their corresponding passage speeds should not exceed 2.5 [m / s] referring to the effective area of these terminal elements. The air flows through the door slots must correspond to a passage speed not exceeding 2 [m / s]. The speed of the indoor air does not exceed 0.25 m / s, except for the speed of the air that will come out of the cassette and wall type equipment, as it is impossible to control the speed of the air outlet.

#### 3.6. MAXIMUM ALLOWABLE NOISE LEVELS

Noise levels below or equal to the curves defined by the Noise Criteria described below are considered acceptable:

Interior of Building
45 dB (A)

#### 4. THERMAL LOADS TO IMPUTE TO SPACES TO CLIMATE

The load calculations were globally evaluated based on the CARRIER program "Hourly Analysis Program" v4.80, with the base data of the construction and probable occupancy times that led to the following values of total thermal cooling loads.

The thermal heating powers of the system designed for the building, did not exceed by more than 40% the design value established by the dynamic simulation.

## 5. CONSIDERATIONS ABOUT THE TYPE OF INSTALLATION

The solutions designed for air conditioning will take into account not only the comfort conditions referred to in point 3, but also other factors, namely technical and economic operating and maintenance.

In the economic aspect regarding the operation of A.V.A.C.'s equipment, account will be taken in addition to maintenance costs; the energy costs attributable to the operator and also those related to the primary energy spent and attributable to the country.

In the technical aspect, a certain autonomy of operation will have to be taken into account in addition to the maintenance facilities of the entire installation.

Taking into account the elements related to the thermal characterization of the surroundings, the orientation and implantation of the building and the foreseeable type and time of exploration, a thermal balance was established for the correct dimensioning of the different systems and networks.

#### 6. SOLUTIONS DESIGNED FOR AIR CONDITIONING AND VENTILATION

Based on the aforementioned characterization, we opted for the use of systems that ensure hygrothermal comfort conditions compatible with the required level of quality.

## 6.1. AIR CONDITIONING SYSTEMS

#### 6.1.1. CLIMATE OF BUILDINGS

The air conditioning of the buildings is generally ensured through split systems, with indoor units like ceiling consoles and murals.

These units are equipped with compressor speed variation technology (Inverter).

The interconnection between the UI and the EU will be made through a network of copper pipes with thermally insulated thickness, complying with the recommended in the RECS.

There will be new and exhaust air fans, thus guaranteeing the renewal of air in the spaces.

The sanitary facilities will always be ventilated through duct circuits and independent fans, so that there are no bad smells inside the other ducts.

All compartments where medicines are stored will be provided with natural ventilation through roof wind fans.

#### 7. THERMAL INSULATION OF PIPES AND DUCTS

The thickness of the copper pipe insulation must comply with Annex III of the RECS.

## 8. PANELS AND ELECTRICAL CONNECTIONS

The supply pipes to the HVAC equipment are part of the present contract and are identified in the Q.E.HVAC singleline scheme.

The connections between motive power and command between these panels and the equipment they control are part of the present contract.

## 9. OBSERVATION

The brands and models of the equipment, which are mentioned in the special technical conditions, constitute a definition of the quality level of the required materials, and not a limitation on the presentation of alternative brands and models.

On site, access to the interior of the false ceiling must be provided in order to be able to carry out preventive and / or corrective maintenance of the equipment, namely, adjustment of fan belts and cleaning of filters.

**B. GENERAL TECHNICAL CONDITIONS** 

#### **1. OBJECT OF THE CONTRACT**

The purpose of this contract is the supply, assembly, testing and commissioning of the materials and equipment of the HVAC FACILITIES of the Beira Medicines Warehouse, in accordance with the Execution project, which includes the Description, the Special Technical Conditions, as well as these General Technical Conditions.

The contractor is responsible for ensuring, at the work site, the real extent and location of the work to be carried out, as any omission will not exempt him from the responsibility of the proper functioning of the installation in order to achieve the purposes for which it was intended.

#### 2.SCOOP OF WORKS

#### 2.2. WORKS AND SUPPLIES INCLUDED

#### This designation includes mainly:

- Outdoor unit of the split system, with local power cut-off, control equipment, as well as all the respective accessories necessary for its proper functioning, and respective appropriate anti-vibration seat;

- Indoor units of the split systems, anti-vibration supports and adequate support, as well as all the accessories and work necessary for its proper functioning;

- Extraction fans and fresh air, including local cut-off switch, speed variators, weather protection roof, anti-rain visor with anti bird grid, differential pressure switch and all the accessories necessary for its proper functioning;

- Wind fans, as well as all accessories and work necessary for its proper functioning;

- Air ducts, thermal insulation and mechanical protection when installed outdoors and all the accessories necessary for its proper assembly and operation, as well as respective supports and suspensions;

- Refrigeration copper piping, properly insulated and mechanically protected when installed outdoors, as well as all the appropriate accessories, supports and suspensions;

- Diffusers, grids and valves including all mounting and fixing accessories necessary for the proper functioning of the installation;

- Flow regulation registers and all the materials necessary for their proper functioning;

- All materials, equipment and accessories that, although omitted, are nevertheless necessary for the proper functioning of the facilities;

- Adequate fixation of equipment to the structure of the walls or slabs of the building;

- Installation of the condensate network in thermal energy production and consumption equipment. If necessary, a circulation pump must be installed to drain the condensates;

- Water treatment system completely installed with all the accessories necessary for its proper functioning;

- Assembly, connection and testing of all equipment;

- Provision of technical support and material means to carry out the tests of the installations provided for in the respective technical specification;

- Supply and assembly of all control and power elements to supply the air conditioning units, including the electrical panel, cables, mats, piping, etc .;

- Means of transport and lifting equipment;

- Preparation and assembly drawings of the installations to be carried out;

- Final Installation screens.

NOTE: The contractor will be obliged to work closely with the other specialties, in particular with the Electrical Installations and Safety Contractor, in order to achieve an indispensable standardization of materials and execution processes.

All the works mentioned are included in the scope of this contract, both in the Written Pieces and in the Drawn Pieces, even if they are not mentioned in the Work Quantities Map.

The facilities included in the contract will be delivered to the Owner of the work, tested and ready to work.

Civil Construction works to support the execution of the contract are not included in this contract, such as:

- Demolition of masonry or concrete panels to create openings for placing air grids, passage of ducts, pipes or any other installations;

- Execution and finishing in plastered and painted masonry, of the gaps necessary for the placement or passage of elements mentioned above;

- Execution of massifs, for the various equipments;
- Opening and closing of notches;
- Opening in false ceilings for placing grids;
- Execution of hatches and visiting windows.

It is the Contractor's obligation to supply, within the established deadlines, and with the necessary detail, all the elements necessary for the dimensioning and execution of supporting civil construction works, with any changes or additional work being carried out, the execution of which will be carried out. necessary as a result of error or omission of those elements, as well as the fireproof sealing of the crossings of walls and ceilings in protected areas, if any.

#### REGULATORY, LEGAL AND OTHER PROVISIONS TO BE OBSERVED

All materials and equipment to be used must be of the best quality existing on the market, and must meet the conditions required for the purpose for which they are intended, comply with the prescriptions of regulations, standards and other national legislation currently in force, and have the characteristics specified in the clauses of these Technical Conditions. In the case of foreign-made materials for which there are no official Mozambican standards, they must comply with the regulations in force in their country of origin.

The drawings contained in this project must not be interpreted as limiting, namely with regard to the indicated routes, which must always be confirmed in view of the real conditions of the work and submitted to the approval of the Inspection before the start of the assembly work.

#### 2.3. GENERAL CHARACTERISTICS OF THE CONTRACTOR

All materials and equipment must, prior to application, be submitted to the Supervisory Board beforehand, accompanied by certificates of origin and the results of analysis or tests carried out in official laboratories, when required. The samples of the materials, which must be presented in due time, after being approved will remain in the work serving as a standard. Catalogs and operating manuals should also be provided.

The Contractor, when authorized in writing by the Inspection, may use alternative materials to those initially provided that their quality, effectiveness and reliability are not impaired and if this alternative does not represent additional costs for the contract.

The Contractor is obliged to execute all the installations with solidity and perfection, in the best technical conditions, according to the rules of the art of building well in strict observance of the Regulations and Standards in force and in harmony with the present Specifications and Parts Attached drawings, fulfilling all instructions provided by the Inspection.

#### 2.4. COORDINATION WITH OTHER CONTRACTORS

The Contractor must submit to the Inspection a work plan and a list of support work from other contractors, which can facilitate the execution of its own contract, namely:

- Civil construction (opening and blocking of openings, opening of access to equipment (Hatches), execution of crossings in floor plates and vertical ducts, drilling of walls, painting finishes, location of support structures for equipment, etc.);

- Electrical installations and equipment (definition and location of equipment to be supplied);

- Waters and Sewers (definition of sockets, pipeline layout, location of valves, pumping station, etc.);

## - Security installations.

The Contractor must collaborate with the Inspection so that the Work does not suffer delays due to uncoordination between works, and should therefore alert the Inspection in a timely manner to any situation that jeopardizes, directly or indirectly, the proper execution of the works.

#### 2.5. QUALITY CONTROL

Before the application of the equipment and materials, the Contractor must submit them for approval by the Inspection.

The Contractor will be entirely responsible for the application of equipment without the prior agreement of the Inspection, so any changes and / or substitutions not indicated by the Inspection will occur at his own risk.

It will also be on behalf of the Contractor to supply any samples requested by the Inspection for the purposes of testing and approval.

The contractor must present the Quality Plan accompanied by the following documents:

- Proof of Purchase Orders;
- Equipment Approval Sheets;
- Execution / Preparation Drawings Approval Sheets;
- Inspection and Testing Plan.

The equipment must bear an identification plate in a clearly visible place and be accompanied by technical documentation in Portuguese or English.

## 2.6. TECHNICAL DOCUMENTATION

Without prejudice to what is specified in the Technical Conditions and without limitation, the following are the general guidelines to be followed regarding the technical documentation to be provided.

With the proposal and by type of equipment, a description of its main characteristics must be provided, as well as a plan for jamming and catalogs of the proposed material.

Before the provisional reception, test bulletins must be delivered and the specific technical documentation of the equipment installed by the competitor, preferably in Portuguese, for approval by the Inspection.

The Contractor is obliged to provide the following documentation:

In the Consultation / Contest phase:

- Adequate and precise descriptive memory of the proposed systems and equipment and the concepts adopted;
- A complete set of designed parts, including plans, diagrams, details, etc., specifications and catalogs or brochures describing the various components that integrate the proposed systems or equipment;
- Intervention planning, in order to guarantee preventive maintenance and driving work, during the warranty period.

## 2.7. OPERATION TESTS

Without prejudice to the tests and tests specified in the Technical Conditions, the Contractor must provide in advance an exhaustive list of all tests that are proposed to be carried out on materials and equipment, which will be subject to inspection approval.

The Contractor will carry out, in the presence of the Inspection, all tests and functional tests contained in the list below, considered necessary to prove the satisfaction of all the technical conditions of the project, as well as proof of the proper operating conditions of the installation in QAI optics, which must be exhaustive, covering all points of insufflation and air extraction.

In accordance with ANNEX XIV of the RSECE, before receiving the installations, it is recommended, at least, the tests listed in the following list, provided that the components to which they refer are present in the installation, as applicable:

- Tightness of the duct network: losses in the duct network must be less than 1.5 I / s.m2 of duct area when subjected to a static pressure of 400 Pa. The test can be done, in the first instance, 10% of the network, chosen at random. If the test of the first instance is not satisfactory, the test of the second instance must be done in 20% of the installation, also chosen at random, in addition to the initial 10%. If this second instance also does not meet the desired criterion, all the following tests must be carried out at 100% of the duct network;

- Measurement of air flow rates: in each component of the system (indoor units and in the duct sections);

- Measurement of temperature and relative humidity (in air circuits): in addition to the measurements indicated in the previous paragraph;

- Measurement of consumption: in each fluid propellant and refrigeration machine;

- Verification of electrical protections: in all fluid propellers, indoor units, fans and condensing units;

- Verification of the direction of rotation: in all engines and fluid propellers;

- Verification of nominal efficiency: in all engines and fluid propellers;

- Verification of directions for placing filters: confirmation that all these components are properly assembled;

- Control system: it must be verified that it reacts as expected in response to a positive or negative request;

- Evidence that the condensates, produced in each place where they may occur, drain correctly.

#### 2.8. FINAL CHECKS BEFORE TESTING THE CONDUCT NETWORKS

Regarding the quality control of the pipeline network and its accessories, in the final stage of the pipeline assembly process, before proceeding to its test, the person in charge of the work must verify the following points:

- The final layout (s) corresponds to the project and the changes made to it are duly justified;
- The type of thermal and / or mechanical insulation applied to the sections is in accordance with the applicable project and standards;
- Visual inspection of the ducts to confirm the existence of the accessories provided for in the project (registers, deflectors, flange clamps, flexible joints, inspection doors, etc.);
- Visual inspection of the supports and their spacing, grips, alignments and adjustments to the hangers;
- If the final route does not correspond to the one drawn in the project, for justified reasons, it must be updated in the final screens, with all the necessary notes for a good understanding for the users of them in the phase of conducting and maintaining the post execution installations.

#### 2.9. WORK PROCESS

The transport operations of installation and assembly of the various equipment to be supplied must comply with the manufacturer's requirements, as well as with the rules of the art of building well and functioning of the installation in order to guarantee the IAQ:

- Pay special attention to the place where the equipment and pipelines are transported and stored, running the risk of the entry of dust, dirt and other contaminants;
- No isolated duct, should have direct contact between the insulation material and the circulating air;
- Cleaning of components built on site (eg masonry ducts, "full", etc.), and coating with material that prevents the release of dust derived from the building materials themselves must be guaranteed;
- Easy access must be provided for the maintenance of the following components: Filters, Batteries, Condensate Trays, Interior of fans and ducts.

#### 2.10. WARRANTY AND TECHNICAL ASSISTANCE

All works and equipment included in this contract will have a warranty period of 5 years from the date of provisional receipt, the Contractor being obliged, in this period, to replace all materials and equipment with defect in assembly, manufacture or without further charges to the Owner of the Work, and provided that there has been proven no abuse of use.

#### 2.11. FORMATION

The Contractor will assume responsibility for the training of operators that the Project Owner designates for the systems' operation and performance phase, supported by operating manuals in Portuguese, for as long as is necessary for complete efficiency.

The supplier must simulate and execute all necessary driving and maintenance actions, demonstrating the accessibility and simplicity of the procedures at any time of the work.

## 2.12. LABOR

The Contractor is obliged before the inspection of the work to present a list of personnel, with their technical classification, as well as to present a photocopy of their professional card.

#### 2.13. EXECUTION DRAWINGS

Before the start of the assemblies, within the period to be defined by the Work Owner and Supervision, the Contractor must present drawings and schemes, for the execution of all installations and details, in order to facilitate compatibility with other specialties, with emphasis on the following:

- Electrical and electronic schematics of the equipment, as well as its command and control devices;

- Detailed drawings for the execution and preparation of the pipeline network, including details of the installation of the equipment and ventilation grids;
- Drawings of metallic structures and details of fixings;
- Elements and details of civil construction necessary for assembly.

#### 2.14. INSTALLATION RECEPTION

All installations of the systems subject to this Regulation must be submitted to acceptance tests according to the defined methodology, at least with coverage of the list indicated in point 8 of this document.

After carrying out the tests and functional tests and its approval by the Work Owner, the Contractor must deliver the following documents to the Work Owner:

- Technical compilation of all equipment supplied and installed, consisting of updated equipment catalogs, technical service manuals (in Portuguese) and technical operation manuals, also in Portuguese;

- Final screens "as built" of the work carried out, the process being composed of 3 copies in digital support and respective plot configuration files and 3 copies on opaque paper.

- List of suppliers of equipment and respective contacts for eventual purchase of materials, after the warranty period.

In addition to the support mentioned above, the elements indicated must all be compiled into a single CD or DVD and delivered to the Work Owner.

#### 2.15. DESIGNATION AND NUMBERING NOTICES AND PLATES

All equipment must be provided with metal identification plates in Portuguese and numbered according to the drawings.

All driving, alarm or driving and maintenance instructions must be provided.

C. SPECIAL TECHNICAL CONDITIONS

#### **1. CLIMATIZATION**

#### 1.1. SPLIT SYSTEMS

The air conditioning of the rooms is ensured through a Split type system, cooled by air, using the ecological refrigerant R410A and equipped with Inverter technology.

They will be split units of the wall type and ceiling consoles to install on the wall / ceiling, respectively.

The unit to be installed inside is equipped with a R410a fluid / air exchanger in copper tube with aluminum fins fixed by mechanical expansion, a tangential centrifugal fan, coupled to a three-speed electric motor, condensate pump with a maximum elevation up to 500 mm, air discharge grille with variable deflectors (auto swing) and infrared receiver, for communication with remote control with liquid crystal display. They are electrically protected and have washable air filters.

Thanks to the new 3D turbo fan, the noise level reduction was 2 to 4 db compared to the previous model.

With the new flow control, using the air distribution angle, this unit has the ability to eliminate the sensation of draft.

This unit incorporates as standard a 3D I-See Sensor system, which consists of an 8-element infrared ray sensor located on the grid, which measures the temperature in different positions while moving from left to right, adapting the inflated air flow, so that the temperature is as uniform as possible in the space to be climatize. Detecting also the human presence or absence in space, thus allowing the adaptation of the air flow.

The outdoor unit consists of a hot-dip galvanized sheet steel casing, with a final finish using epoxy paint. The panels are removable in order to allow easy access to the internal components of the unit. It has a rotary inverter compressor, an R32 / air exchanger in copper tube with aluminum fins fixed by mechanical expansion, axial fan of variable rotation, electronic linear expansion valve, high pressure pressure switches, 4-way valve (cycle inversion), refrigerant accumulator and electronic board (microprocessor).

With the new flow control, using the air distribution angle, this unit has the ability to eliminate the sensation of draft.

The remote control (by cable for cassettes) allows you to control and view the following functions:

- On / Off;
- Operating mode;
- Temperature selection;
- Selection of ventilation speed;
- Hourly programming of the operating period.

#### 2. VENTILATION

#### 2.1 INLINE VENTILATORS

Low-profile helicocentrifugal fans will be extremely quiet for assembly and operation interleaved in the ducts, equipped with a perforated internal structure that directs the sound waves and sound-absorbing insulation that absorbs the radiated noise (\*), made of plastic material, with an external terminal box. , active, removable body, equipped with rubber gaskets at the inlet and outlet ports, for this way of absorption as vibrations.

Equipped with asynchronous induction motors, single-phase 230V-50 / 60Hz, bearing with lubricated porous bearings and watertight self-lubricating ball bearings, Class B - IP44, being able to work at an ambient temperature up to + 40°C or + 60°C, depending on the versions. They will have 2 improvement of functioning and / or improvement to be adjustable by voltage variation, thermally protected by fuse and with thermal protector of automatic reset.

It has an external terminal box orientable through 360° and plastic clamps for disassembling the motor body, allowing the removal of the housing / motor assembly easily, without the need for interference in the duct network in order to proceed with its maintenance. A support foot attached to the suction and discharge nozzles allows easy installation on a wall or ceiling. This support is incorporated as clamps for tightening the motor body.

#### Other data

TD-SILENT-T models incorporate a timer that can be adjusted between 1 and 30 minutes. They have a single speed motor, which is not adjustable.

Options to install:

- Speed variator;
- · Elastic couplings for connection to ducts;
- · Local cut button.

Reference make and model: Soler & Palau, TD model.

#### 2.2 ROOF VENTILATORS

Low-profile helicocentrifugal fans will be extremely quiet for assembly and operation interleaved in the ducts, equipped with a perforated internal structure that directs the sound waves and sound-absorbing insulation that absorbs the radiated noise (\*), built in plastic material, with external terminal box, detachable, active body, equipped with rubber gaskets at the inlet and outlet mouths, to thereby absorb vibrations.

Options to install:

- Speed variator;
- Elastic couplings for connection to ducts;
- Local cut button.

Reference make and model: Soler & Palau, model HCTB

## 2.3 BOX VENTILATORS

Low-profile helicocentrifugal fans will be extremely quiet for assembly and operation interleaved in the ducts, equipped with a perforated internal structure that directs the sound waves and sound-absorbing insulation that absorbs the radiated noise (\*), built in plastic material, with external terminal box , detachable, active body, equipped with rubber gaskets at the inlet and outlet mouths, to thereby absorb vibrations.

Options to install:

- Speed variator;
- G4 filter (fresh air fans);
- Elastic couplings for connection to ducts;
- Local cut button.

Reference make and model: Soler & Palau, model HCTB.

## 3. AIR DIFFUSION NETWORK

## 3.1. GENERAL

This specification concerns the ducts for HVAC installations, constructed from galvanized steel sheets. The mechanical characteristics of the surface treatment and the base steel are in accordance with Standard AFNOR A 36 - 321. The sheets to be used are class 01 with a zinc coating of not less than 275g / m<sup>2</sup>.

The ducts, singularities and accessories must comply with the European Standard EN12097, for low speed networks. The execution and installation of the pipeline networks will be done in accordance with the formally exposed in the Designed Parts with respect to the layout, dimensions and flow rates.

The connections of the ducts to the equipment are made according to what is indicated in the technical specifications and Designed Parts.

In omitted cases, the instructions of the respective manufacturers will be followed.

The dimensioning of the ducts was done according to what is indicated in the publication "HVAC SYSTEMS DUCT DESIGN - 1981 - 2nd EDITION" by SMACNA, (Sheet Metal and Ar Conditioning Contractors National Association,

Inc), for low speed ducts, having if particular attention is paid to the criteria of noise, allowable head losses and leakage flow rates.

The pipelines must be protected from dirt in the works, both during transport and during storage.

Accesses should be considered for cleaning the entire duct network (manholes - according to European Standard EN12097) even if these are not marked on the drawings.

#### 3.2. ACCESSORIES

Competitors are obliged to supply all accessories that, although omitted in the Designed Parts, are necessary for the good aero, mechanical and sound behavior of the air duct networks.

The supply of all air flow registers necessary to obtain the balance of static and dynamic pressures in the pipeline networks is part of the supply, with a view to respecting the flow rates indicated in the Drawings. These registers will be built according to the European Standard EN12097.

The connections of the ducts to the air handling units to the fans or to the joints of sections of ducts of different materials are made through flexible joints, constructed with inorganic materials (neoprene, rubber, vinyl, canvas, etc.). These materials have fire retardant characteristics.

The length of the flexible sleeve is between 75 and 100mm and in no case will it exceed 250mm. The flexible material is perfectly adjusted and fixed by means of stainless steel clamps in the case of circular section pipes. In ducts with a rectangular section, the flexible sleeve is fixed to metal collars, constructed with a sheet of the same thickness as the duct, using connection forms similar to those of the longitudinal seams of the ducts. The fixing of the metal ring or collar to the duct is performed by self-tapping screws or rivets.

Before installing the flexible connections, the ducts and openings of the equipment must be aligned.

The sections of the networks that have flow registers, must have inspection doors (according to the European Standard EN12097).

## 3.2.1. ACCESSORIES

Ducts of rectangular section must be constructed of galvanized steel sheet, with the following thicknesses:

Longest section side (mm)	BG	Plate thickness (mm)
up to 1065	24	0.63

From 1066 to 1220	22	0.80
From 1221 to 1520	20	1.00
From 1521 to 2130	18	1.25
From 2131	16	1.50
Pipes embedded in the slab		5.0

The air outlets for branches, grids and diffusers, T-taps at 90 ° or 45 ° and still other singularities that cause great turbulence (high pressure loss), are provided with deflectors of geometric configuration and adequate dimensions.

## 3.2.2. CIRCULAR SECTION CONDUCT

The ducts of circular section will be built in galvanized steel sheet according to the European Standard EN12097. The plate thicknesses are:

Duct diameter (mm)	Plate thickness (mm)
Up to 355	0.50
400 to 630	0.63
From 710 to 900	0.80
1000 to 1500	1.00
Pipes embedded in the slab	5.0

The cross-sectional dimensions must be in accordance with the supplier's manufacturing range.

## 3.2.3. CONDUCT INSULATION

The new air / insufflation ducts are provided with thermal insulation.

The return ducts to the units when in unconditioned spaces will be thermally insulated, with vapor barrier in kraft paper, reinforced with mineral wool fiber mesh and coated with aluminum.

The thickness of 30mm is used in the supply ducts installed inside the building.

As in the basement area the ductwork network will be visible, special attention should be paid to these areas, as the insulation must be applied taking into account the best aspect as possible.

Thus complying with the stipulated in Annex III, of the RSECE (DL-79/2006).

CONDUCTS	THERMAL INSULATION (thickness)		
	INTERIOR SPACES	EXTERIOR	
HOT AIR	20 mm	30 mm	
COLD AIR	30 mm	50 mm	

The ducts that cross exterior spaces must be covered with an insulation thickness of 50mm and covered with mechanical protection in aluminum or galvanized steel.

The insulation is fixed to the ducts by applying an adhesive material that is resistant to heat.

The thermal insulation must be correctly applied, and must present smooth and regular surfaces, uniformly cemented in the overlaps.

The materials will only be applied after the ducts have been subjected to tightness tests.

The insulation will present a continuous shape regardless of the existence of transversal supports of walls or ceilings.

## 3.2.4. CONDUCT STORAGE

In order to prevent some of the aspects mentioned above, the storage of the ducts must take some care during manufacture, transportation and on site or during assembly. One of the main precautions has to do with the need to cover the ends. For this purpose, three levels of protection are defined and can be summarized as follows:

Levels	Ends equipped with plugs			
	During manufacture	During transportation	During on-site storage	In the assembly
Basic (1)	No	No	No	Only in verticals
Medium (2)	No	No	Yes	Yes
Superior (3)	Yes	Yes	Yes	Yes

- (1) Ducts for simple ventilation and extraction
- (2) Normal conduct (offices and others)
- (3) Pipelines with special requirements (laboratories, pharmaceutical or microelectronic factories)

# 3.2.1 MANUAL CONDUCT RECORDS

The flow registers of circular or rectangular section will be entirely made of galvanized steel sheet. They will be of the butterfly type or multipads, with manual or motorized control. Use for flow regulation, for assembly between ducts. All bushings will be manufactured in bronze, thus preventing oxidation.

The drive will be manual.

Reference equipment: model AK or JZ-G from Trox, or equivalent.

#### 3.2.2 SUPPORT

All duct networks are solidly supported and fixed to building elements (slabs, beams, walls, etc.) or other permanent metal structures, so it will be up to competitors to provide all the accessories and materials necessary for proper execution.

The connections of the ducts to equipment are made in such a way that they do not transmit any efforts. The support of the ducts must be sufficient to withstand the weight of the ducts, insulation, registers and other elements integrated or assembled in them.

The support will have firm fixings in order to avoid vibrations in the pipeline networks, whatever the operating conditions.

The pipes of rectangular or circular section will have a distance between supports not exceeding 2.4m. The suspension support is made by "trapezoid" type supports, or rubber-coated clamps in the areas of contact with the support.

The ducts that are installed vertically, whether rectangular or circular, must have supports with a maximum distance of 3 meters, in the form of clamps, using an angle bracket. The ducts that are mounted in this position will have a set of suitable supports, so that the ends of the vertical path can move freely due to the thermal expansion that may eventually occur.

The profiles of the suspension bars for horizontal ducts must have the minimum dimensions of [25mmx3mm]; the angles will be [25mmx25mmx3mm].

"Trapezoid" supports are constructed according to the following dimensions:

Larger side of duct (mm)	Bracket Horizontal support	Suspension Rod Diameter (mm)	
	(mm)	*	
Up to 400	40x40x5	6	

\* - Alternatively, 25x25 angles can be used.

The vertical duct supports are built according to the following dimensions:

Larger side of duct (mm)	Iron bar or angle bracket (mm)
Up to 400	25x25x3

All wires and other elements used with temporary duct supports, during the installation phase, are completely removed at the end of construction.

No suspension or support should pierce the duct or the insulation.

All support of the ducts (suspensions, anchor bolts, supports, nuts, etc.) will be provided by the contractor.

The nuts, bolts and washers must be zinc-plated or tinted.

The cuts or welds that affect zinc plating will be covered by a thick paint rich in zinc (cold zinc).

The ducts, with external path or when in sight and isolated, will have aluminum sheet coating.

When inside and on a route that makes them visible, they will be properly painted.

#### 3.2.3 FLEXIBLE CONDUITS

This type of duct must be insulated and will only be used to connect the louvre or diffuser insufflation plates to the branches or bypass parts installed in the galvanized steel sheet ducts and provided that the equipment is installed on a false ceiling.

The length of these flexible sections will be essential to make those connections correctly (maximum 1 linear meter). In case it is necessary to make curves with the flexible conduit, the radius of curvature will be twice the diameter of the conduit.

The ducts will not be flattened. When connecting the ends of the ducts to the necks of the plenums, flow register or taps there will be a minimum overlap of 25mm. The tightening is done by means of proper clamps, made of synthetic material, which are adjusted by pliers, which should not be tightened to give rise to any perforations in the duct wall.

The conduits are supported by means of metal clamps in galvanized sheet, with a minimum width of 25 mm.

The edges will be rounded in order to avoid perforation of the flexible conduit wall or the thermal insulation coating.

The suspension of these clamps is made by metal tape with the same width and thickness as the clamps. Galvanized wires may eventually be used for this purpose.

The spacing between clamps is not more than 1.5 m and the deflection arrow of the duct will not exceed 50 mm. If the deflection is greater, the spacing will be reduced.

The ends and the covering of the ducts are made with self-adhesive aluminum tape, with a minimum width of 50 mm and is provided by the duct manufacturer.

#### 3.3 DIFFUSERS AND GRIDS

All grids and diffusers must be of good quality and made of thermo-lacquered aluminum in the color to be defined.

Flow rates and passing speeds must be taken into account, in addition to the air flow range and respective terminal speed.

The peripheral tightness of the grids and diffusers must be guaranteed by means of a rubber gasket or nylon mousse.

The models and characteristics of the grids and diffusers indicated in the drawings and the quantities map are as follows:

## 3.3.1 SIMPLE GRIDS / DOUBLE DEFLECTION

#### **Description**

Grill with individually adjustable horizontal front blades, with beveled frame. The width of this frame can be 27mm or 23mm according to the aesthetics to be defined by the Architecture.

It should include a flow regulation register of the opposite action multi-blade type adjustable from the front of the grid.

Fixing should be hidden - no screws on the front frame.

It should include a peripheral seal located on the front of the frame to ensure a good seal on the contact surface between the grid and the wall.

## Construction / Finishing

Both the frame and the blades are made from anodized aluminum profiles in natural color with possible thermo-lacquer in a color to be defined by the Architecture.

Mounting rings made from galvanized sheet steel profiles.

#### Assembly

It should be mounted in the indicated places, using the mounting ring for a perfect finish of the opening in the wall and an effective posterior mounting of the grid. The size of the negative to be opened should be carefully confirmed with the supplier.

#### <u>Sizing</u>

The nominal size of each grid inscribed in the drawings must be confirmed by means of abacuses, tables, graphs or appropriate software from a suitable manufacturer, which, for the indicated flow rates, must observe the following parameters:

- Max. 20 Pa and Max power level. 40 dB (A) - considering the register 50% open.

Reference equipment: France Air GAC 10 and 21 or equivalent

## 3.3.2 EXTERIOR GRIDS

The grids are suitable for transferring air between partitions or exhausting the air. They have horizontal blades fixed in an inverted "V" shape, in a flat frame with pre-made holes in order to allow a fixation through visible screws.

As an option, these grills have a back-frame that allows a perfect finish of the opening in the door on the opposite side to the one where the grid is installed.

## **Materials**

The grids are made from extruded aluminum profiles in RAL color to be defined.

Reference equipment: France Air GEA and GLA

# 4 FLUID NETWORKS

# 4.1. THERMAL INSULATION

The insulation of pipes and accessories must be applied at ambient temperatures close to 21°C. The tubes must be dry and clean. The contiguous insulating parts must be tightened tightly against each other, in order to minimize the necessary cross-joint.

Likewise, the insulation must not be interrupted when crossing structures (walls, roofs, etc.), in which case to avoid problems of water infiltration, the insulation must be impregnated with an asphalt product or equivalent material.

Only in special and duly justified cases of absolute lack of space, the thickness of the insulation may be less than the minimum required values. The suspensions, supports and moorings will be insulated in a similar way and with the same material of the pipes in a length of not less than 200 mm.

They will be externally insulated with elastomeric foam sleeves, a material that must comply with the following specifications:

- Thermal conductivity coefficient of 0.040 W / m°C.
- Usage temperature = 40°C to + 105 ° C
- The insulation must not be hygroscopic, corrosive to copper, nor attack or feed fungi and bacteria.

Insulation should be applied in a manner recommended by the respective manufacturer, and the glue recommended by the manufacturer must also be applied.

All piping sections of the hot water networks, in the visible areas, will also have mechanical protection in aluminum plate or equivalent.

Due to its cylindrical shape, it must be able to be assembled by threading and, when this is not possible, apply insulation, cutting the tubular elements longitudinally, with the application of glue on each cutting face, compressing the joints to ensure good adhesion. The joints between tubular elements, and between these and the insulation of accessories and valves must be covered with self-adhesive strips with a minimum width of 50 mm, which must also be applied at the ends of the isolated paths.

The insulation should have the following thickness:

Outer diameter [mm]	Fluid temperature °C			
	-20 a -10	-9,9 a 0	0,1 a 10	>10
d ≤ 35	40	30	20	20
35 < d ≤ 60	50	40	30	20
$60 < d \le 90$	50	40	30	30
90 < d ≤ 140	60	50	40	30
140 < d	60	50	40	30

Thus complying with the stipulated in Annex III, of the RSECE (DL-79/2006).

In pipes to be installed outdoors, the thickness of the insulation varies depending on the diameter of the pipe.

In order to protect the insulation, mechanical protection based on aluminum foil with a minimum thickness of 0.8 mm, carried out in half-barrels and closed by cadmium screws or other equivalent mechanical protection, must be provided.

The valves, whether motorized or not, will be isolated in the same way as the piping, being surrounded by removable aluminum shells, surrounded by clamps fixed by spring locks, in cases where there is mechanical protection.

#### 4.2 CONDENSATE NETWORK

The condensate network inherent to this contract includes:

- Condensate network in the air treatment unit, in the indoor and outdoor units and their connection to the nearest storm sewer plumbs or sanitary facilities;
- The connection to the equipment should be made with a horse's neck, in order to leave a siphon, thus avoiding the propagation of network odors into the equipment.
- Condensate drainage pipeline branches with a horizontal path will have a 0.5% slope.

The drainage of the condensates will be carried out (through the false ceiling or embedded in the wall) in PVC piping. The condensate will be conducted through a pipe network to a drainage point previously defined for this purpose.

The entire piping of the condensate network must be insulated, regardless of whether it is on a false ceiling or in a cut in the walls or floor.

## 4.3 COOLING COPPER PIPING

The interconnection piping between the outdoor unit and the direct expansion indoor units (split's and "closecontrol"), will be made of seamless copper tube.

The entire tubing will be thermo-hygroscopically insulated with 120 ° C resistant spongy polyethylene shells with a 20 mm thick anti-vapor barrier. Common insulation on gas and liquid lines is not permitted. Only external protection can be common.

The tubing will be fixed using clamps or, alternatively, you can also "walk" on perforated metal mats, with a size appropriate to the dimensions of the tubing. Outside the metal mat must be protected with a metal plate. All branch forks and manifolds will be properly insulated and adequately protected when installed outdoors.

The sections of the pipes and accessories will be those indicated in the drawings.

Procedures and Recommendations:

• Vacuum the installation (either on the low pressure side or on the high side).

• To vacuum the system, use a vacuum pump with a non-return valve to protect the system in the event of a power failure.

• Check with pressure gauges and thermometers that the supplied refrigerant is actually what the systems use.

• Cleaning of copper installations with nitrogen at 40 Bar for 48 hours.

• Copper welding with 30% Silver ideally.

• Do not leave the copper pipes open for a long time, as there will be no entry and deposit of contaminants / waste.

• After vacuuming the installation, change the filter drier if necessary.

• Compressor plugs should only be removed when connecting to the installation with the vacuum already in place.

• Oxyacetylene welding of covers made preferably with oxygen, acetylene (more common) can also be used. Alternatively, compressed air can be used, however the quality of the weld and the speed decrease.

## 4.4 ASSOCIATED ELECTRICAL INSTALLATIONS

The electrical connections of HVAC equipment are present in the contract for electrical installations.

Mozambique, Matola, 28 October 2020

Andre' Palces

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