**SPECIFICATION FOR THE HVAC INSTALLATION FOR CSIR BUILDING 2 BASEMENT**

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**FOR**

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**HVAC INSTALLATION FOR THE CSIR BUILDING 2 BASEMENT**

**SECTION 1**

**DETAILED PROJECT SPECIFICATION**

# GENERAL

## NOTES

* + 1. The detailed project specification together with all other documentation such as the standard specifications, and all schedules and drawings as described in this tender document, constitute the specification and will be the basis of the contract.

## Scope of Work

The Work to be performed under this contract includes the supply, procurement, delivery, erection, testing, commissioning and handing over of a complete air conditioning and ventilation installation for this building, fully operational to the Employer and the guarantee and comprehensive maintenance thereof for a further period of 12 months.

The installation includes the following:

* 1 × Removal of existing rooftop packaged unit
* 1 × Installation of a new hybrid rooftop packaged unit
* 1 × Installation of a new axial fresh air fan to laboratory as per layout
* Servicing and executing remedial works on existing extraction and fresh air fans to specification.
* Servicing and executing remedial works on existing DX split system units to specification.
* Ducting, motorised dampers, fire dampers, etc. modifications
* Installation of a new air-conditioning monitoring central controller for the rooftop packaged unit.

## SPECIFICATIONS

This detail specification is specifically applicable to this installation and will have preference over the Standard Specifications.

The latest revision of the Standard Specifications listed in Section 5 of this document will apply to this contract.

## RESPONSIBILITY OF THE CONTRACTOR

* + 1. The Contractor shall only use qualified and experienced personnel for this project.
		2. The Contractor is responsible to hand over a complete and fully operational installation to the Employer and shall therefore include for all minor items not specifically specified, but which are required for the proper operation of the systems as specified.

## ARRANGEMENTS WITH THE SUPPLY AUTHORITY

The Contractor shall register with, pay all fees and notify the electrical supply authority regarding all electrical work performed as part of this Contract.

## CONTRACT

Refer to the attached documents regarding all conditions of contract and sub-contract.

## QUALITY AND QUALITY ASSURANCE

* + 1. The Contractor is primarily responsible to ensure that the installation meets the requirements of the Specification.
		2. Refer to Clause 6 of Standard Specification A-SPES-00-01.
		3. It is not compulsory for this project that the Contractor shall be approved to ISO 9001:2000, but it will be expected of the Contractor to implement written systems by competent persons to ensure that the quality of the installation will meet the requirements of this Specification to the satisfaction of the Engineer.

## HOLD POINTS

To assist the Contractor in order that corrective action can be taken in good time, the Engineer requires that at least the following quality control programme be implemented.

* Engineer’s approval of Data Sheets for all major equipment prior to placing of orders.
* Approval of Circuit Diagrams and General Arrangement Drawings of all Control Boards.
* Approval of all shop drawings before commencing installation.

*Written approval shall be obtained from the Engineer prior to proceeding after each Hold Point is reached.*

## PROGRAMMING

* + 1. The Contractor shall compile a detail programme in conjunction with all parties, as set out in Clause 8 of Standard Specification A-SPES-00-01.
		2. This programme shall be submitted to the Engineer within 2 weeks from date of appointment.

## SITE, SITE CONDITIONS & SITE FACILITIES

* + 1. This site is located on the CSIR Campus, Building 2, Meiring Naude Road, Lynwood Manor, Pretoria, 0081, Gauteng
		2. The Contractor shall acquaint himself fully of the prevailing site conditions, access to the site, storage and other facilities prior to submitting a tender since no claim in this regard will be considered.
		3. Arrangements to visit the site during the tender period shall be made with the clients supply chain management if considered necessary.
		4. The Contractor shall allow in their tender price for the cost of hoisting and handling of all material and equipment.
		5. The contractor shall allow in his tender price for site establishment including the provision of an area to store materials and equipment.

## CLAIMS

Refer to Clause 9 of the Standard Specification A-SPES-00-01.

## DRAWINGS

* + 1. Refer to Clause 10 of the Standard Specification A-SPES-00-01
		2. The Contractor will be required to keep a separate set of all approved drawings on site and to continually "mark-up" any alteration, additional information in order that he can produce "as installed" drawings.

## RESPONSIBILITY OF OTHER PARTIES

 None.

## OPERATING AND MAINTENANCE MANUALS

* + 1. One hard copy and two soft copies of the complete operating and maintenance manuals, including "as installed" drawings shall be supplied to the Engineer in terms of Clause 11 of Standard Specification A-SPES-00-01, prior to the Engineer accepting the installation for "Take-over".

## INSPECTION, TESTING, COMMISSIONING AND HANDING OVER

The requirements of Clause 12 of the Standard Specification A-SPES‑00‑01 will apply.

## TRAINING OF EMPLOYER'S PERSONNEL

The requirements of Clause 13 of the Standard Spec A-SPES‑00‑01 will apply.

## TOOLS, EQUIPMENT AND TEST INSTRUMENTS AND MAINTENANCE TOOLS

The requirements of Clause 14 and 15 of the Standard Specification A‑SPES-00-01 apply.

## CODING, LABELLING, NOTICES AND NAME BOARDS

The requirements of Clause 16 of the Standard Specification A-SPES-00-01 apply.

* + 1. In addition to the above requirements, the Contractor shall install a name plate in a position as indicated by the Engineer indicating the installation, the firm’s name and emergency telephone numbers.
		2. No project name board will be required as part of this Contract.

## FIRE EXTINGUISHERS

No fire extinguishers are required as part of this Contract.

## FIRST AID KITS

As required by the OSH act and other applicable local safety codes and by-laws.

## GUARANTEE PERIOD

The Contractor shall guarantee the complete installation for a period of 12 months after the Final Completion Certificate - Form D has been issued, or as agreed to by the Engineer, in terms of Clause 19 of the Standard Specification A-SPES-00-01.

## MAINTENANCE PERIOD

* + 1. The Contractor shall comprehensively maintain the Installation for a period of 12 months after the Final Completion Certificate - Form D has been issued, or as agreed to by the Engineer, in terms of Clause 20 of the Standard Specification A-SPES-00-01.
		2. The Contractor shall attend promptly within 24 hours to all complaints received by email and shall report to the Employer's nominated representative (maintenance manager) on arrival and departure and shall ensure that his written report is countersigned in the "Logbook".
		3. The 12-month maintenance shall include monthly visits to site to wash filters and check all operating components and parameters, **as well as one major annual service**.
		4. All chemicals required during the maintenance period will be for the account of the Employer.
		5. The 12 Month maintenance shall include all required material and labour, i.e. no cost to employer (Filters, Gas, etc.).

## SITE PROCEDURES

Site and other procedures will be issued from time to time by the Employer such as security arrangements, access control etc.

## CERTIFICATE OF COMPLIANCE

The Engineer will not issue a Final Completion Certificate - Form D until he is in receipt of a Certificate of Compliance in terms of Clause 20 of the Standard Specification A-SPES-00-01.

# DESIGN DATA

Altitude : 1700 m

Summer Ambient : 34°C DB / 15,7°C WB

Winter Ambient : -0°C DB

Condenser Coil : 40°C

Inside Design Conditions (Air Cond) :22°C DB ±2°C (Summer)

 : 20°C DB ±2°C (Winter)

# NOISE AND VIBRATION

## The Contractor shall select equipment and shall ensure that the following noise ratings are attained as far as noise generation by air conditioning and ventilation equipment is concerned:

|  |  |
| --- | --- |
| Location | NC Rating |
| Offices / Lab Rooms | NC 30 |

The increase in noise due to any air conditioning and ventilation equipment shall be limited to an increase of 3 dB above back-ground noise, measured on the boundary of the site.

Internal measurements shall be measured anywhere within the air-conditioned space, but not closer than 1200 mm from any air inlet or outlet.

## All equipment generating vibration shall be mounted on anti-vibration mountings and springs to prevent any vibration carry-over to the building structure.

# SCHEDULE OF EQUIPMENT

Any of the equipment listed below can be used for the main offer of the tenderer. No other alternatives may be used without written approval from the engineer.

|  |  |
| --- | --- |
| Equipment | Suppliers |
| Rooftop Packaged Units Main | Eco-Aire, Clivet, Heating Centre, Systemair, Trox |
| VRF/V Units  | Daikin, Mitsubishi, LG, Samsung, Hitachi, Ecoaire, Dunham Bush |
| Diffusers, Disc Valves, Grilles & Weather Louvres | Trox |
| Fire Dampers | Trox |
| Controls | Elliwell, Carell |

# AIR DISTRIBUTION SYSTEM

## DUCTING

 All duct penetrations through exterior walls/dog boxes shall slope away from the outer walls by 5° to prevent water leaking into the building.

* + 1. Round Air Conditioning Ducting (Air Conditioning)

Ducting shall be low pressure galvanised spiral sheet metal ducting. Unless otherwise indicated on the drawings ducting shall be externally insulated with 50mm Duct Wrap insulation. **The first 2400mm of ducting from the HVAC unit to be internally lined with acoustic liner.** Standard Specification A-SPES-31-01 shall apply.

* + 1. Rectangular Air Conditioning Ducting (Air Conditioning)

Ducting shall be low pressure rectangular galvanised sheet metal ducting. Unless otherwise indicated on the drawings ducting shall be externally insulated with 50mm Isover FRK insulation. **The first 2400mm of ducting form the HVAC unit to be internally lined with acoustic liner.** Standard Specification A-SPES-31-01 shall apply.

* + 1. InternalDucting for Ventilation Systems

Ducting shall be uninsulated galvanised steel ducting to SANS 1238: 2005 and SANS 10173: 2003 unless otherwise specified on the drawings.

* + 1. ExternalDucting for Ventilation Systems

Ducting shall be internally insulated galvanised steel ducting to SANS 1238: 2005 and SANS 10173: 2003 unless otherwise specified on the drawings.

* + 1. Existing ExternalDucting

The existing ducting is internally lined and shall be thoroughly cleaned by a duct cleaning specialist. The ducting shall also be cleaned externally, all leaks shall be sealed, and all rust shall be treated and painted with galvanise paint.

All ducting modifications shall be measured on site and internally lined to the same specification as the existing ducting.

* + 1. Existing InternalDucting

 The existing ducting shall be thoroughly cleaned by a duct cleaning specialist. The ducting shall also be cleaned externally, all leaks shall be sealed, and damaged paint to be repaired.

All ducting modifications shall be measured on site and painted to the same colour as the existing connected ducting.

## DIFFUSERS, DISC VALVES, GRILLES AND LOUVRES

The air flow rates of all air inlet and outlets are indicated on the drawings.

The size, type and number of diffusers, disc valves, grilles and louvres are indicated on the drawings.

Technical submittals shall be submitted timeously to the engineer for technical and aesthetic approval before equipment may be ordered, the engineer may also request samples of any items.

Diffusers, disc valves, grilles and louvres shall be powder coated to a colour as specified on the drawings and must be priced for in the BOQ. If not specified, the colour shall be white.

Low pressure insulated flexible ducting shall be used to connect diffusers/grilles with reducers if required. Connections shall be strapped and riveted to eliminate disconnection. No flexible ducting longer than 1.5m will be allowed. All flexible ducting shall be nonflammable.

All fixings shall be concealed.

* + 1. Diffusers

All existing diffusers shall be thoroughly cleaned and flexible ducts shall be replaced. The existing VAV diffusers shall be replaced with new TROX VAV diffusers as indicated on the drawings. The final size and number of diffusers is indicated on the drawings.

Insulated flexible ducting shall be used to connect diffusers with reducers if required. Connections shall be strapped and riveted to eliminate disconnection. No flexible ducting longer than 1.5m will be allowed.

* + 1. Door Grilles

All existing door grilles shall be thoroughly cleaned and where door grilles are missing or are deemed inefficient, these will be replaced or installed with TROX non vision grilles with fixed inverted vee blades.

## SOUND ATTENUATORS

Supply and install sound attenuators in the positions shown on the drawings to meet the specified noise levels.

Sound attenuators shall be manufactured by an approved reputable manufacturer such as DONKIN SILAX P-Series or WOODS. Any alternative to these manufacturers has to be specified in the tender document.

# ROOFTOP PACKAGED UNITS

* 1. Supply and install one hybrid full fresh air rooftop packaged units as indicated on the drawings.
	2. The **main offer** for the VRF Heat Pump can be anyone of the major air conditioning manufactures such as Daikin, LG, Mitsubishi etc. The manufacturer of the VRV units will then work together with a preferred local Rooftop Package Unit manufacturer and build the hybrid unit. This price will be included in the BOQ.
	3. Supply and install the following Rooftop Packaged Full Fresh Air Unit:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Total Cooling Load [kW] | Total Heating Load [kW] | Supply Air [l/s] | Fresh Air [l/s] |
| RTPU 1 | 38 | 54 | 3000 | 3000 |

* 1. Standard Specification A-SPES-31-15 shall be applicable.
	2. The system shall be complete with, ducting, motorized modulating dampers, supply grilles, with filters and associated Controllers.
	3. The rooftop packaged unit must be reversible heat pump systems with the ability to cool or heat depending on the room requirements. Electrical elements to be provided as a back-up.
	4. The RTPU supply air fan shall be fitted with a VSD. A pressure differential sensor shall be fitted over the filters that is connected to the VSD. The VSD will keep the pressure constant by ramping the fan speed up or down depending on the ducting system pressure. The modulating dampers will vary the supply air volume and the RTPU’s must adjust accordingly. The supply air fan will be EC-type plug fans fitted on a fan wall and must have the ability to be changed while the unit is operational.
	5. A manual low leak damper shall be installed on the RTPU for the fresh air intake and shall comply to the general specifications. The entire 100% of the supply air volume shall be outside air.
	6. All condensate drains, interconnecting wiring and trunking shall form part of this Contract.
	7. There is an existing suitably sized electrical supply to the plant room. A new distribution board (DB), with all associated breakers, contactors and relays, will be the responsibility of the contractor. The electrical supply from this distribution board to the RTPU DB’s will also be the responsibility of the contractor.
	8. All exposed piping and cabling shall be installed in steel wiring channels.
	9. The contractor shall make provision for the rigging of the rooftop packaged unit to the plant room situated 5 metres above the car park level.
	10. The rooftop packaged unit shall be installed on a combination spring-rubber anti-vibration mounts with a minimum static deflection of 15mm.
	11. The unit shall have the ability to function in economizer cycle, i.e. switching the compressor and condenser off when outside conditions are favorable.

# CENTRAL CONTROLLER

## A new central controller shall be installed in the south passage of the laboratory - refer to drawing

## The controller shall have the following functionality:

* Monitoring of all RTPU’s
* Supply and return temperature & humidity monitoring of each RTPU
* Temperature adjustments (up or down) of each RTPU and shall be lockable
* Fault/error warnings
* Dirty filter warning
* Turning units “on/off”

## All control wiring, conduits, trunking, hangers, etc. from RTPU’s and the central controller forms part of this contract.

# DRAIN PIPING

## The Air Conditioning subcontractor shall install all drain piping from the unit to a nearby drain point.

## Drainpipes shall be 40mm dia mild steel securely fastened with a slope towards the final drain point.

# ELECTRICAL INSTALLATION

## The complete electrical installation for the operation of the air conditioning and ventilation installations shall form part of this Sub-Contract. SABS 1042 1981 a.a. will be applicable.

## The making off all supply cables and wiring and the connection of all supplies form part of this sub-contract.

## There is an electrical supply to each plant room. The Existing DB’s shall be replaced with new weatherproof DB’s with all required breakers, contactors & relays as specified in the DB schematics. A phase failure relay shall be installed on the main incoming line with the following protections:

* Over and under voltage spike
* Phase failure
* Phase rotation
* Floating neutral
* Asymmetry

## The Contractor shall confirm all electrical supplies within two weeks after the tender is awarded.

## The number and position of the wall mounted thermostats are indicated on the drawings. All associated conduits draw boxes and communication cables vorms part of this contract.

## The wall mounted controllers shall have the following features:

* Temperature control setpoint
* Temperature sensor
* Relative humidity sensor
* Temperature and humidity display

## The wall mounted controller will adjust the associated modulating damper actuator according to the set temperature and room temperature. The control system shall be able to adjust the damper between 0% and 100% and any value in-between.

## It will be the responsibility of the air conditioning contractor to connect all interconnecting communication wiring which includes all conduits, draw boxes, trunking, etc. for the following communication cables:

* From the rooftop packaged units to the central controller on ground floor.
* From the wall mounted thermostats to the actuated dampers

## The supply and installation of the fire rated communication cables between the fire panels and the RTPU’s and between the fire panel and fire dampers do not form part of this contract.

**SECTION 2**

**STANDARD SPECIFICATION**

**FOR THE**

**HVAC INSTALLATION AND REMEDIAL WORKS**

**FOR**

**CSIR BUILDING 2 BASEMENT**

**STANDARD SPECIFICATIONS**

The Standard Specifications of which have been marked as applicable to this Installation shall form part of this Specification and will apply.

Standard Specifications which have been referred to or specified in the Specification, but which have not been included can be obtained from the Engineer.

|  |  |  |
| --- | --- | --- |
| **SPECIFICATION NO.** | **DESCRIPTION** | **APPLICABLE** |
| A-SPES-00-01-W14A-SPES-31-15-R02A-SPES-38-02-R01A-SPES-38-01-R01A-SPES-31-01-R03A-SPES-31-02-R03A-SPES-31-03-R03A-SPES-30-01-W07A-SPES-30-05-W02 | GENERALSTANDARD SPECIFICATION FOR GENERAL REQUIREMENTS OF PROCEDURES (NO 21)MECHANICALSTANDARD SPECIFICATIONS FOR LARGE SELF-CONTAINED ROOFTOP AIR CONDITIONING UNITS.STANDARD SPECIFICATIONS FOR VRF AIR CONDITIONING UNITSSTANDARD SPECIFICATIONS FOR ROOM AIR CONDITIONING UNITS OF THE CONSOLE, SPLIT & VRV/F TYPESTANDARD SPECIFICATION FOR AIR DISTRIBUTION SYSTEMSSTANDARD SPECIFICATION FOR AIR CONDITIONING AND VENTILATION FANSSTANDARD SPECIFICATION FOR AIR FILTERSSTANDARD SPECIFICATION FOR PAINTING AND COATINGS (NO 63)STANDARD SPECIFICATION FOR NOISE AND VIBRATION CONTROLS (NO 67) | YESYESYESYESYESYESYESYESYES |

**STANDARD SPECIFICATION**

**FOR**

**GENERAL REQUIREMENTS**

**AND**

**PROCEDURES**

**STANDARD SPECIFICATION FOR GENERAL REQUIREMENTS AND PROCEDURES**

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[17. FIRE EXTINGUISHERS 36](file:///%5C%5CSRV1%5CPublic%5CStandard%20Specifications%20and%20Lists%5CPlantech%5CFile%2021%20%28A-SPES-00-01-W13%29%20General%20Requirements%20and%20Procedures%5CA-SPES-00-01-W14%20Standard%20spec%20for%20general%20requirements%20and%20procedures%202017-08-17.doc#_Toc527449252)

[18. EMERGENCY EQUIPMENT, MEDICINE AND FIRST AID 36](file:///%5C%5CSRV1%5CPublic%5CStandard%20Specifications%20and%20Lists%5CPlantech%5CFile%2021%20%28A-SPES-00-01-W13%29%20General%20Requirements%20and%20Procedures%5CA-SPES-00-01-W14%20Standard%20spec%20for%20general%20requirements%20and%20procedures%202017-08-17.doc#_Toc527449253)

[19. GUARANTEE PERIOD 36](file:///%5C%5CSRV1%5CPublic%5CStandard%20Specifications%20and%20Lists%5CPlantech%5CFile%2021%20%28A-SPES-00-01-W13%29%20General%20Requirements%20and%20Procedures%5CA-SPES-00-01-W14%20Standard%20spec%20for%20general%20requirements%20and%20procedures%202017-08-17.doc#_Toc527449254)

[20. MAINTENANCE PERIOD 36](file:///%5C%5CSRV1%5CPublic%5CStandard%20Specifications%20and%20Lists%5CPlantech%5CFile%2021%20%28A-SPES-00-01-W13%29%20General%20Requirements%20and%20Procedures%5CA-SPES-00-01-W14%20Standard%20spec%20for%20general%20requirements%20and%20procedures%202017-08-17.doc#_Toc527449255)

[21. OCCUPATIONAL HEALTH AND SAFETY ACT REQUIREMENTS 37](file:///%5C%5CSRV1%5CPublic%5CStandard%20Specifications%20and%20Lists%5CPlantech%5CFile%2021%20%28A-SPES-00-01-W13%29%20General%20Requirements%20and%20Procedures%5CA-SPES-00-01-W14%20Standard%20spec%20for%20general%20requirements%20and%20procedures%202017-08-17.doc#_Toc527449256)

**STANDARD SPECIFICATION FOR GENERAL REQUIREMENTS AND PROCEDURES**

1. **GENERAL**
	1. Documentation

The specification for this installation consists of all written documents such as Conditions of Tender and Contract, Standard Specifications, Project or Detail Specifications, Bills of Quantities and Schedules together with applicable Drawings.

* 1. Discrepancies, Conflicts And Ambiguities

Any discrepancy or contradiction between the Tender/Contract documents and drawings, shall be brought to the notice of the Engineer in writing for a ruling, prior to submitting a Tender.

* 1. Contractor / Subcontractor

Where the Installation referred to in this Tender is a subcontract of the Principal contract, the word “Contractor” refers to the Subcontractor responsible for the Installation.

1. **SCOPE OF WORK**
	1. The installation and scope of works is fully described in the Project Specification.
	2. Unless otherwise specified the specification includes the design, supply, delivery, erection, testing, commissioning and handing over in complete working order as well as the maintenance and guarantee for a period of 12 months after acceptance by the Engineer.
	3. The installation shall be complete and shall include all material and equipment necessary for the proper functioning thereof.
2. **SPECIFICATIONS**
	1. The Project Specification will specifically apply to this installation and will have precedence over the Standard Specifications.
	2. The Standard Specifications of the Engineer which apply to this Contract are listed in the Project Specification.
	3. 3.3 REFERENCE SPECIFICATIONS

The latest revisions of any Specification or Code issued by the SABS/ISO or other Standards referred to in this Specification, will be applicable.

1. **STATUTORY AND REGULATORY REQUIREMENTS**
	1. The Contractor shall ensure that the Installation, including all equipment used, is designed, installed and maintained in compliance with the following regulations:
2. SANS 10142: Code of Practice for Wiring of Premises.
3. Occupational Health and Safety Act - Act 85: 1993 as amended by the Occupational Health and Safety Amended Act No. 181 of 1993 and the labour Relations Act, No. 66 of 1995.
4. National Building Regulations ‑ Act 103 of 1977 a.a. as deemed to be satisfactory in terms of SANS 10400‑2010 a.a.
5. Applicable regulations of Telkom S.A.
6. Municipal, Local or where applicable other authorities by laws and regulations with regard to building, electrical, fire, gas, water, traffic and health requirements.
7. The Montreal Protocol for refrigerants.
8. Regulations, requirements and licensing as laid down by SATRA for radio installations.
9. General Machinery Regulations GNR 1521 of 5 August 1988.
10. General Safety Regulations GNR 1031 of 30 May 1986.
11. General Administrative Regulations GNR 929 of 25 June 2003.
	1. The latest revisions amendments or additions to the above-mentioned regulations will apply.
	2. The Contractor shall exempt the Employer from any claims, losses or expenditure which may arise as a result of the Contractor's negligence or failure to comply with the above-mentioned regulations.
	3. The Contractor shall be responsible for all notifications and payments required by any Authority for inspections, tests and supply of any service required for this Installation. The Tenderers are therefore required to fully acquaint themselves with these requirements prior to Tendering.
	4. The Contractor shall supply and install all notices and warning signs that are required by relevant laws or regulations, to the full approval of the Engineer and the applicable authorities. All uncertainties of any such requirements shall be clarified prior to tendering. The cost of all such notices shall be allowed for in the tender.
	5. Refer to Clause 21 specifically with regard to the OHSA requirements.
12. **CONTRACT**

Refer to the Conditions of Contract in this regard.

1. **QUALITY OF MATERIALS AND WORKMANSHIP**
	1. All material and equipment for this Installation shall be new and undamaged, unless otherwise stated in the Project Specification.
	2. All equipment and material shall be of the highest quality as specified and shall be suitable for the application and prevailing conditions on site.
	3. A comprehensive CV of the person responsible for site supervision shall be submitted to the Engineer. The Engineer may require an interview with the proposed supervisor and may request replacement of the supervisor, which shall in no way alter the contract tender amount.
	4. The labour used by the Contractor on this Installation shall at all times be adequately qualified and experienced for the particular task and shall execute the work in a professional manner to the full satisfaction of the Engineer.
	5. The Contractor is responsible to ensure that the Installation meets all the requirements of this Specification.
	6. Refer to the specific requirements for this Contract regarding Quality Assurance procedures.
	7. Under no circumstances may any material or equipment be ordered or installed other than the equipment offered in the respective schedules of Information, without obtaining written approval from the Engineer.
	8. **APPROVAL OF EQUIPMENT SELECTIONS**

The Contractor shall obtain written approval from the Engineers in writing before major equipment is ordered.

* 1. **SAMPLES**

The Contractor shall, if requested to do so, provide samples of any material, equipment or test section of a fabrication process.

1. **SITE LOCATION, SITE CONDITIONS & SITE FACILITIES**
	1. The location of the site is described in the Project Specification.
	2. **SITE VISIT**

Tenderers are advised to visit the site and acquaint themselves fully of all local conditions pertaining to the execution of the contract before the tender closing date, since no claims arising from insufficient knowledge of site or related conditions will be considered.

* 1. **STORAGE OF MATERIAL**

The Contractor shall provide the necessary storage facilities to ensure that all material and equipment is safely stored and protected against any possible loss or damage.

Unless otherwise agreed in writing payment will only be made for materials delivered and stored on site.

* 1. **SITE OFFICE**

The Contractor shall provide the site office and all other necessary facilities required by his personnel for the proper execution of this Contract.

1. **PROJECT MANAGEMENT AND PROGRAMMING**

The Contractor shall at all times ensure that he has the necessary experience and expertise for the successful internal project management, programming and reporting of the total project.

The programme to carry out the Work shall be submitted in detail covering all significant operations and shall be presented as a bar chart to the Engineer within 4 weeks from date of appointment.

The Contractor's programme shall cover each item of equipment in the Contract and indicate periods for:

1. Preparation, approval and finalization of manufacturing drawings.
2. Ordering and procurement
3. Manufacturing
4. Inspection and testing during manufacture
5. Delivery
6. Installation on Site
7. Testing
8. Commissioning.
9. Take-over
10. Maintenance visits

The programme shall furthermore clearly indicate the required cashflow, as well as the full details of the planned manpower requirements throughout the project.

The programme shall be updated regularly and the required copies shall be supplied to the Engineer at each meeting.

A written progress report, clearly indicating the latest progress as well as any deviations from the approved programme, complete with proposals for corrective action, shall be submitted at each site meeting.

All procedures to be followed during the execution of the Contract will be determined at a Briefing Meeting to be attended by all concerned parties shortly after the awarding of the Contract.

1. **CLAIMS**

All claims which may result in additional cost or extension of time shall be submitted to the Engineer as set out in the Conditions of Contract, but the following shall apply at all times irrespective of that which is stated elsewhere:

* + The Engineer shall be notified of any possible claim within 7 days of the occurrence.
	+ The cost of the claim shall be submitted within a further 14 days.
	+ Should an event/instruction cause a possible disruptive influence on the progress of the Contractor, it shall immediately be brought under the attention of the Engineer in writing, in order that the necessary arrangements and possible reprogramming can be done to eliminate or minimize the disruption or delay.
1. **DRAWINGS**
	1. **AVAILABLE DRAWINGS**

The Contractor shall acquaint himself fully with the available information on the following drawings:

* Architect's drawings
* Structural Engineer's drawings
* Drawings available of all other services such as electrical, mechanical, plumbing and other specialised services.

The Contractor shall be responsible for all site co‑ordination of his Installation with the other Contractors and Subcontractors.

* 1. **STANDARD OF DRAWINGS**

All drawings shall be of sufficient quality to ensure ‑ clear and legible copies at all times.

* 1. **BUILDER'S WORK DRAWINGS**

The Contractor shall provide Builder's Work Drawings in accordance with the construction programme but not later than 4 weeks after acceptance of his tender which shall indicate all openings in concrete slabs, brick walls or building structure, walls or structure to be temporary left out for access to install equipment, the mass and dimensions of all heavy equipment, wooden frames and any other builder's work such as plinths, bases etc. including services to be provided i.e. electrical, water and drainage.

* 1. **DETAIL DESIGN DRAWINGS (SHOP DRAWINGS)**

The Contractor shall submit to the Engineer, in accordance with the construction programme, 2 copies of each shop drawing for approval. A marked‑up copy with the Engineer's and if applicable Architect's comments will be returned to the Contractor who will update the original accordingly after which the original shall be submitted to the Engineer for his signature.

The Engineer's approval shall not relieve the Contractor of his responsibility for erection or installation or of errors or omissions in the shop drawings.

Five (5) copies of each certified drawing or revision shall be issued to the Engineer for distribution during construction.

The Contractor will be required to produce the following Project Design Drawings:

(a) Electrical Systems

General Arrangement Drawings

Schematic and Circuit Diagrams

Basic Logic Diagrams

Interconnection Diagrams

Cable Schedules

Cable Route Lay‑out Drawings, complete with supporting details

(b) Mechanical Systems

General Arrangement Drawings

Process Flow Diagrams

(c) Instrumentation System

Control Diagrams

Sequence Diagrams

Logic Diagrams

The drawings shall be sufficiently in detailed to enable the Employer's staff to maintain, dismantle, reassemble and adjust all parts of the works. The layouts shall indicate the location of all manual and automatic control devices, control panels, sensors, thermostats, etc. The wiring diagrams shall indicate all motor kilowatt ratings and circuit breaker and contactor ratings and protection settings.

A copy of the wiring diagram shall be mounted in the plant room in a glass fronted frame. The diagrams shall be printed by a non‑fading process.

* 1. **“AS INSTALLED” DRAWINGS**

Drawings shall be updated as work progresses in order that the “As-Installed” Drawings on completion reflect the final Installation.

One set of hard copy and soft copy drawings shall form part of each O&M manual.

Soft copy drawings shall be compatible with AUTOCAD software.

1. **OPERATING AND MAINTENANCE MANUAL**

The Contractor shall prepare and supply O & M manuals for the successful operation and maintenance of the Installation.

The manual shall include:

1. A system description of the Installation
2. Step‑by‑step operating instructions with start‑up and shut‑down procedures
3. Full information of the Contractor including emergency telephone and fax numbers and contact persons.
4. A list of equipment (and spares) giving the following information for each item:

Description :

Make :

Model No :

Manufacturer/Agent : (Name, address, tel & fax no)

Comment : (Indicate spares to be held if of a critical nature)

1. Data sheets, characteristic curves and calculations
2. Catalogues and brochures
3. List of recommended lubricants
4. Set of "As‑Installed" drawings
5. All commissioning data and settings
6. Test certificates
7. Completed Certificate of Compliance

A draft copy shall be submitted to the Engineer prior to commencement of commissioning. Prior to Taking‑over the Installation by the Employer, the Contractor shall supply 3 complete manuals which have been updated and which include all commissioning data and "As‑Installed" drawings called for in Clause 9. The Engineer will not issue "Form C" until all the approved O & M manuals and drawings have been received.

1. **INSPECTIONS, TESTING, COMMISSIONING AND TAKING OVER**
	1. **PROGRESS INSPECTIONS**

The Engineer will hold inspections at his discretion during the contract to ensure that the Contractor meets the requirements of the Specification and that the Contractor is fulfilling his responsibility regarding quality control.

Should remedial action be required the Engineer will notify the Contractor, and the Contractor shall rectify this work within 7 days.

* 1. **"HOLD POINT" INSPECTIONS AND TESTS**

“Hold Point” inspections and Tests are identified in the Project specification and the Contractor requires written approval to proceed.

The Engineer is required to inspect, and test certain equipment listed in the specification under "Hold Points" at their place of manufacture and such equipment may not be delivered to the Contract site, nor may the Contractor proceed with the manufacture and/or installation of such equipment without prior written consent from the Engineer.

The Contractor must give the Engineer at least 7 days advance notice of the date at which such tests and inspection are to be carried out unless otherwise agreed by both parties.

* 1. **COMPLETION AND TAKE-OVER PROCEDURES**

In terms of the Conditions of Contract the following procedure will apply to the "take-over" of the Installation, or if required by the Employer to the sectional completion of a portion thereof.

FORM A: APPLICATION FOR PRACTICAL COMPLETION INSPECTION (COMPLETION TEST INSPECTION – FIDIC)

After the physical completion of manufacturing and upon completion of the installation, the Contractor shall carry out his own internal quality control checks on all the various items of the installation, where after such "Contractor’s Inspection List" shall be signed off by the Contractor and be submitted to the Engineer together with a "Form A" to apply to the Engineer within one week for the Practical Completion Inspection List.

Subject to the discretion of the Engineer detailed in writing, the Installation may be divided into different sections for the application of the above inspection procedure.

Any inspection carried out by the Engineer on the request of the Contractor without the above documentation will be regarded as unofficial, and the cost may be recovered from the Contractor.

* + 1. FORM B: PRACTICAL COMPLETION INSPECTION CERTIFICATE (COMPLETION TEST CERTIFICATE – FIDIC)

Once the Engineer has received a "Form A" from the Contractor he will officially inspect the Installation, listing all minor outstanding items still to be rectified on a Practical Completion List - Form B1.

**Commissioning:**

All site testing and all commissioning activities as specified shall be carried out in close co-operation with the Engineer.

It is a requirement of this Contract that the Contractor shall submit a complete testing and commissioning procedure to the Engineer for approval, at least two weeks prior to the commencing of the actual testing and commissioning activities on Site.

All testing and commissioning shall be carried out in the presence of the Engineer or his duly authorised representative and shall at all times be thorough and in strict accordance with the specified requirements and approved procedures. All tests carried out without the Engineer been duly notified, will be regarded as unofficial and may at the discretion of the Engineer have to be repeated at the cost of the Contractor.

* + 1. FORM C: WORKS COMPLETION CERTIFICATE (TAKE-OVER CERTIFICATE – FIDIC)

The Engineer will issue Form C, after the items listed on Form B1 have been completed to his satisfaction, together with his Final Completion List containing all outstanding and unacceptable work (except undetected patent and latent defects). The Contractor shall complete all items listed within 20 working days.

The Engineer will only issue Form C if all O&M manuals, and “As-Installed” drawings have been received and training of personnel has taken place.

* + 1. FORM D: FINAL COMPLETION CERTIFICATE (PERFORMANCE CERTIFICATE – FIDIC)

The Engineer will issue, on request by the Contractor, a Final Completion Certificate at the end of the Defects Liability (Retention) Period.

* 1. **COST OF RE-INSPECTIONS**

Should the Engineer, after an inspection or test, find that the number of outstanding defects is of such a nature that he is unable to issue a meaningful list or certificate, or that due to the Contractor not attending to previous lists or reports, re‑inspections are required, such reinspections will be charged to the Contractor and deducted from the balance of his account by means of a variation order. The Engineer will be compensated accordingly by the Employer.

1. **TRAINING OF EMPLOYER'S PERSONNEL**
	1. Once the Contractor has completed and commissioned the Installation and issued the O & M manuals to the satisfaction of the Engineer, he shall train the Employer's personnel the proper operation and maintenance of the plant.
	2. The Contractor shall prepare and submit a recommended training program to the Engineer for approval.
	3. The Contractor shall give the Engineer sufficient time to make the necessary arrangements.
	4. The Contractor will remain responsible to operate the Installation on a daily basis until he has adequately trained such personnel.
2. **TOOLS, EQUIPMENT AND TEST INSTRUMENTS**
	1. The Contractor shall provide all tools and equipment necessary for the proper and efficient execution of the work.
	2. The Contractor shall provide all test instruments necessary for the proper testing of equipment or systems to ensure that the specified requirements are met.
	3. The Contractor shall provide valid calibration certificates for all instruments.
	4. If necessary the Engineer will arrange for test instruments and the cost will be recovered from the Contractor, as set out in clause 12.4.
3. **MAINTENANCE TOOLS**
	1. The Contractor shall provide one complete set of all special tools, such as gland keys, lockshield valve keys, air cock keys, etc., required for testing, dismantling or operating all items of equipment.
	2. Duplicate keys shall be provided for all control panels, instrument locks, safety valve locks etc.
4. **CODING, LABELLING AND NOTICES**
	1. The language shall be English, or as specified by the Engineer.

To reduce the possibility of incorrect wording the Contractor shall submit a proposed "Schedule of Labels and Notices" to the Engineer for approval prior to manufacture and at least 4 (four) weeks in advance thereof.

* 1. For painting/colour coding refer to the Standard Specification for Painting and Coatings A-SPES-30‑01.
	2. **MANUFACTURER'S NAMEPLATE**

All equipment shall be provided with a manufacturer's nameplate, which shall be a copper, anodised aluminium or stainless-steel tag, welded or riveted to the equipment. (No "glue‑on" plates will be accepted.) The lettering thereon shall be suitable to withstand the climatic or other conditions under which the equipment is to operate.

The nameplates shall display the information required by the relevant SANS specifications. At least the following shall be shown:

Manufacturer’s name

Model number

Volume where applicable

Size, Speed, Power input, Power output, FLA,

All letters shall be hard stamped and at least 4 mm.

Supply Voltage, etc whichever may be applicable.

* 1. **IDENTIFICATION TAG**

The Contractor shall provide an identification tag or label with the equipment identification code, in approved format, screwed or riveted next to each piece of equipment (no 'glue on' attachment will be accepted).

Labelling shall be CRITCHLEY UNILABEL Cable Marker or engraved "IVORENE" or "TRAFOLITE" labels.

Black letters on a white background shall be used.

The minimum height of letters shall be as follows:

Equipment identification = 10 mm

* 1. **NOTICES**

The Contractor shall install all notices required in terms of Statutory Regulations and shall amongst others include the following:

* + 1. Prohibiting unauthorised persons from entering.
		2. Prohibiting unauthorised persons from handling or interfering with electrical apparatus.
		3. Directions and procedures to be followed in case of fire or emergency.
		4. Directions as to resuscitation of persons suffering from the effects of electrical shock.
1. **FIRE EXTINGUISHERS**

The Contractor shall install the fire extinguishers specified in the Project Specification which meet the requirements of SANS 1910 / 1151 as applicable and to the approval of the Local Authorities in all locations where installation work is done as part of this Contract.

1. **EMERGENCY EQUIPMENT, MEDICINE AND FIRST AID**

The Contractor shall provide a first aid box or boxes as specified in the Project Specification in the plant room(s) which meets the requirements of Machinery and Occupational Safety Act (Act no. 6 of 1983) a.a.

1. **GUARANTEE PERIOD**

The Contractor is required to guarantee the complete installation against defective material and workmanship for a minimum period of 12 months after the Final Completion Certificate ‑ Form D has been issued by the Engineer. During this period the Contractor will be required to rectify or replace all defective items at his cost.

The Contractor shall cede all manufacturers’ warranties to the Employer.

1. **MAINTENANCE PERIOD**

The Contractor shall comprehensively maintain the installation as part of this Contract for a minimum period of 12 months after the Final Completion Certificate ‑ Form C has been issued by the Engineer.

The Contractor shall submit a maintenance programme to the Engineer for approval and shall allow for a monthly maintenance visit during this period.

The Employer shall not be expected to do any maintenance work during this period and only consumable items such as water, electricity etc. and items specifically mentioned in the Project Specification will be paid for by the Employer, while all other costs will be for the account of the Contractor.

In addition to regular maintenance visits, the Contractor shall attend and react promptly to all complaints by the Employer, regarding failure of any item of equipment.

The Contractor shall report to the Employer's nominated representative on site both his arrival and departure times and shall make the necessary entries in the "Maintenance Log Book" of all visits to the Installation.

The Contractor shall timeously, prior to the expiry of the 12-month maintenance period, submit a quotation to the Employer for a further maintenance contract.

1. **OCCUPATIONAL HEALTH AND SAFETY ACT REQUIREMENTS**
	1. The Contractor shall ensure that all requirements of the Act are adhered to and shall point out any shortcomings in this regard.
	2. **CERTIFICATE OF COMPLIANCE FOR ELECTRICAL INSTALLATIONS**

The Contractor shall issue a Certificate of Compliance for all electrical work which forms part of the installation under his control. The Engineer will not certify the installation as complete until he is in possession of this certificate.

* 1. **SAFETY**

The safety specification is as follows and the Contractor shall adhere to, but not limited, to the following:

* + 1. All requirements of the latest OSH Act and Regulations will apply.
		2. The Contractor shall take note of the potential hazards related to a construction site, such as:
1. Explosive materials will not be allowed.
2. Work in confirmed spaces and fumes – adequate ventilation shall be provided.
3. Excessive dust – Take measures to reduce dust and issue dust masks to workers.
4. Work above 2 m – Provide workers with harnesses and ensure that scaffolding is inspected for safety.
5. Excavations deeper than 1 m – Provide anti-subsidence measures.
6. Falling materials – Ensure that all workers wear hand hats and safety shoes.
7. Electrical equipment – Check cords and connections daily and ensure that earth leakage relays and circuit breakers operate correctly
8. Welding – Ensure adequate ventilation and take measures against potential fire hazards.
9. Ensure that flammable and combustible materials are safely stored.
10. Ensure that fire fighting equipment is functioning and clearly identified with approved notice signage.
	* 1. Safety plan – The Contractor shall compile a safety plan prior to the commencement of work on site.
		2. Safety training – The Contractor shall train all workers on site regarding safety and provide induction courses for all persons who enter the site.
		3. Safety audits – The Contractor shall appoint a safety officer. The Contractor shall prepare regular safety reports and appoint a safety consultant if he does not have the necessary safety skills.
	1. **PRESSURE VESSELS**

All pressure vessels shall be manufactured and tested as required by the Act.

* 1. **LIFTS AND ESCALATORS**

All lifts and escalators shall be manufactured, erected and tested by a registered Contractor in terms of the Act.

**APPENDIX TO STANDARD SPECIFICATION A‑SPES‑00‑01**

**FORM A :** Application for Practical Completion Inspection

 The forms below are not necessarily included in the Tender Document but are available:

**FORM B :** **B:** Practical Completion Certificate (Completion Test Certificate – FIDIC)

**B1:** Practical Completion List

**FORM C :** Works Completion Certificate (Take-Over Certificate - FIDIC)

**FORM D :** Final Completion Certificate (Performance Certificate – FIDIC)

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| **FORM A** |
| **APPLICATION FOR PRACTICAL COMPLETION INSPECTION (COMPLETION TEST INSPECTION - FIDIC)**PROJECT : ........................................................................................................................................INSTALLATION : ........................................................................................................................................PORTION : ........................................................................................................................................CONTRACTOR : ........................................................................................................................................REFERENCE NO. : ........................................................................................................................................ |
| As Contractor responsible for the erection of the abovementioned Installation, I hereby certify that the Installation has been completed in full accordance with the Specification and the Engineer's instructions, and that initial commissioning has been completed.As responsible person of the Contractor I hereby certify that I have inspected the installation and that all the items as listed on my “Contractor’s Inspection List”, a copy of which is attached, have been completed to my satisfaction.I therefore officially request that the "Practical Completion Inspection" in terms of the contract be performed by the Engineer. I accept that should the inspection prove fruitless due to false declarations in the above paragraphs, I will be liable for the Engineer's cost in performing additional inspections.I herewith hand over draft copies of the Operation and Maintenance Manual, "As Installed Drawings" and Commissioning Procedures for the Engineer's comments.SIGNED : \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ For Contractor Print NameDATE : ......./......./........**COPIES:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Plantech\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Principal Agent\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Principal Contractor |
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| **FORM B** |
| **PRACTICAL COMPLETION CERTIFICATE (COMPLETION TEST CERTIFICATE - FIDIC)**PROJECT : ........................................................................................................................................INSTALLATION : ........................................................................................................................................PORTION : ........................................................................................................................................CONTRACTOR : ........................................................................................................................................REFERENCE NO. : ........................................................................................................................................ |
| **NOTE:** A Practical Completion Certificate will be issued for each portion for sectional completion.The installation is substantially completed and can be used for the purposes intended and has passed the initial tests.**ENGINEER'S REPORT**Contractor's Final Inspection List received? NO/YES DATE : ...../..../.....Draft O & M Manual received? NO/YES DATE : ...../..../.....Draft "As Installed Drawings" received? NO/YES DATE : ...../..../.....Commissioning Data received? NO/YES DATE : ...../..../.....The items listed on the attached Practical Completion List (Form B1) shall be rectified before the Contractor requests a Works Completion Inspection.The Principal Agent shall ensure that the items marked as the responsibility of other parties be attended to by such parties.SIGNED:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_For Plantech (Pty) Ltd Date**COPIES:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Employer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Principal Agent\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Principal Contractor\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Contractor |

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| **FORM B1** |
| **QUALITY REPORT / PRACTICAL COMPLETION LIST** (Delete if not applicable)PROJECT : ........................................................................................................................................INSTALLATION : ........................................................................................................................................PORTION : ........................................................................................................................................CONTRACTOR : ........................................................................................................................................REFERENCE NO. : ........................................................................................................................................ |
| **NOTE:** This Quality Report gives a “running” record of quality and other matters which require attention and rectification and the outstanding items at date of the issue of the Practical Completion Certificate, becomes the Practical Completion List.

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| --- | --- | --- | --- | --- |
| **ITEM** | **DESCRIPTION** | **RESPONSIBLE PARTY** | **DATE OF INSPECTION** | **DATE ACCEPTED** |
|  |  |  |  |  |

SIGNED:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_For Plantech (Pty) Ltd Date |

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| **FORM C** |
| **WORKS COMPLETION CERTIFICATE (TAKE-OVER CERTIFICATE - FIDIC)**PROJECT : ........................................................................................................................................INSTALLATION : ........................................................................................................................................PORTION : ........................................................................................................................................CONTRACTOR : ........................................................................................................................................REFERENCE NO. : ........................................................................................................................................ |
| The items marked for the responsibility of the Contractor on the Practical Completion List (Form B1) have been rectified and completed.The defects liability period will commence on the date of this Certificate.Three hard & soft copies of the Operation and Maintenance Manual were received and that two copies have been handed to the Employer ................................. NO/YES DATE: ....................Three hard and soft copies of the "As-Installed" drawings have been received and two sets has been handed over to the Employer ................................. NO/YES DATE: ....................The Employer's personnel have been trained by the Contractor to operate the Installation. NO/YES DATE: ....................The Contractor has satisfactorily completed all his contractual commitments in terms of the Contract with the exception of his responsibilities during the maintenance and guarantee period, which he undertakes to do punctually.All rights of equipment guarantees and warranties are hereby ceded by the Contractor to the Employer.All parties accept the final contract sum to be R............................................................... including VAT, as the full and final payment regarding the Contract signed and declares that no further claims will be submitted.Refer to the attached Final Contract Sum Summary.The Employer shall take cognisance of the expiry date of the one-year maintenance and guarantee period by the Contractor and will be responsible for all maintenance of the Installation from .........................The Employer shall take cognisance that from the date of this Certificate he is fully responsible for the Installation and the safe operation thereof in terms of the Occupational Health and Safety Act (Act 85 of 1993).Admission to the installation for retention and maintenance work shall be under the full control and authority of the Employer and the Contractor shall approach the Employer in order to make arrangements for admission for such work during the Guarantee and Maintenance period.The Employer shall record all complaints regarding the operation of the Installation in the “Maintenance Log Book” and notify the Contractor thereof.Dates of all visits and reports on written complaints recorded by the Employer or User shall be signed by both the Contractor and the representative or the Employer in the "Maintenance Log Book" held on site.Final Completion List: The following additional remedial items shall be attended to by the Contractor within 20 days.

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| **ITEM** | **DESCRIPTION** | **DATE ACCEPTED** |
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SIGNED:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_For Plantech (Pty) Ltd Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Employer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Principal Agent\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Principal Contractor\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ContractorCopies: Issued to all above |

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| **FORM D** |
| **FINAL COMPLETION CERTIFICATE (PERFORMANCE CERTIFICATE – FIDIC)**PROJECT : ........................................................................................................................................INSTALLATION : ........................................................................................................................................CONTRACTOR : ........................................................................................................................................REFERENCE NO. : ........................................................................................................................................ |
| It is hereby certified that the Contractor has completed his obligations during the Defects Liability Period (Defects Notification Period – FIDIC) and will be relieved of further responsibilities upon acceptance by the Engineer of the following defects identified during the said period.

|  |  |  |
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| **ITEM** | **DESCRIPTION** | **DATE OF ACCEPTANCE** |
|  |  |  |
| For JBCC contracts | The Contractor shall complete all his responsibilities in respect of the 12-month maintenance and guarantee period for the remaining 9 months. | As per Contract |

Liability for Latest Defects will be in accordance with the Contract.SIGNED:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_For Plantech (Pty) Ltd Date**COPIES:**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Employer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Principal Agent\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Principal Contractor\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Contractor |

**STANDARD SPECIFICATION**

**FOR**

**ROOFTOP PACKAGE UNITS**

**STANDARD SPECIFICATION FOR ROOFTOP PACKAGE UNITS**

**CONTENT OVERVIEW**

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* **GENERAL**
	1. All units shall be factory assembled, self-contained and fully catalogued equipment.
	2. The units shall be rated in accordance with ISO 13253:2017 or other approved rating but shall be de-rated for the specific altitude and ambient temperature as listed in the detailed specification.
	3. All equipment shall be installed in strict accordance with the manufacturer's requirements.
	4. No electric resistance heating elements will be accepted, space heating shall be achieved by reverse cycle heat pump refrigeration systems, unless specified otherwise in the detailed specifications.
	5. Equipment offered shall meet the specified requirements. Acceptance of a tender based on brochures or information supplied shall not imply that other standards have been accepted.
	6. The required manufacturer is specified in the detailed specifications. Any alternatives must be approved by the engineer and must be stated in the tender document on a signed cover letter submitted by the tenderer.
* **CASING, DOORS & LOUVRES**
	1. The units shall be weatherproof and shall require no additional protection from the elements.
	2. The unit shall be manufactured from heavy duty galvanised steel forming a sandwich construction, inner and outer skin, with a 50 mm glass wool or 25 mm polyurethane insulation. The insulating material shall have a minimum thermal résistance of 0.714 m².k/W.
	3. The outer skin shall have a baked enamel, or an 80 Micron powder coated finish and it will be the responsibility of the contractor to repair any damages to the unit/finish in a manner approved by the engineer. If it cannot be repaired satisfactorily the affected panels shall be replaced.
	4. The assembled casing shall be leak proof, with thermal breaks and allow for drainage from the roof.
	5. Where fittings protrude through the sandwich construction the holes shall be sealed to prevent moisture or oil to penetrate the insulation.
	6. Access doors shall be hinge type with black nylon or stainless-steel hinges. The doors shall be fitted with lockable door handles or black nylon lock bolts with hand fasteners. All doors shall have at least one locking device fitted, openable with a key or a panel key.
	7. The mixing plenum of unit shall be fitted with an adjustable low leak outside air damper with an aluminium weather louvre. The damper shall be fitted with a fine stainless steel or aluminium screen to prevent debris entering the unit and clogging up the primary filters.
	8. Louvres utilised for access shall be mounted on a rigid frame utilizing the same hinges and handles as specified for the access doors.
	9. The floor of the unit shall consist of a rigid steel construction to support the sandwich panel flooring. Aluminium chequered plate shall be installed on the floors for large units.
	10. The steel base frame shall be manufactured from C channels and shall be fitted with metal brackets/shipping loops to hoist the complete unit.
	11. The supply and fresh air opening shall be fitted with flanges for easy connection to ducting. Some units may require bottom or top return/discharge, refer to detailed specification.
	12. A stainless-steel drain pan shall be fitted to the unit and shall cover the entire DX coil with no joints. The condensate pan shall be sized to prevent any moisture to carry over into the air stream and shall be insulated with seamless polyurethane insulation with a minimum thickness of 10 mm.
	13. A suitable drainpipe shall be installed from the unit to a suitable position for easy drainage and shall be fitted with a trap between the condensate pan and exterior drainpipe.
	14. The drain trap shall have a water seal with a sealing pressure of at least twice the static pressure as developed by the fan at the drain pan.
* **REFRIGERATION**
	+ **GENERAL**
		1. Only R410a and R32 refrigerants may be used unless specified otherwise in the detailed specifications.
		2. Units shall contain a minimum of two refrigeration circuits with the following:
* A compressor mounted on vibration isolators with embedded thermostats
* Direct expansion coils
* Air cooled condenser coils
* Crankcase oil heater
* Stop valves on suction and discharge lines at the compressor
* High-pressure and low-pressure switches
* Filter dryer
* Liquid line sight glass
* Charging valve
* Automatic refrigerant reversing valve
* LP, HP pressure gauges
* Electronic expansion valves
	+ 1. Any apparatus containing refrigerant shall comply with the relative safety requirements of the Machinery and Occupational safety Act No 6 of 1983 a.a. and with the latest edition of the American Safety Code of Mechanical Refrigeration.
		2. SANS 10147 will be applicable. Liquid receivers shall be fitted with a safety valve to safely release pressure in the event of excess pressure from any cause. Liquid receivers shall be fitted with a means of ascertaining liquid level such as test cocks, air purge valve, and connection for charging and/or removing refrigerant and isolating valves on the liquid outlet.
	+ **VARIABLE REFRIGERANT VOLUME / FLOW AIR COOLED CONDENSOR**
		1. Compressors of the number and minimum capacity specified in the Detail Specification shall be installed complete with the usual standard equipment such as refrigerant piping, valves, pressure gauges, thermometers, etc. as required for the satisfactory operation, convenient testing and maintenance of the machine.
		2. All compressors shall be of the hermetic, direct driven, variable speed (Inverter), scroll type.
		3. Each compressor shall be installed with anti-vibration mountings.
		4. Each compressor shall be equipped with a fully automatic lubrication system.
		5. The main parts of the refrigerating machine shall be of recognised manufacture and the rotational speed, capacity, refrigerant flow rates shall be within the standard range recommended by the Manufacturer for the particular type and size of machine.
		6. A sight glass for observing the oil level in the crankcase shall be provided as well as a crankcase heating element.
		7. Each compressor shall be equipped with a fully automatic lubrication system.
	+ **AIR COOLED CONDENSERS**
		1. Air cooled condensers shall be factory assembled units comprising a heat exchanger (condenser coil), fan(s), casing, etc.
		2. The condenser coil shall be of seamless copper tubing with copper or aluminium fins.
		3. Fans shall be of the slow running propeller type fans and shall comply with the requirements set out for fans elsewhere in this Specification. The fans shall be mounted with anti-vibration pads so as not to transmit vibrations to the unit casing.
		4. The coil face velocity shall not exceed 3 m/s.
		5. The air intake and discharge shall be screened with a suitable galvanized wire mesh screen.
		6. Access to all components shall be provided by means of removable panels.
		7. The Contractor shall submit manufacturer’s ratings for the full range of the model offered for various ambient air temperatures and condensing temperatures.
		8. The condensing coils shall be selected based on an operating temperature of at least 5°C above ambient conditions listed in the detailed specification.
		9. Hail guards shall be fitted to protect the condenser coils.
	+ **DIRECT EXPANSION (DX) COILS**
		1. Direct expansion cooling coils shall be of copper tube with aluminium or copper fins. The wall thickness of the tube shall not be less than 0,04 times the outside diameter.
		2. The fin spacing and number of rows shall be such that the air leaving the coil is at the conditions set out in the Detail Specification.
		3. The fins shall be mechanically bonded to the tubes.
		4. The face velocity of the air does may not exceed 2,50 m/s.
		5. The coils shall be mounted together with headers, expansion valves, refrigerant distributors, etc. inside the main unit casing so that only the two connecting pipes to the coil pass through the outer casing. The penetration points shall be sealed with purpose made UV resistant, high temperature silicone rubber boots. The boots shall fit tightly to the copper pipes and secured to the casing with stainless steel screws.
		6. All coil frames shall be manufactured of hot dipped galvanised sheet metal or of a suitable approved corrosion resistant material. Galvanised frames shall be bolted together to prevent the occurrence of damage to the galvanising which may be caused by welding.
		7. The coil frame shall be so arranged that all moisture condensing on the coil runs freely into the drain pan.
	+ **REFRIGERANT ISOLATING VALVES**
		1. Refrigerant isolating valves shall be of the back-seating type with stems squared for key operation and shall be provided with sealing caps.
		2. Isolating valves requiring regular attention shall be provided with soldered flanged connection pieces or screw ends.
	+ **REFRIGERANT TUBING & INSULATION**
		1. All connections in refrigerant piping shall be hard soldered with silver or copper.
		2. Refrigerant tubing shall be of deoxidised, dehydrated seamless hard drawn copper tubing. Refrigerant tubing shall be Class 2: Medium Copper Piping in accordance with SANS 460 as amended: Copper and Copper Alloy Tubing.
		3. All joints, couplings, etc., shall be hard soldered with silver or copper and pipes shall be protected against oxidation during the welding process by means of dry nitrogen flowing through the pipes. Wrought copper fittings shall be employed. Small lines, less than 10 mm O.D., may be of soft copper tubing with flared fittings.
		4. Flexible metal vibration absorbers shall be fitted at the compressor discharge and suction connections.
		5. Refrigerant tubing shall be secured in fittings padded with at least 13 mm thick felt strip, to prevent transmission of vibration.
		6. All refrigerant piping shall be insulated with 10 mm polyethylene foam tube insulation with quick zip fastener, which shall meet the following requirements:
* Temperature Range: -80°C to 120°C
* Thermal conductivity: 0,038 w/m.k
* Specific mass: 35 kg/m³
* Fire properties: Self extinguishing
	+ 1. Insulation exposed to weather, or protection against mechanical damage, shall be protected with aluminium, galvanised steel or stainless-steel sheet metal cladding.
* **FILTERS**
	1. Filters shall comply with the specific standard specification for Filters and to EN-779.
	2. High performance washable pleated panel type filters, with a minimum of 50 mm thickness, shall be installed in each unit and housed in adequate holding frames. The holding frames shall be fitted with gaskets to ensure an airtight seal around the filters.
	3. A pressure differential switch shall be fitted across the filters with indication light on the control panel.
	4. Filters shall have a maximum face velocity of 2,5m/s.
* **FANS**
	1. The fan and drive unit shall comply with the specified Standard Specification.
	2. The supply air fan shall be a direct drive E.C. plug fan.
	3. The fan wheel shall be statically balanced before installation and dynamically balanced and tested after being installed in the casing.
	4. The fan shaft shall be designed to run well below its first critical speed.
	5. Fan bearings shall be silent running, permanently lubricated ball bearing plumber blocks, located on the suction eye on each side of the impeller
	6. The supply fan shall be able to deliver a minimum of 250 Pa external static pressure unless specified otherwise in the detailed specification.
	7. The fan shall not exceed 1440 r.p.m.
	8. The supply fan, direct drive motor & side rails shall be mounted on a common frame.
	9. Each fan shall be installed with anti-vibration mounts.
	10. All supply fans shall be fitted with variable speed drives.
* **NOISE AND VIBRATION**
	1. Noise and vibration on the unit shall comply with A-SPES-30-05
	2. Fan noise
		1. Sound power levels (S.W.L.) in DB (RE 10-12 WATTS) for the unit at the specified air quantity and static pressure shall be available in octave bands for:
1. In duct noise calculations
2. Casing radiation noise calculations
3. Free discharge noise calculations
	* **VIBRATION**
		1. Anti-vibration mountings shall be installed underneath the RTPU with the static deflectors as specified in the Detail Specification.
		2. All connections to the unit shall prevent short circuiting of the vibration isolation.
		3. The anti-vibration hangers and mountings shall comply with the specified Standard Specification
		4. No drumming or noise shall be emitted by any part of the air handling unit.
* **ELECTRICAL & CONTROLS**
	1. Electrical equipment shall comply with SANS
	2. A DB shall be fitted to each unit and shall contain all the necessary circuit breakers, contactors, relays and protection devices necessary for the control of cooling, heating and fan speeds as specified. The board shall be fitted with an adequately sized main isolator with an associated safety fuse with a minimum capacity to suit the system fault level.
	3. The switch gear shall be fully interlocked to ensure that heating and cooling cannot operate simultaneously, and that the compressor cannot operate without the condenser fans and supply air fans are in operation.
	4. The DB shall have provision for emergency backup power where all refrigeration circuits & condenser fans are switched off and only the supply air fan can run on backup power.
	5. All wiring inside the DB and unit shall comply to all relevant local regulations and shall be installed neatly in vertical/horizontal PVC trunking. All exposed current carrying parts shall be fully insulated with PVC tape.
	6. All wiring inside the DB and unit shall be fitted with numbered ferrules and both ends of the same wire shall have the same number.
	7. The unit shall be fitted with a fire relay that will turn the entire unit off when a fire signal is received.
	8. A 7-day programmable timer, with a backup battery, shall be installed in each unit.
	9. A phase failure relay shall be fitted to each unit and shall monitor high voltage low voltage, phase failure and floating neutral.
	10. A laminated wiring and control logic diagram shall be provided for each unit.
	11. Dirty filter indication lights shall be fitted to the switch board to indicate if the filters require cleaning.
	12. The sensor for controlling the air temperature shall be installed in the return air, unless specified otherwise
	13. The unit shall be provided with an economy cycle utilising the dry bulb temperature of the outside air and return air in selecting the most economical air for the cooling and heating modes.
	14. Provision shall be made for remote control of the unit and shall be BMS compatible as well as Modbus RTU. The controls must be upgradable to interface with BACnet or similar BMS interface logic.
	15. The controls on the unit itself must have full diagnostic capabilities for each main component of the unit itself.
	16. A remote-control panel shall be provided with full control and monitoring capabilities and will be installed in the manager’s office unless specified otherwise in the detailed specification or drawings.
	17. The controls shall incorporate a remote room sensing thermostat, additional to the return air thermostat in the unit. The controls shall enable to sense and control off ether one thermostat or an average of the two.
	18. All units to have an auto restart facility in case of a power failure.
	19. Each refrigeration system shall have the following safety devices:
* High- and low-pressure protection (manual reset)
* Compressor motor winding thermal protection
* Low oil pressure protection (manual reset)
* Compressor motor over current protection (manual reset)
* Delay timers on compressors
* Phase failure/Low voltage protection
* Anti-cycling timer
* Protection against liquid slugging in the compressors
* Overload protection on motors for all three phases

**STANDARD SPECIFICATION**

**FOR**

**VRF AIR CONDITIONING UNITS**

**STANDARD SPECIFICATION FOR**

**VRF AIR CONDITIONING UNITS**

CONTENT OVERVIEW

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[5. APPROVED UNITS 68](#_Toc528746019)

**STANDARD SPECIFICATION FOR**

**VRF AIR CONDITIONING UNITS**

1. **GENERAL**

 All units shall be designed and installed so as to provide ease of access for inspection, cleaning and maintenance of all components in the system of the unit.

 All units shall have a neat appearance, shall be vibration free and shall meet the specified noise ratings.

 The (sub) contractor shall be a qualified installer of the VRV/F system manufacturer and must supply the technicians training certificates for the specified manufacturer to the engineer prior to construction.

Unless otherwise specified in the Project Specification the (sub) contractor shall be responsible to provide all openings, sleeves and bases.

 The VRF systems and all of its components shall be installed as per the manufacturers recommendations.

 No aluminium piping will be accepted.

1. **STANDARDS AND SPECIFICATIONS AND TEST REPORTS**

 All units shall be manufactured in accordance with SANS-1125; 2004 .a.a: Room Air Conditioners and heat pumps. The manufacturer shall supply a certificate of the SABS to certify that the unit is electrically safe.

 All units shall be manufactured and tested in accordance with ISO 15042:2017 – Multiple split-system air conditioners and air to air heat pumps and certified test reports shall be supplied by the manufacturer of the following ratings:

* Total cooling capacity
* Total sensible cooling capacity
* Total heating capacity
* Airflow rates
* Electrical input

 The unit shall be acoustically tested by theSABS in terms of SANS 10196:1984 & ISO 13253:23017 and certified test reports shall be supplied by the manufacturer.

 The following Standard Specifications will apply:

A-SPES-00-01: STANDARD SPECIFICATION FOR GENERAL REQUIREMENTS AND PROCEDURES

 REGULATIONS

The Contractor shall be registered as a Competent Practitioner in terms of the “Pressure Equipment Regulations” and “the communique for SAQCC GAS”/

The following SANS specification will apply:

* Occupational Health and Safety Act, 1993 (Act no. 85 of 1993)
* SANS 151
* SANS 347
* SANS 10227
1. **REFRIGERANTS**

Only R410a & R32 shall be used unless otherwise specified in the Project Specification.

1. **CAPACITY**

**COOLING**

Since the ISO 15042:2017 rating is at 27º C DB/19º C WB indoor and 35ºC DB/24º C WB outdoor conditions at sea level the nominal rating shall be de-rated according to the site conditions specified in the detailed specifications..

**HEATING**

Heating shall be by means of heat pump unless otherwise specified in the Project Specification.

The unit shall be designed to perform at a C.O.P. of at least 2,8 under design cooling conditions and heat pumps with a C.O.P. of at least 2,5 under design heating conditions.

1. **APPROVED UNITS**

 Approved makes of units are specified in the Project Specification.

 Should Contractors wish to offer non-approved units in their tender, this should be done as an alternative to the main offer, the latter which shall be based on one of the makes approved.

**OUTDOOR UNITS**

The outdoor units shall be factory assembled units.

The refrigerant pipe lengths between the outdoor unit and the DX Coil shall be strictly according to the manufacturer’s specification

Outdoor units shall be of the inverter heat pump type. The outdoor units’ compressors shall be equipped with inverter controllers. Inverter units shall have variable speed compressors to deliver a variable cooling/ heating output from 5% - 100%.

Each outdoor unit shall be equipped with more than one scroll compressor. The outdoor unit must be able to continue functioning in the case where one compressor is out of order. The compressors must be hermetic scroll type compressors.

The aluminium fins on the heat exchanger must be coated by an anti-corrosion resin film.

The refrigeration circuits shall include liquid and gas shut off valves and solenoid valves. Units shall be equipped with oil recovery systems. The outdoor units shall be complete with high pressure switches, overload relays and inverter overload protectors.

The noise levels of the outdoor units may not exceed 60 dB(A) measured 1m horizontally and 1.5m from the units.

Main power supplies to the VRV/F systems must be from the air conditioning electrical distribution board located at the condensing units on the roof of the building unless otherwise specified in the Project Specification. Each outdoor unit must have an isolator on the unit. All power supply cabling between switchboard and VRV outdoor unit isolators to be installed in approved cable trays.

All power supplies to the outdoor units shall be fitted with a Schneider Multifunction phase control relay “RM35-TF30” that will monitor the incoming power supply for power quality issues and break the supply if required. The following parameters shall be monitored:

* Asymmetry
* Phase Failure
* Phase sequence
* Undervoltage and overvoltage

All outdoor units shall be mounted on anti-vibration pads in accordance with A-SPES-30-05-W02

**CENTRAL CONTROLLER**

The entire VRV/F installation shall be managed by a central controller

The central controller shall be of the same manufacturer and supplier as the rest of the VRV/F installation.

The central controller shall be area code identification controllers. The controller shall have a colour LCD display with touch panel.

The central controller must be able to control the ON/OFF switching of each indoor unit, individually or as a zone. Temperature setting, switching between operation modes, time schedule settings, setting of direction of fan speed and disabling/enabling of the remote controllers must also form part of the features of the central controller to control each indoor unit, individually or as a zone.

The central controller must also be able to monitor the operation of each indoor unit as well as the temperature setting, maintenance information and troubleshooting of each indoor unit.

The central controller shall be located inside the VRV/F electrical distribution board on the roof, unless otherwise stipulated.

**INSTALLATION**

INSTALLATION OF OUTDOOR UNITS

Condensing units shall be mounted on concrete or galvanised steel plinths at least 200 mm high with anti-vibration pads under the unit. If steel plinths are used, anti-vibration pads shall be installed between the plinth feet and the floor.

There shall be at least 500 mm clear space around each outdoor unit for ease of access and maintenance unless more space is required by the unit’s manufacturer’s specifications.

**INSTALLATION OF REFRIGERANT PIPING**

Refrigeration Grade hard drawn seamless, dehydrated, de-oxidised copper tubing shall be used, unless otherwise specified by the unit manufacturer.

The sizing of refrigeration piping shall be in strict accordance with the unit manufacturer’s specification.

All refrigerant piping must be filled with nitrous oxide gas during welding (0.02 MPa) and flushed with nitrous oxide gas (0.5 MPa), after all welding has been completed and before charging with refrigerant gas as per manufacturers specifications.

Oil traps shall be installed in the suction lines at all pipe risers.

A filter drier and moisture indicator shall be installed after the compressor.

Charging connections shall be provided at the compressor.

All refrigeration lines shall be insulated, separately with “ARMAFLEX” Class O, K value of 0.037 W/m.k at 20°C.

The wall thicknesses of the insulation shall be:

|  |  |
| --- | --- |
| Pipe Diameter | Thickness |
| Ø 6.35 – 15.88 mm | ≥13 mm |
| Ø 19.05 – 34.93 mm | ≥ 19 mm |
| > Ø 34.93 mm | ≥ 25 mm |

Where the refrigeration pipes penetrate walls, sleeves shall be used and supplied by the HVAC sub-contractor.

All refrigeration piping and wiring external to the building or in visible positions shall be installed in galvanised steel wiring channels with removable cover plates or protected by means of 0,6 mm galvanised cladding.

In concealed spaces and ceiling voids piping and wiring shall be fastened to a perforated/wire mesh galvanised cable tray or other acceptable means approved by the Engineer. The last section of ≥500 mm length of copper piping to the indoor unit may be unsuspended.

Refrigerant piping in cable trays shall be fastened to the cable trays with velcro straps of at least 10 mm in width and may not compress the insulation at any point around the refrigerant piping.

All pipe insulation exposed to the weather or in visible positions shall be installed in galvanised steel wiring channels with removable cover plates or protected by means of 0,6 mm galvanised cladding.

All refnet joints, headers, branches, etc. shall be installed with the manufacturers supplied insulation boxes/covers.

All refnet joints, headers, branches, etc. shall be installed as per the manufacturers requirements and according to good installation practice. No bends (hard or slow bends) before and after the refnet joints, headers, branches, etc. are allowed closer than 500mm.

When refnet joints, headers, branches, etc. is installed horizontally, the maximum allowable tilt is ±7,5°.

The refrigerant piping shall be marked tape/spray/paint every 3 m with the following colours:

* Heat Recovery (3 Pipe)
	+ Liquid Supply: Blue
	+ Hot Gas Supply: Red
	+ Return: Yellow
* Heat Pump (2 Pipe)
	+ Supply: Blue
	+ Return: Yellow
	1. **ELECTRICAL**

Unless otherwise specified in the Project Specification, an isolator will be provided at the outside unit by others and all inter-connecting power and control wiring will be installed by the air conditioning (sub) contractor.

All wiring shall be installed in accordance with SANS 10142 and in accordance with the unit manufactures specifications.

Communication wires may not be grey of colour. The communication cables shall be a different colour than the data cables installed in the building for ease of tracing and future maintenance.

* 1. **COMMISSIONING**

The system shall be commissioned in terms of Code R of CIBS.

The pressure tests and vacuum of the piping shall be witnessed by the manufacturer’s technicians and by the engineer. The pressure tests shall be done for a minimum of 24 hours at a pressure specified by the manufacturer.

A photo report of each pressure tests performed shall be supplied to the engineer and shall also be included in the O&M Manual.

A photo report of each systems vacuum performed shall be supplied to the engineer and shall also be included in the O&M Manual.

The technician from the supplier shall witness all required tests and must supply a commissioning report to the contractor for each system commissioned. These commissioning reports shall be included in the O&M Manuals.

| **DATA SHEET FOR VRF AIR CONDITIONING SYSTEMS** |
| --- |
| **TO BE SPECIFIED PER OUTDOOR UNIT** | **OUTDOOR UNIT** |
| 1. Make : |   |
| 2. Model Number : |   |
| 3. Cooling capacity corrected for 35°C DB Outdoor temp and 1500 mm above sea level : | ISO 15042:2017  W |
| 4. Heating capacity corrected for 6°C DB room temp and 1500 mm above sea level : |  W |
| 5. Type of heating : | Heat pump/Heat Recovery |
| 6. Electrical Supply | Voltage: …………………… VInput Power………………… AFLA …………………………. A |
| 7. Dimension : | Width = mmDepth = mmHeight = mm |
| 8. Weight : | Weight = kg |
| 9. Discharge Direction : |  |
| 10. Sound Power Level Sound Pressure Level | ………… dB………… dB |
| 11. Operating Range  Cooling Heating | Max: …….. °C Min:……… °CMax: …….. °C Min:……… °C |
| 12. Refrigerant Type |  |

| **DATA SHEET FOR VRF AIR CONDITIONING SYSTEMS** |
| --- |
| **TO BE SPECIFIED** | **INDOOR UNITS** |
| 1. Make : |   |
| 2. Model Number : |   |
| 3. Cooling capacity corrected for 35°C DB Outdoor temp and 1500 mm above sea level : | ISO 15042:2017  W |
| 4. Heating capacity corrected for 6°C DB room temp and 1500 mm above sea level : |  W |
| 5. Heating capacity : |  W |
| 7. Indoor air flow rate : | Low = m3/sMed = m3/sHigh = m3/s |
| 8. Condenser coil material : | Cu pipe / Al fins |
| 9. Built in Condensate Pump Included Third Party Condensate Pump | Yes/NoYes/No |
| 10. Electrical Supply | Voltage: …………………… VInput Power………………… AFLA …………………………. A |
| 11. Dimension : | Width = mmDepth = mmHeight = mm |
| 12. Weight : | Weight = kg |
| 13. Sound Power Level Sound Pressure Level | ………… dB………… dB |
| 14. Colour of unit : |   |

| **DATA SHEET FOR VRF AIR CONDITIONING SYSTEMS** |
| --- |
| **TO BE SPECIFIED (if heat recovery system)** | **BS/SELECTOR/MCU BOXES** |
| 1. Make : |   |
| 2. Model Number : |   |
| 3. Number of Ports : |  W |
| 4. Max Heating/cooling load per port : |  W |
| 5. Condensate Drain Required | Yes/No |
| 6. Electrical Supply | Voltage: …………………… VInput Power………………… AFLA …………………………. A |
| 7. Dimension : | Width = mmDepth = mmHeight = mm |
| 8. Weight : | Weight = kg |
| 9. Sound Power Level Sound Pressure Level | ………… dB………… dB |

**STANDARD SPECIFICATION**

**FOR**

**ROOM AIR CONDITIONING UNITS**

**OF THE**

**CONSOLE, SPLIT & VRV/F TYPE**

**STANDARD SPECIFICATION FOR ROOM AIR CONDITIONING UNITS OF THE SPLIT AND VRV/F TYPE**

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**STANDARD SPECIFICATION FOR ROOM AIR CONDITIONING UNITS OF THE SPLIT & VRV/F TYPE**

1. **GENERAL**

 This Standard Specification generally covers the supply, installation and commissioning of individual through the wall console units and wall mounted, under ceiling or “in ceiling” split and VRV/F type units.

 The units shall be designed and installed so as to provide ease of access for inspection, cleaning and maintenance of all components in the system of the unit.

 All units shall have a neat appearance, shall be vibration free and shall meet the specified noise ratings.

1. **STANDARDS AND SPECIFICATIONS AND TEST REPORTS**

 Console units shall be manufactured in accordance with SANS-1125; 2004 .a.a: Room Air Conditioners and heat pumps. The manufacturer shall supply a certificate of the SABS to certify that the unit is electrically safe.

 The unit shall be tested by the SABS in terms of ISO 5151:2017 and certified test reports shall be supplied by the manufacturer of the following ratings:

* Total cooling capacity
* Total sensible cooling capacity
* Total heating capacity
* Airflow rates
* Electrical input

 The unit shall be acoustically tested by theSABS in terms of SANS 10196:1984 & ISO 13253:23017 and certified test reports shall be supplied by the manufacturer.

 The following Standard Specifications will apply:

A-SPES-00-01: STANDARD SPECIFICATION FOR GENERAL REQUIREMENTS AND PROCEDURES

* 1. **REGULATIONS**

The Contractor shall be registered as a Competent Practioner in terms of the “Pressure Equipment Regulations” and “the communique for SAQCC GAS”/

The following SANS specification will apply:

* Occupational Health and Safety Act, 1993 (Act no. 85 of 1993)
* SANS 151
* SANS 347
* SANS 10227
1. **REFRIGERANTS**

Only R410a & R32 shall be used unless otherwise specified in the Project Specification.

1. **CAPACITY**
	1. **COOLING**

Since the ISO 5151:2017 rating is at 27º C DB/19º C WB indoor and 35ºC DB/24º C WB outdoor conditions at sea level the nominal rating shall be de-rated according to the site conditions specified in the detailed specifications..

* 1. **HEATING**

Heating shall be by means of heat pump unless otherwise specified in the Project Specification.

 The unit shall be designed to perform at a C.O.P. of at least 2,7 under design cooling conditions and heat pumps with a C.O.P. of at least 2,5 under design heating conditions.

1. **APPROVED UNITS**

 Approved makes of units are specified in the Project Specification.

 Should Contractors wish to offer non-approved units in their tender, this should be done as an alternative to the main offer, the latter which shall be based on one of the makes approved.

1. **CONSOLE UNITS**
	1. **RESPONSIBILITY OF THE PRINCIPAL BUILDING CONTRACTOR**

Unless otherwise specified, all wall sleeves required for the installation of the units shall be provided by the Air Conditioning (Sub) Contractor and supplied to the Principal Contractor in good time, to allow him to build these in, in accordance with his requirements and the drawings. It will, at all times, remain the (Sub) Contractor's responsibility to ensure that the correct size sleeve is supplied and identified for building-in purposes and that the sleeves have been built in correctly. Any corrective action will be for the (Sub) Contractor’s account unless proven otherwise.

* 1. **COMPRESSOR**

The compressor shall be a hermetically sealed unit.

The compressor shall be mounted on springs with rubber seating.

* 1. **EVAPORATOR**

The evaporator shall be a multi pass copper coil with aluminium fins unless otherwise specified.

The fin spacing shall be at least 2 mm to ensure that even with build-up of dirt on the fins, the units still meets its capacity as stated.

* 1. **EVAPORATOR FAN**

The fan shall be rated for continuous duty.

The fan shall be of the non-overloading type.

The fan shall be of the direct coupled centrifugal type.

The fan motor shall be a multi speed or variable speed motor.

* 1. **CONDENSER**

The condenser shall be a single or multi pass copper coil with mechanically bonded copper or aluminium fins. Copper fins shall be used in corrosive atmospheres or in coastal areas when specified in the Project Specification.

The fin spacing shall be at least 1,8 mm.

* 1. **CONDENSER FAN**

The fan shall be rated for continuous duty.

The fan shall be of the non-overloading type.

The fan motor shall be a totally enclosed motor.

* 1. **SUPPLY AIR GRILLES**

The outlet grilles shall be adjustable.

The grilles shall not rattle, hum or vibrate under any operational conditions.

The grilles shall not melt with the outlet grilles blocked and the heaters on at full capacity for 30 minutes.

* 1. **FILTERS**

The unit shall filter outside air as well as return air.

The filter shall be of the washable type.

The filter shall be easily accessible for cleaning purposes.

The filter shall prevent the clogging of the evaporator coil.

* 1. **CASING**

The casing shall be constructed from heavy gauge steel, galvanised or zinc coated.

The casing shall be powder coated to provide a durable colour fast scratch resistant surface finish.

The casing shall be acoustically and thermally insulated.

The casing shall not drum, vibrate or emit noises when the compressor comes in operation.

The casing shall be treated for corrosion.

* 1. **CONDENSATE**

The unit shall be constructed to collect the condensate from the evaporator coil.

The fan shall not carry condensate over into the conditioned space.

The collected condensate shall adequately be removed by a slinger ring or other device. The manufacturer of the unit shall provide proof of the rate at which condensate can be removed.

The thermal and acoustic isolation shall not absorb condensate.

Provision shall be made for all heat pump units for a drain pipe for condensate water which shall be piped to the nearest drain point.

* 1. **ELECTRIC HEATERS**

When specified electrical heating elements shall be electric resistance heaters of the rust proof type with Incalloy or monel sheeting. Open spiral wire type heater elements are not acceptable.

All heater elements shall be low heat density types, i.e. less than 3,2 watt/cm². Heaters shall provide black heat at a minimum air speed of 1m/s.

The heater element shall be rated for continuous operation at the full supply voltage.

Wiring of the heater batteries shall be carried out in silicon-rubber insulated wiring of adequate cross section.

All electrical air heating devices shall comply with the relevant requirements of SANS 160.

The heaters shall be interlocked with the supply air fan motor.

* 1. **SAFETY CONTROLS**

COMPRESSOR

The compressor shall be protected against over current and over temperature with a Klixon type cut-out/auto restart device. “Low voltage” protection shall be provided.

HEATERS

The heaters shall be fitted with manual reset safety thermostats to protect the heaters against over temperature.

* 1. **CONTROLS**

The units shall be fitted with a manually adjustable thermostat.

The thermostat shall automatically select cooling, heating or recirculation according to the return air temperature.

The thermostat shall be so designed that it will be impossible for the heater element to be energised simultaneously with the cooling cycle.

The unit shall be fitted with an on-off switch.

Proven electronic controls will also be acceptable.

A "holding relay" function shall be provided in order that the units can be switched off remotely by interrupting the power supply.

* 1. **ELECTRICAL**

The unit shall be able to operate on a single phase 50 Hz, 220 V three wire system.

The unit shall not draw more than 15 Amps when operating on either heating or cooling mode.

An electrical outlet point will be provided on the left-hand side when facing the console unit from inside the room, in the form of an isolator, unless otherwise specified.

Each unit shall be fitted with a cap tire cord of 1m and shall be shortened as required during installation by the (Sub) Contractor.

* 1. **WALL SLEEVES**

Unless otherwise specified the (Sub) Contractor shall supply steel wall sleeves for console units. The sleeves shall be handed to the Principal Contractor to build into walls in accordance with Clause 6.1 of this Specification.

* 1. **WALL BOXES**

Unless otherwise specified wall boxes manufactured by the manufacturer of the console units shall be fitted into the steel wall sleeves, where no aluminium external louvre has been specified.

The wall boxes shall be pre-power coated in a colour to be specified by the Engineers and shall have pressed louvres approved by the manufacturer of the unit.

* 1. **ALUMINIUM EXTERNAL LOUVRE**

When specified in the detail specification extruded aluminium louvres similar to EUROPAIR approved by the manufacturer of the console units and with a powder coated finish in a colour to be specified by the Engineer shall be fitted to the wall sleeves.

* 1. **INSTALLATION**

Console units shall be fixed in position from the inside by means of wall plugs and self-tapping screws or other suitable fixing mechanism.

Adhesive foam sealing strips shall be provided on the sides and top of the console units to form an airtight seal against the wall or wall sleeve while the joint between the underside of the unit and the wall sleeve shall be sealed with silicone sealer after final testing. Special care shall be taken to ensure that the seals are of a high standard to prevent compressor or condenser fan noise from breaking into the conditioned space.

Vertical splitters shall be installed in wall sleeves to prevent the short circuitry of inlet and hot discharge air, where the depth of the walls requires wall sleeves deeper than the condensing section on the unit.

1. **SPLIT TYPE AIR CONDITIONING UNITS**
	1. **GENERAL**

In general, the requirements specified in regard to console units, where applicable, shall also apply to split units.

Unless otherwise specified in the Project Specification the (sub) contractor shall be responsible to provide all openings, sleeves and bases.

* 1. **HEATING**

Unless otherwise specified split units shall be of the reverse cycle heat pump type.

* 1. **CONDENSATE DRAINAGE**

Condensate drains shall be installed from the indoor unit to the nearest drain point. All condensate drain piping shall be 22 mm dia. hard drawn Class 0 copper tubing, 25 mm dia GMS or 25 mm dia uPVC.

Drain piping shall be supported at 2,0 m intervals with a fall of at least 1:80

The connection to the indoor unit shall be made in translucent plastic tubing of not more than 250 mm in length.

A T-piece for a vertical venting pipe of 200 mm shall be provided close to the unit in the copper drain pipe.

Provision shall be made for all heat pump units to drain the condensate of the outdoor unit to the nearest drain point.

A galvanised sheet metal drip pan shall be provided under condensing units.

All “Cassette” split units shall be fitted with drain pumps and unless otherwise specified in the Project Specification, approved drain pumps shall also be fitted to “In Ceiling” units.

* 1. **REFRIGERATION PIPING**

Refrigeration Grade hard drawn seamless, dehydrated, de-oxidised copper tubing shall be used, unless hand drawn piping has been specified.

The sizing of refrigeration piping shall be in strict accordance with the unit manufacturer’s specification.

All refrigerant piping must be filled with nitrous oxide gas during welding and purged after welding and before charging with refrigerant gas as per manufacturers specifications.

Oil traps shall be installed in the suction lines at all pipeA filter drier and moisture indicator shall be installed after the compressor.

Charging connections shall be provided at the compressor.

All suction lines shall be insulated with “ARMA FLEX” of 13 mm.

* 1. **INSTALLATION**

INSTALLATION OF INDOOR UNITS

Mounting brackets for “Under ceiling” and wall mounted units shall be approved by the Engineer.

“Cassette” and “In-ceiling” units shall be supported from the roof structure and not by the ceiling grid.

Each indoor unit shall be complete with a wired wall mounted controller.

INSTALLATION OF OUTDOOR UNITS

Condensing units shall be mounted on walls by means of galvanised steel supports or shall be mounted on a 75 mm concrete base 200 mm larger than the foot print of the condensing unit.

INSTALLATION OF PIPING

All refrigeration piping and wiring external to the building or in visible positions shall be installed in galvanised steel wiring channels with removable cover plates or protected by means of 0,6 mm galvanised cladding.

In concealed spaces and ceiling voids piping and wiring shall be strapped to a perforated/wire mesh galvanised cable tray or other acceptable means approved by the Engineer.

1. Refrigerant piping in cable trays shall be fastened to the cable trays with velcro straps of at least 10 mm in width and may not compress the insulation at any point around the refrigerant piping.

All pipe insulation exposed to the weather or in visible positions shall be installed in galvanised steel wiring channels with removable cover plates or protected by means of 0,6 mm galvanised cladding.

The refrigerant piping shall be marked tape/spray/paint every 3 m with the following colours:

* Supply: Blue
* Return: Yellow
	1. **ELECTRICAL**

Unless otherwise specified in the Project Specification, an isolator will be provided at the outside unit by others and all inter-connecting power and control wiring will be installed by the air conditioning (sub) contractor.

Surfix cable may be used

All wiring shall be installed in accordance to 7.5.

Communication wires may not be grey of colour. The communication cables shall be a different colour than the data cables installed in the building for ease of tracing and future maintenance.

* 1. **COMMISSIONING**

The system shall be commissioned in terms of Code R of CIBS.

|  |
| --- |
| **DATA SHEET FOR ROOM AIR CONDITIONERS** |
| **TO BE SPECIFIED** | **CONSOLE UNITS** | **SPLIT UNITS** |
| 1. TYPE : |   |   |
| 2. QUANTITY : |   |   |
| 3. Cooling capacity corrected for 23oDB room temp and 1500 mm above sea level : | ISO R859 W | ISO R859 W |
| 4. Type of heating : | Heat pump/Electric | Heat pump |
| 5. Heating capacity : |  W |  W |
| 6. Outside air : |   |   |
| 7. Indoor air flow rate : | Low = m3/sMed = m3/sHigh = m3/s | Low = m3/sMed = m3/sHigh = m3/s |
| 8. Condenser coil material : | Cu pipe / Al fins | Cu pipe / Al fins |
| 9. "Holding Relay" facility : | Yes | No |
| 10. "Low Voltage" facility : | Yes | Yes |
| 11. Electrical supply outlet : | 15A Isolator left of unit | ....An Isolator at ......... condensing unit |
| 12. Limitations to dimensions, if any : |   |   |
| 13. Colour of unit : |   |   |
| 14. Wall sleeve : | To drw. A-000-38-00-001 | NA |
| 15. Wall box : | Only wall sleeve | NA |
| 16. External louvre : | Extruded Aluminium | NA |
| 17. Colour of louvre : |   | NA |
| 18. General : |     |     |
| TO BE COMPLETED BY TENDERER  |  |  |
| Make : |   |   |
| Model No. : |   |   |
| Cooling capacity : |  kW |  kW |
| Heating capacity : |  kW |  kW |
| Type of heating : |   |   |
| Single or Three Phase : |   |   |
| FLA : |  A |  A |

**STANDARD SPECIFICATION**

**FOR**

**AIR DISTRIBUTION SYSTEMS**

**STANDARD SPECIFICATION FOR AIR DISTRIBUTION SYSTEMS**

**CONTENT OVERVIEW**

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[4. PVC DUCTWORK 56](file:///%5C%5CSRV1%5CPublic%5CStandard%20Specifications%20and%20Lists%5CPlantech%5CFile%2068%20%28A-SPES-31-01-W02%29%20Air%20Distribtuion%20Systems%5CA-SPES-31-01-R03%20Standard%20Spec%20for%20Air%20Distribution%20Systems.docx#_Toc515437363)

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[8. DIFFUSERS 58](file:///%5C%5CSRV1%5CPublic%5CStandard%20Specifications%20and%20Lists%5CPlantech%5CFile%2068%20%28A-SPES-31-01-W02%29%20Air%20Distribtuion%20Systems%5CA-SPES-31-01-R03%20Standard%20Spec%20for%20Air%20Distribution%20Systems.docx#_Toc515437367)

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**STANDARD SPECIFICATION FOR AIR DISTRIBUTION SYSTEMS**

* + - 1. **GENERAL**

All ducting shown on the Engineer's drawings, including all associated equipment, shall be manufactured, installed, tested and balanced in accordance with the requirements of this Specification.

* + - 1. **STANDARDS**

The latest editions of the following standards shall apply.

SANS 1238 : 2005 ‑ AIR CONDITIONING DUCT WORK

SANS 10173 : 2003 ‑ THE INSTALLATION, TESTING A BALANCING OF AIR CONDITIONING DUCTWORK

CIBS SERIES A : Commissioning Code for Air Distribution Systems, High and Low Velocity

* + - 1. **SHEETMETAL DUCTWORK**

**3.1 STANDARD**

Air Conditioning and Ventilation ducting shall be manufactured in accordance with SANS 1238: 2005 a.a.

**3.2 MATERIAL**

Unless otherwise specified, all air conditioning and ventilation ducting shall be manufactured from hot dipped galvanised sheet metal to SANS 1238.

**3.3 DIMENSIONS**

Dimensions shall relate to the nominal sheet metal dimensions of ducts and fittings.

The dimensions on drawings are given as follows:

Dimension seen x Dimension not seen

i.e. Plan = Width x Height

Elevation = Height x Width

**3.4 INSULATION**

3.4.1 Air conditioning ducting manufactured from galvanized sheet metal shall be insulated as follows, unless otherwise specified:

|  |  |
| --- | --- |
| Low & medium pressure supply and return air ducts in roof voids under sheet metal roofing | 25 mm internal Insulation |
| Low & medium pressure supply and return air ducts in ceiling voids under concrete slabs | 25 mm external insulation |
| High pressure ducting | 25 mm external insulation |
| Ducting exposed to weather (external) | 25 mm internal insulation and ducting must be painted to spec. |
| Ducting supplying high risk areas such as hospital theatres and isolation rooms (Internal and External Ducting). | 25 mm External insulation (Internal)25 mm External Insulation protected by sheet metal cladding on all four sides (External) |

3.4.2 The maximum air velocity for internal insulation is 15 m/s.

3.4.3 Internal insulation shall be FIBRE GLASS SONIC LINER (glass fibre insulation faced with a woven glass fibre layer) glued to the exposed surface.

Thermal conductivity = 0,037 W/m deg K at 0 deg C

Density = 24 kg / m³

3.4.4 Spigots to diffusers and grilles need not be insulated unless such spigots are longer than 1000 mm in which case they will be considered to be ducts.

3.4.5 The thickness of compressed insulation material shall be 75% to 85% of the original thickness.

3.4.6 Impact applied pins "Grip Nails" may only be used with prior approval of the Engineer, for replacing loose weld‑on pins.

3.4.7 No exposed fibres will be tolerated and therefore sealant shall be applied to all exposed edges.

3.4.8 External insulation shall be DUCT WRAP with a foil laminated covering reinforced with bi-directional mineral fibre yarn with the same or better conductivity and density as specified in par 3.4.3.

3.4.9 The insulating material and liner at heaters shall be protected, for a distance of 500 mm upstream and 1000 mm downstream of the heater.

**3.5 DUCT CONSTRUCTION**

3.5.1 Only sealed or closed pop rivets shall be used.

3.5.2 The back edge of nosings shall have no sharp edges and shall not compress the insulation to the extent that the membrane is cut. Coat the surface under the nose with sealant before fixing the nose to the insulated duct.

3.5.3 All bolts, nuts, rivets and spot welds shall be distanced 50 mm from the ends and at 100 mm centres. All exposed ducting shall use MEZ type flanges or approved equal.

**3.6 SPIGOTS**

3.6.1 Spigots to grilles shall have 100 mm, 45° shoes unless the Engineer approves straight spigots.

3.6.2 If ducts are internally insulated, the membrane shall be folded over the opening edges and shall be sandwiched between the spigot and the duct when fixing the spigot to the duct.

3.6.3 Where spigots have to be cut through stiffeners, or where cross breaking of ducts causes excessive malalignment of spigots, a stiffener shall butt into one side of the spigot in the case of spigots with a width (dimension in direction of air flow) of less than 400 mm and onto both sides of the spigot if the width exceeds 400 mm.

**3.7 TURNING VANES**

The spacing in bends of which the throat radius exceeds 100 mm, shall be selected using Figure B.1 – Turning vane spacing selection chart in Annex B, in the SANS 1238

**3.8 ACCESS PANELS AND DOORS**

Access panels shall be 500 x 500, similar to TROX Type BS. Access panels installed in internally insulated ducting shall be of double wall construction. Each panel shall be hinged or fitted with a latch on all sides.

Access doors in ducts and air handling units or plenums shall be either;

 600 x 1600 TROX Type ST; or

1280 x 1600 TROX Type ST‑D

Whichever is specified

**3.9 DUCTING JOINTS**

All ducting joints on the outside of the buildings shall be sealed with a reinforcing waterproofing mesh membrane, coated with an acrylic paint and painted with a UV resistant silver metallic paint (“Lap & Pap”).

**3.10 INSPECTIONS**

The Contractor must advise the Engineer at least 3 days in advance that progress inspection is required of ducting at the following stages:

‑ Before dispatch from the Factory

‑ On Site prior to erection

‑ Once erected and spigots cut but prior to the fitting of grilles. HOLD POINT

All duct sections shall be identified by duct sequence erection numbers which shall also appear on the duct layout drawings. The flow direction shall be marked on each duct section.

Ducts which are not painted shall be thoroughly cleaned and all markings removed once approved.

**3.11 INSTALLATION, TESTING, BALANCING AND COMMISSIONING**

STANDARD

Air conditioning and ventilation ducting shall be installed, tested and balanced in accordance with SANS 10173‑1980 a.a.

FLEXIBLE JOINTS

The flexible duct connectors shall be Clim or Europair and shall be for heavy duty, low pressure systems and extra heavy duty for high pressure systems.

Flexible joints exposed to the weather, shall be protected by means of galvanised sheet metal covers. The butt joints of the flexible material shall be glued and stitched.

All flexible joints shall be fitted with a copper earthing strap.

PRESSURE TESTS

Pressure tests and certificates are required for all ducts and shall be witnessed and signed by the Engineer, except for certain low-pressure applications where written exemption may be granted by the Engineer.

VELOCITY MEASUREMENTS

Holes required for pitot tube measurements shall be drilled into the ductwork after erection at positions and centres, requested and indicated by the Engineer in terms of the requirements of Smacna Industrial Ventilation, latest edition, par. 9‑3 to 9‑5. The size of the pitot tube holes shall be 25 mm diameter. Each hole shall be fitted with a suitable bung closure cap after drilling.

COMMISSIONING

All air distribution systems shall be commissioned in accordance with the CIBSE COMMISSIONING CODE A: Air Distribution Series 2006.

**3.12 PAINTING**

Unless otherwise specified only visible ducts, i.e. ducts not covered by ceilings or in shafts shall be externally painted in accordance with the latest amendment of the STANDARD SPECIFICATION FOR PAINTING ‑ Specification A‑SPES‑30‑01.

The colour of the final coat shall be confirmed with the Engineer before it is applied.

**3.13 DISCREPANCIES**

If the relevant SANS documents do not cover or are vague with regards to manufacturing details of the ducting, SMACNA HVAC duct construction standards 2006 will be applicable.

* + - 1. **PVC DUCTWORK**

The SMACNA Standards for Thermoplastic Ducts (PVC) apply to contracts covered hereby.

**5. FLEXIBLE DUCTWORK**

5.1 Duct connections to mixing boxes, fan air terminals and diffusers shall be of spiral aluminium flexible ducting.

5.2 Flexible ducts longer than 1000 mm shall be insulated.

5.3 Flexible ducts shall not have more than two 90°, long radius bends and shall these not flatten or distort.

5.4 Flexible ducts shall not be longer than 1,5 m.

5.5 The flexible ducting shall be fire rated in accordance with SANS 10177-3 and shall comply with municipal fire codes.

**6. AIR DAMPERS**

6.1 Volume control dampers for all services shall incorporate the following:

a) Top and bottom stoppers

b) External linkages (preferred)

c) Fixed bushes (Nylon/bronze/sealed bearings)

d) Removable blades

6.2 Volume dampers used at air velocities in excess of 7,5 m/s shall be of double skin aerofoil construction.

6.3 Dampers used at an air velocity in excess of 7,5 m/s shall be of double skin aerofoil construction.

6.3 MANUAL BALANCING DAMPERS

6.3.1 All dampers must be easily accessible at any time during and after construction. It is the responsibility of the sub-contractor to ensure that access panels are provided wherever the dampers are inside ceiling voids.

6.3.2 Single blade/butterfly dampers may be used for round/spiral up to 750 mm in diameter. The blades shall be manufactured from rigid galvanised steel and the edges shall be hemmed. The turning rod/shaft shall be a single piece and shall have a rigid quadrant locking device. The quadrant locking device shall have clear markings on it indicating the “open”/”close” positions.

6.3.3 Single blade dampers may only be used for rectangular up to 600 mm (maximum dimension). The blades shall be manufactured from rigid galvanised steel and the edges shall be hemmed. The turning rod/shaft shall be a single piece and shall have a rigid quadrant locking device. The quadrant locking device shall have clear markings on it indicating the “open”/”close” positions.

6.3.4 Multiple opposed blade dampers must be used for rectangular larger than 600 mm (maximum dimension). The blades shall be manufactured from rigid galvanised steel and the edges shall be hemmed. Stiffener bars between damper flanges may be required to prevent distortion. The individual blade lengths may not exceed 1200 mm and the depth of 165 mm.

**6.4 AUTOMATIC BALANCING DAMPERS**

6.4.1 All automatic balancing dampers shall be multiple opposed blade dampers. The blades shall be manufactured from rigid galvanised steel and the edges shall be hemmed. Stiffener bars between damper flanges may be required to prevent distortion. The individual blade lengths may not exceed 1200 mm and the depth of 165 mm.

6.4.2 All linkages shall be of the external type and the linkages shall be fitted with nylon bushes.

**6.5 FIRE DAMPERS**

Fire dampers shall be manufactured to SANS 193 Specification and built into walls and slabs to ensure a fire barrier at the structural penetration.

All fire dampers shall be operated by fusible links unless otherwise specified.

**7. GRILLES**

7.1 Grilles shall be neat in appearance and shall, unless otherwise specified, be manufactured from natural anodised aluminium.

7.2 Grilles shall be fitted with a felt or foam rubber sealing gasket to ensure an air tight seal.

7.3 All fixings of grilles shall be concealed.

7.4 Unless otherwise specified the supply and installation of sub-frames for the fixing of the grilles are the responsibility of the sub-contractor.

**7.5 SUPPLY AIR GRILLES**

Supply air grilles shall be of the horizontal and vertical deflexion type horizontally and vertically. Each supply air grille shall be fitted with an opposed blade damper which is adjustable through the face of the grille. No parts of the adjustment mechanism shall protrude through the grille face. Adjustment shall be possible without removing the grill. The nominal vane spacing shall be 20 mm.

**7.6 RETURN AIR GRILLES**

Return air grilles shall be provided with adjustable opposed blade dampers (Refer to Clause 3.6) behind with a single set of fixed vanes. Opposed blade dampers shall be adjustable without removing the grille. The nominal vane spacing shall be 20 mm. Wall mounted grilles shall have 45 deg curved vanes and ceiling mounted grilles shall be of the egg‑crate type.

**7.7 OUTSIDE AIR LOUVRES**

Unless otherwise specified, outside air louvres shall be manufactured from natural anodised aluminium or ferrous metal galvanised by the hot dip process after fabrication. Painting if specified is also acceptable. The construction shall prevent raindrops entry at an air velocity of 2,5 m/s. A 13 mm square grit x 1,6 mm galvanised screen shall be provided behind each louvre.

**7.8 DOOR GRILLES**

Door grilles shall be of the inverted V‑blade type, manufactured from natural anodised aluminium and flanged on both sides of the door.

The bottom of all door grilles shall be installed 250 mm from the bottom of the doors.

Unless otherwise specified door grilles shall be 500 mm wide.

7.9 Alternatively and only after this is specifically approved by the engineers may doors be cut short if the gaps do not become unsightly. If approved, doors shall be cut by the builder (suitable for small quantities).

**8. DIFFUSERS**

8.1 Diffusers shall be neat in appearance manufactured from natural anodised extruded aluminium sections or powder coated pressed steel, whichever is specified.

8.2 Each diffuser shall be capable of handling the specified air flow rate without creating undue resistance, noise and local draughts.

8.3 Diffusers shall be neat and rigidly constructed.

8.4 An opposed blade or circular steel disc type volume control damper shall be provided for each diffuser.

8.5 The outlet velocity under normal conditions shall not exceed 3,0 m/s but the throw and spread shall ensure complete diffusion in the room without drafts.

**9. FAN AIR TERMINALS**

9.1 Fan Air Terminals shall be of the floor discharge type.

9.2 The minimum acceptable service life is ten years with 3000 operating hours per annum with a maximum acceptable deviation from the standard for 15% of the total number of fan air terminals.

9.3 The terminals shall be fully catalogued standard products of an approved manufacturer.

9.4 All components shall be easily accessible, and it shall be possible for two persons to remove and re‑install the terminal within 10 minutes.

9.5 Unless otherwise specified the terminal shall be supported from a concrete slab.

**STANDARD SPECIFICATION**

**FOR**

**AIR‑CONDITIONING AND VENTILATION FANS**

**STANDARD SPECIFICATION FOR AIR‑CONDITIONING AND**

**VENTILATION FANS**

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**STANDARD SPECIFICATION FOR AIR‑CONDITIONING AND VENTILATION FANS**

* **GENERAL**

This Specification deals with the following types of fans for general air conditioning and ventilation applications:

Centrifugal Fans : Backward Curved

 Forward Curved

 Airfoil

 Radial

Axial Fans : Vane axial (or Axial Airfoil)

 Propeller

Special Fans : Fan/Filter Units

 Wall/Window Fans

 Roof Ventilators

 Jet Fans

 Smoke Extract Fans

Although this Specification does not specifically cover fans contained within proprietary pre‑assembled packaged units, the general requirements set out in this Specification, will nevertheless still apply.

Inlets and outlets, except where directly connected to ducts or plenums accessible to personnel, shall be fitted with heavy wire mesh screens which shall be easily removable. All safety guards shall comply with the requirements of the Machinery and Occupational Safety Act No 6 of 1983 a.a.

* **STANDARDS**

2.1 Fans shall be tested, and performance graphs shall be in accordance with BS 848, ISO 5801, AMCA 210-07 or similar approved standards.

2.2 The following standards are applicable to this specification:

ISO 3117 & ISO 3912 ‑ Keys

ISO 1940 ‑ Balancing

ISO 254 ‑ Belt drives

SANS 1804 ‑ Electrical motors

* **SELECTION**

Each fan shall be able to handle the required air flow rate, against the system resistance and under the operating conditions indicated in the Detail Specification.

Fans shall be selected for maximum efficiency without causing unstable operating conditions.

Where fans are connected to duct systems, the fans shall be capable of handling 10% more than the specified air flow rates to allow for possible leakages.

* **IDENTIFICATION**

Apart from the general information specified for the manufacturer's nameplate the following is also required:

* Size (Dimeter / Width × Depth × Length)
* Air Flow Volume
* Selected Rotation Speed
* Selected Absorbed Power
* Indicating arrows for both the direction of rotation and air flow.
* **DOWN TIME**

Fans shall be so constructed and installed to permit the safe and easy removal of any sub-component, by a qualified building manager/technician, in the following maximum time:

* Centrifugal fan: 1 Day
* Axial Fan: 1 Day
* In-Line Duct Fan: 2 Hours
* Propeller Fan: 2 Hours
* Roof Extract Fan: 2 Hours
* **INSTALLATION CONSTRAINTS**

All fans shall be installed according to the supplier’s recommendations and requirements.

* **CENTRIFUGAL FANS**
	+ **GENERAL**

Centrifugal fans shall be backward curved, forward curved, airfoil, radial with single or double inlets, as called for in the Detail Specification.

Backward curved or airfoil fans shall only be permitted where clean air is displaced and shall be designed for a continuous increasing static pressure curve and non-overloading characteristics.

The impellers of single inlet fans shall be overhung on two external plummer blocks mounted on a pedestal on the same side of the casings. The shafts shall be extended past the pedestals to attach drives.

Double inlet, double width fans, where called for, shall be of similar construction to single entry fans with the exception that impellers shall be of the double entry type and bearings shall be mounted on rigid supports on either side of each air inlet, which on smaller fans may be part of the casing construction.

* + **CONSTRUCTION**

Fan casings shall be adequately stiffened to prevent drumming or excessive vibrations.

The casings of fans larger than 1.525 (Impeller diameters) shall be split or made in sections which shall be small enough for ease of transportation and installation or removal through the openings provided in the building. Joints shall be flanged and bolted with approved gaskets, without causing an obstruction to airflow.

Fan casings or sections thereof shall be equipped with lifting lugs.

On the pedestals of single inlet fans, and the bearing supports of double inlet fans, steel pads must be provided under each plummer block bearing, which must not be less than 10 mm thick and have their bearing surfaces fully machined to ensure flat even surfaces, after welding to their respective support members.

Casings shall be fabricated from steel having the following minimum metal thicknesses (mm):

|  |  |  |
| --- | --- | --- |
| D = Impellerdiameter(mm) | Class I | Class II |
|  | Side Plates | Volute | Side Plates | Volute |
| D Ø 380 | 2,00 | 1,60 | 2,80 | 2,80 |
|  | No Stiffeners | Min Stiffeners |
| 380 < D Ø 695 | 2,80 | 2,80 | 2,80 | 2,80 |
|  | Min Stiffeners | Med Stiffeners |
| 685 < D Ø 525 | 5,00 | 5,00 | 5,00 | 5,00 |
|  | Min Stiffeners | Med Stiffeners |
| 1525 < D Ø 1850 | 5,00 | 5,00 | 6,00 | 6,00 |
|  | Med Stiffeners | Heavy Stiffeners |
| D > 1850 | DESIGN TO BE SUBMITTED FOR APPROVAL |

Definitions used by the National Association of Fan Manufacturers:

Class 1 : These fans shall be designed to operate against a maximum 920 Pa total pressure when handling air at 21 ºC DB at sea level and a tip speed not exceeding 50 m/s.

Class 2 : These fans shall be designed to operate against a maximum 1650 Pa total pressure when handling air at 21ºC DB at sea level and a tip speed not exceeding 66 m/s.

A socketed and plugged drain shall be provided at the lowest point in each fan casing, except where the discharge of the fan is located at the lowest point.

Air inlets of fans shall consist of efficiently designed inlet cones with a minimum safe gap between impeller and inlet cone.

* + **IMPELLERS FOR CENTRIFUGAL FANS**

Impellers shall be single entry on single width and double entry on double width fans.

Impellers shall be statically and dynamically balanced in accordance with ISO 21940-11:2016, within G 6,3 for quiet vibration free operation.

Impellers and shafts shall be designed for a rotational speed of at least 25% greater than the selected maximum speed.

Each impeller shall be welded to an impeller boss which in turn shall be secured to the fan shaft with sunken keys of standard dimensions to (ISO 3117 & ISO 3912) for interchangeability. Keys shall be secured in position by means of Allen screws. Tapered Grub‑head type screws will not be accepted.

* + **SHAFTS**

Shafts shall be fully machined and shaped from medium tensile steel. Before shipping, shafts shall be protected against corrosion by means of a suitable rust inhibitor or protective grease coating.

Each shaft shall be capable of withstanding the deflection and vibration when operating at the critical speed. However, the maximum operating speed of a fan may not exceed 80% of the true critical speed, except in the case of large multistage fans.

Where applicable shafts shall have centre points on ends to facilitate speed measuring.

* + **BEARINGS**

Bearings shall be heavy duty external self‑aligning double row roller bearings, housed in plummer blocks. Similar ball bearings may be used on the following fans:

Class 1 Fans : Located bearing : Up to 400 mm impeller

 : Free bearing : Up to 800 mm impeller

Class 2 Fans : Located bearing : Not acceptable

 : Free bearing : Up to 700 mm impeller

Sealed bearings or bearings with external seals shall be used to prevent the loss of lubricant or the ingress of dirt.

Pillow block type bearings will not be accepted.

Classes 1 and 2 centrifugal fans shall be fitted with grease lubricated bearings, which shall be pre-lubricated if the impeller diameter is less than 1 850 mm. Larger fans shall be fitted with horizontally split roller or sleeve bearings fitted with grease nipples equipped with readily accessible filling connections.

When fans are fitted with oil lubricated bearings such fans shall be provided with oil reservoirs and sight glasses readily accessible in locations outside the ducts or casings and so constructed that their operation will not be affected by changes in air pressure and so that oil may be added while the fan is in operation without danger of over‑oiling. Bearings shall have a minimum rating life of 60 000 hours, for commercial and 100 000 hours for continuous industrial applications, allowance being made for extensive periods of dead load of impeller and shaft and for maximum pull of the drive under starting up as well as under conditions 1,25 times the selected rotation speed.

Where bearings require to be lubricated during operation, the Machinery and Occupational Safety Act No. 6: 1983 aa. shall apply 5.6 DRIVES

Unless otherwise specified, all centrifugal fans shall be provided with multiple endless V‑belt drives.

V‑BELT DRIVES

V‑belt drives shall be rated at 125% full load (Service factor = 1,25).

Belts shall be a matching set.

Endless V‑belt drives shall comply with ISO 254.

Pulleys shall have taper lock bushes.

Pulleys shall be statically and dynamically balanced. Motors shall be mounted on slide rails with lockable belt tension adjustment bolts.

The motors of belt driven fans shall be mounted on adjustable slide rails to permit belt tensioning. Slide rails shall be bolted at both ends to the fan frame. All mounting bolts and nuts shall be cadmium plated or galvanised and fitted with locking washers.

GEAR UNITS

Flexible couplings shall be provided both between motor and gear unit as well as gear unit and fan shaft.

Gear units shall be of helical designs with parallel shaft axes or bevel/helical type with shaft axes at right angles. Both types shall be of single, double or triple stage as required to suit the ratios.

Gear housings shall be suitable for gears for ratios which could be 20% higher or 10% lower than the selected requirements.

Gear units and gears shall be suitable in all respects for the selected duties with allowance for 20% higher or 10% lower ratios.

Gears shall be made from high quality steel forgings. Shafts shall be in accordance with the requirements of an approved standard. Gears and bearings shall have a rating life of 100 000 hours.

Provision shall be made for oil level indicators, breather vents, drains and oil make‑up plugs.

DRIVE GUARDS

All drive guards shall comply with Regulation of the Machinery and Occupational Safety Act (Act no. 6 of 1983) as amended.

Drive guards shall be easily removable and shall preferably split longitudinally and shall be oversized to accommodate larger than required pulleys.

Access holes of 50 mm diameter shall be provided in drive guards in line with the fan and motor shafts suitable for speed recordings, unless easy access is available elsewhere for recordings of motor and fan speeds.

Mesh shall be provided on the sides of V‑belt drives in order to provide sufficient ventilation to prevent the overheating of belts.

All exposed shafts and couplings shall be covered by guards.

* + **FAN MOTORS**

Fan motors for centrifugal fans shall be squirrel cage induction motors (TECF) and shall comply to SANS 1804.

When selecting a fan motor, the inertia of the impeller and drive during starting as well as the maximum running power requirements shall be taken into consideration. Suitable overload protection shall be provided for both the starting and running motor characteristics.

Unless specified differently in the Detailed Specification, fan motors with IP23 shall be drip‑proof motors protection, unless used in a draw‑through position in a system with spray cooler or sprayed coil, in which case a totally enclosed fan cooled (TECF) motor to IP 55, shall be used.

The requirements specified in the standard Specification A‑SPES‑08‑01 (Electric Motors, Motor Starters and Motor Protection) will apply.

* + **INLET VANES**

The fan shall be fitted with inlet vanes if specified. The shafts of variable inlet vanes shall be supported by pre‑lubricated sealed bearings. The shafts shall be connected to the control ring by means of crank arms and removable pins.

The control ring shall be activated by a control lever, fitted with bearings, extended to the outside of the casing.

Both sets of variable inlet vanes on double inlet centrifugal fans, shall be controlled simultaneously.

Where a fan is equipped with inlet vanes an airtight access panel shall be provided on the volute for inspection of the impeller. The access panel shall be equipped with camlock type handles or bolted.

Variable inlet vanes shall remain closed during start‑up until the fan has achieved the selected speed.

* + **ACTUATORS**

Actuators shall be capable in all respects of closing and opening the variable inlet vanes when the fan is delivering the selected air flow rate under design conditions.

The stroke of each actuator shall match the movement of the variable inlet vanes to prevent stressing or sticking of vanes in their extreme positions.

Actuators shall be either pneumatic, hydraulic or electrically operated whichever is specified in the Detailed Specification.

* + **BRAKES**

Brakes shall be provided when required in the Detailed Specification.

Brakes shall be either drum or disc brakes and shall be fitted between the motor and drive.

Brakes shall be either pneumatic or hydraulic, whichever is specified in the Detail Specification.

* + **HIGH TEMPERATURE APPLICATIONS**

An airtight access panel, with fire rated seals and camlock type handles or secured with bolts, shall be provided on the volute for inspection and cleaning the impeller.

Centrifugal fans displacing air or gas above 65°C shall be single inlet fans. Fans shall be fitted with pre-drilled flanges for inlet and discharge connections. For fans displacing air or gas from 100 ºC to 180 ºC heat slingers shall be provided on the shaft between the casing and the first bearing to protect the bearings from overheating.

* + **HIGH PRESSURE BLOWERS**

Blowers shall have single inlets with welded steel, aluminium alloy or stainless-steel impellers as specified in the Detailed Specification.

Pre‑drilled flanges shall be provided for both inlet and discharge connections.

The inlet plate shall be large enough to permit inspection and withdrawal of the impeller, or the casing shall be split horizontally.

A stuffing box shall be provided around the shaft where it enters the casing to prevent air leakage.

* **AXIAL FANS**
	+ **GENERAL**

Vane axial fans shall be axial fans with individually adjustable multiple aerofoil blades.

Fans shall be selected for the lowest practicable blade tip speed and noise level but shall never exceed 1450 RPM.

* + **CASINGS**

Casings shall be fabricated from mild steel with a minimum thickness of 3 mm.

Pre‑drilled flanges shall be welded to both the inlets and outlets.

When the Vane axial fan-inlet and outlet are both connected to ducting, the long casing type shall be used, such that the casing completely shrouds the impeller and motor.

Fans with only the inlet or outlet connected to ducting shall be of the short casing type; whereby the casing encloses the impeller only while the motor remains outside the ducting/casing.

Where bifurcated casings are specified, the bifurcation shall be streamlined, and a shaft seal shall be provided.

* + **IMPELLERS**

Impellers shall be statically and dynamically balanced, in accordance with ISO 21940-11:2016 within G6, 3.

Impeller blades shall be either cast aluminium, steel, stainless steel or moulded reinforced plastic, to suit the application and conditions specified in the Detailed Specification. Bronze tipped spark resistant steel blades shall be provided only if specifically required.

* + **BEARINGS**

Fans fitted with bearings requiring regular lubrication, shall be fitted with extended lubrication lines to the outside of the casings.

* + **FAN MOTORS**

Unless otherwise specified in the Detailed Specification, vane axial fans shall be directly coupled, and impellers shall be overhung on the motor shafts.

Motors shall be totally enclosed squirrel cage induction motors and shall comply to SANS 1804, with a protection rating of IP 55.

Motors shall be selected to be continuously rated at a maximum operating temperature of 55 ºC for Class "F" insulation in accordance with IEC 85, unless required in the Detailed Specification to operate at higher temperatures.

When required, belt driven axial fans shall be provided which are to be driven by means of multiple V‑belt drives, fitted with internal belt fairings and external belt guards, and externally mounted motors.

The motors shall be totally enclosed fan cooled (TEEFC) motors suitable for continuous operation at 100 ºC.

Motors on belt driven fans shall be mounted on adjustable mounting frames.

WEATHERPROOFING

Only fans with long casings shall be used for outside applications. An external weatherproof terminal box shall be mounted to the casing with a sealing gasket fitted between the terminal box and lid.

Belt driven axial fans mounted outside the casing shall be equipped with weatherproof motor and drive covers.

Fans used for saturated atmosphere conditions shall have compounded joints between bearing end shields and casings and between terminal boxes and casings.

SPECIFIC REQUIREMENTS

Specific requirements such as inlet or outlet cones, variable inlet vanes, automatically operated variable pitch blades, vortex breakers, marine type casings, etc., shall only be provided if specified in the Detailed Specification.

* **IN-LINE DUCT FANS**

In-line duct fans shall have flanges that are standard sizes on both sides for rectangular duct fans and shall be standard flexible sizes for round type duct fans.

All bearing shall be permanently lubricated.

All in-line duct fans shall be fitted with manually operated speed controllers.

All fan casings shall be insulated with high density acoustic foam/insulation if installed above an occupied space.

* **PROPELLER FANS**

Propeller fans shall be directly coupled, and the impellers shall be overhung on the motor shaft and balanced.

Propeller fans shall be ring mounted and fitted with bell mouths when handling air on a free intake and discharge basis or diaphragm mounted if attached to ducting, cowls, louvres, filters or any application resulting in static pressure development.

Propeller fans shall be selected for the lowest noise level practical and the fan speed shall not exceed 960 r p m.

Wire Guard/s to be installed on both sides of the fan if the fan is accessible from both sides.

* **FAN/FILTER UNITS**

Fan/Filter units shall consist of a propeller fan, air filter and louvre housed in a rigid sheet metal casing fitted with a pre‑drilled mounting flange.

* **WALL/WINDOW EXTRACT FANS**

Small wall/window extract fans shall have a white colour finish, shall be fitted with automatically operated shutters and have single phase motors.

The capacities and methods of mounting, control and electrical supply shall be as specified in the Detailed Specification.

* **ROOF EXTRACT FANS**

Roof extract fans shall have either propeller or mixed flow impellers, whichever is specified in the Detailed Specification.

Vertical discharge fans shall always be fitted with shutters while fans with mushroom type housings shall be equipped with shutters when called for in the Detailed Specification.

* **BASES, MOUNTINGS AND CONNECTING DETAILS**

Unless otherwise specified, or in the case of unit construction, a common base frame fabricated from mild steel channel sections shall be provided, which shall be adequate to support the fan, drive and motor.

Provision shall be made for spring mountings or holding down bolts.

Bases and spring mountings or hangers shall be as specified in the Standard Specification for Noise and vibration Control (A-SPES-30-05-W02).

The inlet and/or outlet of the fan when connected to plenums or ducts shall be equipped with flexible connections, the requirements of which are specified in the Standard Specification for air Distribution Systems (A-SPES-31-01-R03). When flexible connections are required, the relevant fan inlet and/or outlet shall be fitted with bolted flanges of at least 40 x 40 x 3. An earthing strap shall be installed over all flexible connections.

Thrust restraints shall be fitted if necessary but are required for all fans delivering more than 30 m³/s and mounted on spring mountings or hangers. All mounting assembling and adjustment bolts, nuts and washers, shall be galvanised.

* **PRE-COMMISSIONING REQUIREMENTS**

No fan shall be started for any purpose such as temporarily ventilation, testing or commissioning, unless all ducts and plenums have been cleaned, filters installed if applicable and the total system checked for loose material.

* **COMMISSIONING**

All fans shall be commissioned in accordance with CIBS Commissioning Code A.

**STANDARD SPECIFICATION**

**FOR**

**AIR FILTERS**

**STANDARD SPECIFICATION FOR AIR FILTERS**

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**STANDARD SPECIFICATIONS FOR AIR FILTERS**

**1. GENERAL**

**1.1** The Engineer will only approve for use on this project those filter units which the tenderer can show to meet the requirements of this specification for filter units as a whole, or that the actual filter elements, media curtains, cells and holding frames, incorporated in filter units assembled in his own workshop are the standard products of a reputable manufacturer, regularly engaged in the fabrication of the particular type of air filter and of which full catalogued information and test results are available. If an imported product, the Contractor must be able to prove that such products are well represented in the Republic of South Africa.

**1.2** All disposable panel and disposable bag filters shall comply with SANS 1424.

1.3 Only filters tested by the South African Bureau of Standards to Ashrae standards 52 will be acceptable. Arrestance (gravimetric), efficiency (photometric), dust holding capacity and resistance against air flow must have been tested and recorded and shown to be within Ashrae limits before filters are accepted.

**1.3** Filter media shall have self‑extinguishing fire characteristics to Din 5 3438 Class F1 or similar International Standards.

**1.4** Frames and filters shall be constructed in such a manner that the passage of unfiltered air is prevented. Gaskets shall be provided between filters, frames and unit casings.

**1.5** Each filter bank shall be supplied with an identification label stating the type of filters, quantity of filter elements, model numbers and all other information necessary for reordering and replacing filter media.

**1.6** Filters shall be adequately protected against dirt during construction and shall not be operated until the system is thoroughly cleaned.

**1.7** An inclined manometer shall be installed on each filter bank. The gauge shall be connected to static pressure taps of approved design so that it will indicate the resistance to airflow of filters correctly. Connections shall be made in copper tubing. The range of the manometers shall be 0 to 250 Pa or to 1,5 times the maximum pressure over the dirty filters, or

 Shall be fitted with pressure differential switches, over each filter bank, which shall operate when the pressure drop across the filter reach a maximum value recommended by the manufacturers. The switch shall then energise a pilot light on the main control board.

**1.9** Filter dimensions shall be selected to suit the air handling units at a maximum face velocity of 2,5 m/s or as per manufacturers recommendations.

**1.10** All filter accessories including the filter holding frames and clips shall be proprietary items.

**1.11** All metal parts shall be sufficiently protected against corrosion.

**1.12** All metal parts shall be coated with baked enamel, galvanised or other approved paint.

**1.13** All filters and filter media for a project shall be of the same manufacturer, unless approved by the Engineer.

**2. PANEL FILTERS**

**2.1** Each filter bank shall consist of a factory made robust sectional steel supporting frame, to house the filter cells.

**2.2** All filter cells on a project shall have the same dimensions.

**2.3** The filter medium shall be pleated and bonded to the media holding frames.

**4. HIGH EFFICIENCY SECONDARY FILTERS**

**4.1** The filter media of high efficiency filters shall consist of preformed deep pleats made up as replaceable filter cartridges supported by metal retainers. The retainer baskets shall be constructed of heavy steel wire, shaped and welded to support the pleats of the filter cartridges.

**4.2** High efficiency filters shall be used as a secondary filter together with an acceptable primary or pre‑filter.

**5. HEPA FILTERS**

**5.1** Filter frames and retaining mechanisms shall be supplied and installed by the filter manufacturer.

**5.2** The filter to frame seal shall be a routed fluid seal. The sealing fluid shall be highly viscous, non‑solidifying silicon and shall not support bacterial growth. The sealing fluid shall be selected for the particular application.

**5.3** Close to the coast the filter material shall be water repellent.

**5.4** The filter media enclosing frame shall be corrosion protected steel or aluminium.

**5.5** The complete filter installation shall be leak tested by the filter manufacturer or a reputable 3rd party. The leak test shall be either a DOP or sodium flame test.

**5.6** The filter efficiency of each filter cell shall be tested and certified.

**6. GREASE ELIMINATORS**

**6.1** Grease eliminators shall be "CYCLO CLEAN" stainless steel type filter units arranged in a V‑formation, unless approved by the Engineer.

**6.2** The unit shall be made from interlocking frames for the individual filter units, or bolted in a common assembly. The ends of the assembly shall be suitably blanked off.

**6.3** Each pair of filter units shall be provided with a readily removable drip tray.

**6.4** Filters shall be fitted with suitable handles.

**6.5** The filter depth shall not be less than 50 mm.

**7. SPARE MEDIAS**

**7.1** No fan is to be run without filters. The initial set of filters used for commissioning purposes shall be washed prior to hand‑over or replaced if not washable.

**7.2** One complete set of spare filters shall be supplied for all washable filters on the entire project.

**7.3** Spare filters shall be suitably packed and protected for storage. The packing shall be able to withstand normal handling without damage to the filters.

**STANDARD SPECIFICATION**

**FOR**

**NOISE AND VIBRATION CONTROL**

**STANDARD SPECIFICATION FOR NOISE AND VIBRATION CONTROL**

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**STANDARD SPECIFICATION FOR NOISE AND VIBRATION CONTROL**

**1. GENERAL**

**1.1** The Installation shall operate without causing undue noise and vibration. The Contractor shall take the necessary precautions to ensure that noise levels in plant rooms and adjacent occupied areas as specified in the Detail Specification are not exceeded.

**1.2** Noise generating equipment such as fans, compressors, pumps and motors shall be selected to operate as close to the point of maximum efficiency as possible. It is the responsibility of the Contractor to check operating noise levels of equipment before tendering. Tenderers offering equipment with low noise ratings may receive preference.

**1.3** Where it is not possible to meet the specified sound levels due to the noise generated by the equipment offered, or due to inadequacies in the building structure, such deficiencies shall be qualified in the tender.

**2. SOUND ATTENUATORS**

**2.1** Sound attenuators shall be provided and installed where indicated on the relevant drawings and in such places where the system attenuation alone is inadequate. Special attention shall be given to noise regeneration due to heater banks and dampers inside ductwork.

**2.2** Internally lined plenum chambers for low frequency attenuation may as an alternative be installed in a duct in lieu of proprietary manufactured sound attenuators. The material and lining shall comply with Clauses 2.3 and 2.7.

**2.3** The absorption material shall be moisture repellent, odour free, non inflammable and shall be abrasion proof up to air speeds of 20 m/s.

**2.4** Sound attenuators shall be suitable for the system working pressure, velocity and air temperatures up to 80 degrees Celsius.

**2.5** Except where otherwise stated in the Detail Specification, sound attenuators in ductwork after supply air fans shall be designed for an insertion loss large enough to limit the total sound pressure level of the noise at a distance of 1,5 metres directly in front of the first air outlet in the duct system to the NC level specified in the Detail Specification. Background noise levels shall be measured separately with the plant switched off and shall be deducted from the total sound pressure levels.

**2.6** Sound attenuators shall be of the proprietary manufactured type. Field fabricated sound attenuators of the lined duct type or plenum chamber type shall only be used as indicated in clause 2.2 or when specified in the Detail Specification or where written approval is obtained from the Engineer.

**2.7** Field fabricated sound attenuators shall be double walled with the inner wall consisting of galvanised perforated plate. The perforations shall be 10 mm holes at 25 mm centres or the Manufacturer's nearest standard. Expanded metal will not be acceptable The inner and outer walls shall be held together with stiffening webs at approximately 300 mm centres. The lining thickness shall be at least 80 mm.

**2.8** Casings shall be constructed of galvanised sheetmetal, of which the minimum thickness is in accordance with the requirements laid down in A‑SPES‑31‑01‑ for Ducting.

**2.9** The internal free area of field fabricated sound attenuators shall not be less than the cross sectional area of the connecting ductwork as indicated on the drawing. The static pressure loss through proprietary manufactured sound attenuators shall not exceed the maximum permissible pressure loss at the design NC level as recommended by the Manufacturer. Where sound attenuators are larger than the ducts, the joining duct sections shall be enlarged to the size of the attenuator. All sound attenuators shall be provided with flanged connections.

**2.10** Sound attenuators in plant rooms shall be installed in or as close to the plant room wall as possible to prevent break‑in of plant room noise into the duct after the sound attenuator. Where this is not feasible due to space limitations, the duct section between the sound attenuator and plant room wall shall be insulated and plastered with a suitable hard setting plaster at least 10 mm thick on all four sides.

**2.11** The Contractor shall submit noise estimating sheets for all systems as well as the insertion loss ratings of sound attenuators for approval before ordering. Failure to do so may result in additional costs to the Contractor if noise levels in any area should exceed the specified limits.

**2.12** Sound attenuators in the airflow of kitchen extraction systems shall have a sound absorbing lining which shall not absorb any grease or fat.

**3. PLANT ROOM ABSORPTION**

**3.1** Where indicated on the drawings, plant room walls and ceilings shall be acoustically treated to reduce reverberant sound pressure levels inside the plant room.

**3.2** The acoustic lining shall consist of fibreglass or mineral wool insulation held in position by PVC battens and covered with a vapour barrier and acoustic tiles or hardboard.

**3.3** Battens shall be 50 x 50 mm PVC square tubes and shall be bolted or screwed to walls and ceilings at approximately 500 to 600 mm centres. Battens against walls shall be installed horizontally. The space between battens shall be filled with 50 mm thick fibreglass or mineral wool having a density of not less than 40 kg/m3. The lining shall then be covered with a PVC vapour barrier. All joints shall coincide with battens and shall be sealed together with nail heads with a suitable sealer.

**3.4** Where the predominant noise levels of the machinery in the plant room are below 500 Hz, such as for centrifugal fans and reciprocating compressors the lining shall be covered over the vapour barrier with 3 mm thick solid hardboard and painted as specified elsewhere. Joints between battens shall be avoided.

**3.5** Where the predominant noise levels of the machinery in the plant room are 500 Hz and higher, such as for axial flow fans and centrifugal compressors, the lining shall be covered over the vapour barrier with perforated metal or boards and painted as specified elsewhere.

**3.6** Where thermal insulation is not required, such as on plant room surfaces outside air handling units, the 50 mm fibreglass or mineral wool blankets and vapour barrier specified above, are not required. Proprietary acoustic tiles may as an alternative to perforated metal or boards on wooden battens, be installed directly on walls or ceilings where thermal insulation is not required.

**4. VIBRATION ISOLATION**

**4.1** Vibration transmission to the building shall be avoided. All rotating machines shall be isolated from the floor by means of proprietary vibration isolators having isolation efficiencies of approximately 90 %. Flexible connections shall be provided between equipment which generate vibration and connecting pipes and ducts. It is the Contractor's responsibility to ensure that where piping and ductwork pass through building structures, suitable sleeves and PVC frames are provided around piping and ducting respectively.

**4.2** Where piping and ducting pass through plant room walls direct into occupied spaces or corridors or into the ceiling space above the space or corridor the opening around the pipe, duct or sound attenuator, shall be sealed. Building shafts without walls or floors, between the shaft and plant room, shall be considered as part of the plant room.

**4.3 Plinths**

**4.3.1** Plinths shall be provided for all mechanical and electrical equipment which is to be mounted on plant room floors. Plinths shall protrude at least 50 mm above finished floor levels and depending on the position of the vibration mountings, shall be at least 300mm wider or longer than the inertia bases mounted on top. Plinths for equipment which do not need inertia bases or plinths for inertia bases with recessed vibration mountings shall be the same size as the equipment or bases mounted on top. Plinths shall consist of 3 mm thick channel or angle iron formers with 10 mm thick reinforcing bars welded to the formers at a 150 mm pitch in each direction and filled with concrete. The top surface of the concrete shall be floated to an even and smooth finish.

**4.3.2** Plinths as specified above shall also be provided for field assembled plenum chambers. Additional sub‑bases shall be provided below cooling and heating coils and filters. These sub‑bases shall consist of either structural steel, concrete or masonry.

**4.3.3** Sub‑bases shall be provided for all equipment mounted on flat roofs. These bases shall protrude at least 150 mm above the finished roof level and shall be sized to suit individual equipment.

Generally these bases are required only underneath mounting feet of units and not underneath the entire base area of the unit. Bases shall consist of 3 mm thick sheet metal formers, reinforced with 10 mm rods welded to the formers at 150 mm centres each way and filled with concrete. It is the (Sub) Contractors responsibility to work closely with the Principal Contractor to avoid any damage to the weather proofing, and to ensure that roofs are completely weather sealed where sub‑bases are provided.

**4.3.4** Where the cooling tower is on the same floor level as the condenser water pumps, the cooling tower shall be installed on concrete or masonry walls high enough to ensure a flooded suction at all times.

**4.4** **Bases**

**4.4.1** Concrete or steel inertia or floating bases shall be provided for equipment as specified in the following schedule:

|  |  |
| --- | --- |
| **MACHINE** | **TYPE OF FLOATING BASE** |
| **kW-rating refers to electrical motor size** | **Plantroom On Ground Floor Or Basement** | **Plantroom On Roof Or Floor Slab** |
| a) Pumps: i) 3 kW and smaller, close coupledii) 3 kW and smaller, long couplediii) Above 3 kWb) Reciprocating Water Chillersc) Centrifugal Water Chillersd) Reciprocating Compressors:i) 3 kW and smallerii) above 3 kWe) Condensing Units:i) 3 kW and smallerii) Above 3 kWf) Air Compressors:i) 3 kW and smallerii) Above 3 kWg) Cooling Towersh) Evaporative Condensersi) Air Cooled Condensersj) Fans: i) Axial flow and roof ventilatorsii) Centrifugal 3 kW and smalleriii) Centrifugal above 3 kW and below 50 mm static pressureiv) Centrifugal pressure 50mm and abovek) Air handling unitsl) Screw compressors: | NoneSteelConcreteSteelSteelSteelConcreteNoneSteelSteelConcreteNoneNoneNoneNoneNoneSteelConcreteNoneConcrete on 25mm neoprene mat inside 80mm galvanised angle frame bolted to concrete floor. | SteelSteelConcreteConcreteSteelSteelConcreteSteelSteelSteelConcreteSteelSteelSteelSteelSteelSteelConcreteSteel |

**SECTION 3**

**SCHEDULE OF EQUIPMENT**

**FOR THE**

**HVAC INSTALLATION**

**FOR**

**CSIR BUILDING 2 BASEMENT**

**SECTION 3**

**MECHANICAL INSTALLATION FOR THE CSIR BUILDING 2 BASEMENT**

**SCHEDULE OF EQUIPMENT OFFERED**

|  |  |  |
| --- | --- | --- |
| **EQUIPMENT** | **SUPPLIER/****MANUFACTURER** | **TYPE** |
| 1. VRV/F Condensing Unit |  |  |
| 2. Rooftop Package Unit |  |  |
| 3. Fans  |  |  |
| 4. Diffusers & Disk Valves  |  |  |
| 5. Split Units  |  |  |
| 6. Switchgear  |  |  |
| 7. Isolators  |  |  |
| 8. Wiring Trunking |  |  |

**SIGNED BY TENDERER:**

**DATE: ....................................................................................**

**SECTION 4**

**SCHEDULE OF DRAWINGS**

**FOR THE**

**HVAC INSTALLATION**

**FOR**

**CSIR BUILDING 2 BASEMENT**

**SECTION 5**

**SCHEDULE OF PRICES**

**FOR THE**

**HVAC INSTALLATION**

**FOR**

**CSIR BUILDING 2 BASEMENT**

**GENERAL NOTES TO BILLS OF QUANTITIES FOR THE MECHANICAL INSTALLATIONS**

1. The attached Bills of Quantities form part of the Tender Document and shall be read in conjunction therewith.
2. Reference shall be made to the Specifications for the full meaning and description of work to be done and material/equipment to be used.
3. The Bills of Quantities shall be fully completed and returned to form part of a valid tender before the tender closing time.
4. No alterations, addition or erasure may be made to the text of the Bills. If such an alteration, addition or erasure is made it shall not be acknowledged and the original wording of the text shall apply.
5. All prices or rates shall be given against each item of the Bills of Quantities irrespective of any quantities given or not. The cost of items if not priced shall be taken as being included in other price or rates in the Bills of Quantities.
6. “Rates only” items, as all other rates and item prices will be used for costing variations.
7. Provisional Amounts and Contingency Sums are budgetary costs for use by the Engineer at his discretion and may be omitted in total without any compensation to the Contractor whatsoever.
8. Since the Specifications call for complete operational systems, the rates submitted shall cover the cost of associated items not specifically listed, but which are required for a complete operational installation in terms of the Specifications. Should the Tenderer wish to list such items separately, or if any requirements of the Specifications are not specifically covered by items in the Bills of Quantities, the Tenderer shall allow for these as additional items or in his Tender covering letter.
9. Unless otherwise measured all rates shall include for the detail design, engineering, procurement, supply, delivery, erection, waste, storage, commissioning, testing, maintenance and guarantee of material or equipment in terms of the Specifications.
10. The Engineer will use his discretion to correct conspicuous arithmetical errors when adjudicating the tenders.
11. No orders shall be placed on the basis of the quantities in the bills, but shall be verified on site by the Contractor prior to placement of orders.