SECTION G

GENERAL MECHANICAL SPECIFICATIONS

SECTION G

GENERAL MECHANICAL SPECIFICATIONS

GENERAL MECHANICAL SPECIFICATION

CLAUSE	DESCRIPTION	PAGE
2.01	GENERAL	G-1
2.02	QUALITY OF MATERIALS	G-1
2.03	REGULATIONS AND STANDARDS	G-1
2.04	ELECTRICAL REQUIREMENTS	G-2
2.05	TRANSPORT AND STORAGE	G-2
2.06	SITE SUPERVISION	G-3
2.07	INSTALLATION	G-3
2.08	TESTING	G-3
2.09	COLOUR CODING	G-4
2.10	WELDING	G-5

SECTION G

GENERAL MECHANICAL SPECIFICATIONS

2.01 General

This section specifies the general requirement for plant, equipment and materials forming part of the Sub-contract Works and shall apply except where specifically stated elsewhere in the Specification or on the Contract Drawings.

2.02 Quality of Materials

All plant, equipment and materials supplied as part of the Sub-contract Works shall be new and of first class commercial quality, shall be free from defects and imperfections and where indicated shall be of grades and classifications designated herein.

All products or materials not manufactured by the Sub-contractor shall be products of reputable manufacturers and so far as the provisions of the Specification is concerned shall be as if they had been manufactured by the Sub-contractor.

Materials and apparatus required for the complete installation as called for by the Specification and Contract Drawings shall be supplied by the Sub-contractor unless mention is made otherwise.

Materials and apparatus supplied by others for installation and connection by the Sub-contractor shall be carefully examined on receipt. Should any defects be noted, the Sub-contractor shall immediately notify the Engineer.

Defective equipment or that damaged in the course of installation or tests shall be replaced as required to the approval of the Engineer.

2.03 Regulations and Standards

The Sub-contract Works shall comply with the current editions of the following:

a) The Kenya Government Regulations.

b) The United Kingdom Institution of Electrical Engineers (IEE) Regulations for the Electrical Equipment of Buildings.

a) The United Kingdom Chartered Institute of Building Services Engineers (CIBSE) Guides.

d) British Standard and Codes of Practice as published by the British Standards Institution (BSI)

e) The Local Council By-laws.

f) The Electricity Supply Authority By-laws.

g) Local Authority By-laws.

h) The Kenya Building Code Regulations.

i) The Kenya Bureau of Standards

2.04 Electrical Requirements

Plant and equipment supplied under this Sub-contract shall be complete with all necessary motor starters, control boards, and other control apparatus. Where control panels incorporating several starters are supplied they shall be complete with a main isolator.

The supply power up to and including local isolators shall be provided and installed by the Electrical Sub-contractor. All other wiring and connections to equipment shall form part of this Sub-contract and be the responsibility of the Sub-contractor.

The Sub-contractor shall supply three copies of all schematic, cabling and wiring diagrams for the Engineer's approval.

The starting current of all electric motors and equipment shall not exceed the maximum permissible starting currents described in the Kenya Power and Lighting Company (KPLC) By-laws.

All electrical plant and equipment supplied by the Sub-contractor shall be rated for the supply voltage and frequency obtained in Kenya, that is 415 Volts, 50Hz, 3-Phase or 240Volts, 50Hz, 1-phase.

Any equipment that is not rated for the above voltages and frequencies shall be rejected by the Engineer.

2.05 Transport and Storage

All plant and equipment shall, during transportation be suitably packed, crated and protected to minimise the possibility of damage and to prevent corrosion or other deterioration.

On arrival at site all plant and equipment shall be examined and any damage to parts and protective priming coats made good before storage or installation.

Adequate measures shall be taken by the Sub-contractor to ensure that plant and equipment do not suffer any deterioration during storage.

Prior to installation all piping and equipment shall be thoroughly cleaned.

If, in the opinion of the Engineer any equipment has deteriorated or been damaged to such an extent that it is not suitable for installation, the Sub-contractor shall replace this equipment at his own cost.

2.06 **Site Supervision**

The Sub-contractor shall ensure that there is an English-speaking supervisor on the site at all times during normal working hours.

2.07 **Installation**

Installation of all special plant and equipment shall be carried out by the Sub-contractor under adequate supervision from skilled staff provided by the plant and equipment manufacturer or his appointed agent in accordance with the best standards of modern practice and to the relevant regulations and standards described under Clause 2.03 of this Section.

2.08 **Testing**

2.08.1 **General**

The Sub-contractor's attention is drawn to Part 'C' Clause 1.38 of the "Preliminaries and General Conditions".

2.08.2 **Material Tests**

All material for plant and equipment to be installed under this Sub-contract shall be tested, unless otherwise directed, in accordance with the relevant B.S Specification concerned.

For materials where no B.S. Specification exists, tests are to be made in accordance with the best modern commercial methods to the approval of the Engineer, having regard to the particular type of the materials concerned.

The Sub-contractor shall prepare specimens and performance tests and analyses to demonstrate conformance of the various materials with the applicable standards.

If stock material, which has not been specially manufactured for the plant and equipment specified is used, then the Sub-contractor shall submit satisfactory evidence to the Engineer that such materials conform to the requirements stated herein in which case tests of material may be partially or completely waived.

Certified mill test reports of plates, piping and other materials shall be deemed acceptable.

2.08.3 **Manufactured Plant and Equipment – Work Tests**

The rights of the Engineer relating to the inspection, examination and testing of plant and equipment during manufacture shall be applicable to the Insurance Companies or Inspection Authorities so nominated by the Engineer.

The Sub-contractor shall give two week's notice to the Engineer of the manufacturer's intention to carry out such tests and inspections.

The Engineer or his representative shall be entitled to witness such tests and inspections. The cost of such tests and inspections shall be borne by the Sub-contractor.

Six copies of all test and inspection certificates and performance graphs shall be submitted to the Engineer for his approval as soon as possible after the completion of such tests and inspections.

Plant and equipment which is shipped before the relevant test certificate has been approved by the Engineer shall be shipped at the Sub-contractor's own risk and should the test and inspection certificates not be approved, new tests may be ordered by the Engineer at the Sub-contractor's expense.

2.08.4 **Pressure Testing**

All pipework installations shall be pressure tested in accordance with the requirements of the various sections of this Specification. The installations may be tested in sections to suit the progress of the works but all tests must be carried out before the work is buried or concealed behind building finishes. All tests must be witnessed by the Engineer or his representative and the Sub-contractor shall give 48 hours notice to the Engineer of his intention to carry out such tests.

Any pipework that is buried or concealed before witnessed pressure tests have been carried out shall be exposed at the expense of the Sub-contractor and the specified tests shall then be applied.

The Sub-contractor shall prepare test certificates for signature by the Engineer and shall keep a progressive and up-to-date record of the section of the work that has been tested.

2.09 **Colour Coding**

Unless stated otherwise in the Particular Specification all pipe work shall be colour coded in accordance with the latest edition of B.S 1710 and to the approval of the Engineer or Architect.

2.10 **Welding**

2.10.1 **Preparation**

Joints to be made by welding shall be accurately cut to size with edges sheared, flame cut or machined to suit the required type of joint. The prepared surface shall be free from all visible defects such as lamination, surface imperfection due to shearing or flame cutting operation, etc., and shall be free from rust scale, grease and other foreign matter.

2.10.2 **Method**

All welding shall be carried out by the electric arc processing using covered electrodes in accordance with B.S. 639.

Gas welding may be employed in certain circumstances provided that prior approval is obtained from the Engineer.

2.10.3 **Welding Code and Construction**

All welded joints shall be carried out in accordance with the following Specifications:

a) **Pipe Welding**

All pipe welds shall be carried out in accordance with the requirements of B.S.806.

b) **General Welding**

All welding of mild steel components other than pipework shall comply with the general requirements of B.S. 1856.

2.10.4 **Welders Qualifications**

Any welder employed on this Sub-contractor shall have passed the trade tests as laid down by the Government of Kenya.

The Engineer may require to see the appropriate to see the appropriate certificate obtained by any welder and should it be proved that the welder does not have the necessary qualifications the Engineer may instruct the Sub- contractor to replace him by a qualified welder.

SECTION H

PARTICULAR MECHANICAL

VENTILATION AND AIR CONDITIONING SYSTEMS

SECTION H

STANDARD SPECIFICATIONS FOR MECHANICAL VENTILATION AND AIR CONDITIONING SYSTEMS

TABLE OF CONTENTS

DESCRIPION **PAGE**

TABLE OF CONTENTS……1

GENERAL SPECIFICATON FOR MECHANICAL VENTILATION SYSTEM……..…4

1.SCOPE OF WORK…….4

2.SYSTEM OF COMPONENTS……....4

3.DRAWINGS……4

4.MATERIALS AND GENERAL WORKMANSHIP……...4

5.GENERAL DUCTWORK……...5

1.1 Ductwork……....5
1.2 Rectangular ductwork……..5
1.3 Brackets and Supports……..7
1.4 Joints……..7
1.4.1 Flexible joints……..7
1.4.2 Flexible connections……...8
1.5 *Finish painting*…….8

6.0 AIR INTAKES AND OUTLETS……..9

7.FANS…….....9

7.1 General……..9
7.2 Axial Flow Fans……..10

8.DAMPERS……...11

8.1 General……..11
8.2 Butterfly dampers…… …11
8.3 Bifurcating dampers……..11
8.4 Multi-leaf dampers……..11
8.5 Damper Quadrants and Operating Handles……12
8.6 Self-closing dampers……12
8.7 Sliding Dampers……..12

8.8 Iris type dampers……..12

9.GRILLES…….12

9.1 Supply and Return Registers……..12
9.2 Extract grilles……12
9.3 Fresh Air Grilles……..13
9.4 Diffusers……13
9.5 Louvres……13

10.ATTENUATORS……..13

11.INSTRUMENTS……....14
11.1 Gneral……14
11.2 System Static Pressure Gauge……14

12.VIBRATION,NOICE AND SOUND INSULATION……..14

12.1 Anti-vibration Mountings……14
12.2 Noise……14

13.THERMAL INSULATION……....15
13.1 General Description……15
13.2 Ductwork in Plant Room……15
13.3 Ductwork External to Plant Rooms……16

14.ELECTRICAL EQUIPMENT AND WIRING……16
14.1 Scopes……16
14.2 General……16
14.3 Electrical Motors……...16

15.INSPECTION,COMMISSION AND TESTING…….17

15.1 General……17
15.2 Testing……17
15.2.1 Site Tests……17
15.2.2 Site Tests-Fans……17
15.2.3 Completion Of Works-Balance and commissioning……18

16.NOISE AND SOUND CONTROL……..19

17.OPERATION AND MAINTENANCE INSTRUCTION……....19

18.SPARE PARTS……...20

GENERAL SPECIFICATIONS FOR AIR CONDITIONING SYSTEMS…….21

19.SCOPE OF WORKS……..21

20.CLIMATIC CONDITIONS……...21

21.SYSTEMS DESIGN DATA……...22

22.SPLIT AIR CONDITIONING SYSTEM……..22

22.1 Indoor wall mounted cooling unit(Evaporator)…….....22
22.2 Outdoor Units…….....23
22.3 Refrigeration piping……24

23.VARIABLE REFRIGERATION FLOW(VRF) SYSTEM…….24

23.1 Inverter Controlled Outdoor Unit…….....25
23.2 Indoor cooling unit(Evaporator)……26
23.3 Control panel……27
23.4 System Controls Unit…….....27
23.5 Testing and Commissioning Standards…….....28
23.6 As-Built-Drawings and maintenance manuals……28
23.7 Training……29

24.DUCTED AIR CONDITIONING SYSTEM……...29

24.1 Packaged Air Handling Units……29

25.TESTING AND COMMISSIONING……..30

26.ELECTRIC WORKS……30

27.BUILDERS WORKS……...30

GENERAL SPECIFICATION FOR MECHANICAL VENTILATION

SYSTEM

1.SCOPE OF WORK

The scope of the works coprises Installation,Testing and Commissioning of Mechanical Ventilation and Air Conditioning systems in accordance with Specifications and drawings.All the necessary elements and details for complete system are to be included.

Excluded from the specifications are the following:-

A)All concrete works

B)All block work

c)Electrical wiring,isolators and switch boards,except internal wiring for control system from a local isolator

2.SYSTEM COMPONENTS

Dimensions and capacities of ducts and fans are calculated and based on a specific requirements of air, and on an aasumed resistance through grilles, silencers, etc. However the installer shall be responsible for the correct functioning of the system.Subsequently it is therefore his duty to size the systems' components with consideration to his offered equipment

3.DRAWINGS

The Engineer's drawings show the main layout and principles for the ventilation and Air Conditioning Systems.If need for further detailing is required in order to carry out the work,working drawings and details shall be produced for approval by the Engineer before the work is executed.

In preparation of the working drawings care should be taken to coordinate the Ventilation and Air Conditioning works with other services involved and avoid any interference with these.

4.MATERIALS AND GENERAL WORKMANSHIP

In the specification,equipment is generally described according to capacities and a given standard in order to aid in identification of the particular equipment to satisfy specifications.The equipment selected shall be of reputable manufacture with adequate Back-Up service.

If the Engineer finds it necessary,samples of the materials will be submitted for approval beforeplacing an order.The Engineer shal l reject any materials which he finds to be of unsatisfactory quality.

Works shall be carried out by competent workmen under experienced supervision

The Engineer shall have the authority to have any substandard work or equipment redone and/or equipment replaced

5.GENERAL DUCTWORK

5.1 Ductwork

All seams,joints and connections to plant shall be so made as to reduced air leakage to a minimum.Internal roughness and obstructions to airflow will not be accepted.Sharp edges or corners on the outside of ductwork,flanges,supports,etc will not be accepted.Any part of galvanized ductwork where the galvanizing is damaged during manufacture or erection shall be painted with two coats of aluminium,zinc or other erosion-resisting paint to the approval of the Engineer.

Where ducts pass through roofs(and external walls where applicable)these shall be fitted with angle flanges and weather cravats to ensure a weather-proof fitting to the building structure.

Connections to equipment shall be made with angle flanged joints.Ductwork which may have to be moved to enable plant to be removed shall incorporate angle flanged joints.For long duct runs,angle flanged shall be included at intervals to facilitate any subsequent alternations.

Bends and offsets shall have a minimum throat radius equal to the width of duct.Where short radius elbows are indicated or agreed by the Engineeras necessary due to site limitations the dimensions and internal vane(s) shall be in accordance with HVAC publication DW/121

Ductwork shall be constructed by galvanized,cold rolled,close annealed patent flattened sheets.Test holes shall be provided in branch ducts from grilles and there shall be three or four tests holes on size of duct according to duct depth at each test position.At branch positions shall be one test hole.Air tight swivel type metalcovers shall be fitted over the test holes in such amanner that they shall be readily removed as required.

5.2 Rectangular ductwork

Construction of ductwork shall be as per the following Guidelines:

i)Up to 300mm longer side-22 S.W.G

ii)Over 300mm and up to 460mm longer size-20 S.W.G

iii)Over 460mm and up to 900mm longer side 18 S.W.G(stiffening to be 25mm x 25mm x3mm.M.S. angle at slip joints at 180mm spacing)

iv)Over 900mm and up to 1370mm longer side 16 S.W.G(stiffening to be 30mm x 30mm x 3mm M.S.angle at 900mm spacing)

v)Over 1370mm longer side-14 S.W.G(Stiffening to be 40mm x 40mm x 5mm M.S.angle at 900mm spacing)

Ductwork constructed from 22 and 20 S.W.G. sheet shall have folded locked seams and ductwork constructed from 18,16 and 14 S.W.G. sheets shall have a riveted seam with 8 S.W.G. rivets at 2'' pinch.

Joints for ductwork having a side greater in width than 610mm shall be flanged by means of 30mm x 30mm x 3mm mild steel angles.

Airtight access doors shall be provided on the ductwork wherever indicated on the drawings.The access door, of sufficiently heavy construction to avoid distortion,complete with handles,shall be secured by brass wing nuts screwed into studs provided,on galvanized mild steel stiffening frames riveted,or bolted to the ductwork.The access doors shall be ptovided with felt or rubber gaskets to ensure that when closed they are perfectly tight.

The ductwork shall be installed with all joints air tight and adequately stiffened and braced shall have the radius possible with a mminimum throat radius of one diameter if possible.Square or miter elbows will only be allowed where shown on the drawings.Turning vanes shall be fitted in square or miter elbows.

Transformer pieces except where situated on fan section shall be constructed so that the angle on any side does not exceed 15degrees celcious to the ais of duct where possible

Branch ducts shall enter main ducts expansion sections where possible.Where branch ducts occur,at taper or transformation pieces,the length of such pieces in the main duct shall be systematically about the axis of the branch.

5.3 Brackecks and supports

Supports and brackets for duct works shall be made adjustable for height,speced to ensure support and where practicable shall be fitted at each joint of the ductwork.Vertical ductwork shall be supported at each floor level,horizontal ducts at intervals not exceeding 2280mm and adjacent to fans,canvas joints and other equipment.All members of supports in contact with metal ductwork shall be galvanized after fabrication.

Socketed joints shall have a minimum overlap of 50mm in the direction of flow.The joint shall be made with an approved type jointing compound with bolts or riverts at centres not exceeding 50mm.W herever access cannot be made for riverting or bolting self tapping crew of the shortest length which will give a satisfactory joint shall be used in lieu of the riverts or bolts,on size or diameters up to 530mm.

All slip joints on circular ductwork are to have a spigot carefully swaged damper leaves shall be multi leave type.The quadrants shall be of robust construction and securely fixed to the ductwork.The leaves shall be linked with a connecting rod and the ends of the spindle shall be housed in bearings.Dampers are to indicate the full and the closed positions and are to be marked and then locked after air volume has been set.

5.4Joints

5.4.1Flexible Joints

Flexible joints shall be provided on fan inlet and outlet connections and elsewhere on the ductwork where indicated.They shall be over full cross-sectional area of the mating fan inlet or outlet section.The ends of the duct and fan connections shall be in line.

Flexible joints shall consist of ,or be protected by ,material having a fire penetrating time of at least fifteen minutes when tested in accordance with BS 476 Part 1 Section 3.T he material shall be of the grass fire cloth type ,canvas or other approved material.The width of joints from metal edge shall not be less than 80mm or more than 250mm.

All flexible joints other than fan inlet connections shall be between flanged ends.The flexible material flange shall be backed by an angle or flat iron flange and the flexible joint flat iron bar used with fan inlets shall not be less than 5mm thick.

5.4.2 Flexible connections

Where flexible connections are indicated or required between rigid ductwork and particular components or items of equipments ,the internal diameter of the flexible duct shall be equal to the external diameter of the rigid ductwork and the spigot type.The use of flexible duct between rigid sections of sheet metal ductwork to change direction or plane will not be permitted except where indicated or expressly authorized by the Engineer.

The flexible duct shall have a liner a cover of tough tea-resistant fabric equal in durability and flexibility to glass fibre shall be impregnated and coated with plastics.It shall be reinforced with a bonded galvanized spring steel wire helix or glass fibre cord or equal and shall be bonded to cover to ensure regular convolutions.

Alternatively the flexible duct shall consist of flexible corrugated metal tubing of stainless steel,aluminium,timplated steel or aluminium coated steel.The metal may be lined on the inside or the outside or both with plastic materials.

The joints to rigid spigots shall be sealed with a brush coat of pipe jointing paste or mastic compound.Ducts up to 150mm diameter shall be secured with a worm drive type hose clip complying with BS 3628.Ducts over 150mm diameter shall be secured with band clip.

The frictional resistance to air flow per unit length of the flexible duct shall not exceed 50% more than frictional resistance per unit length of the galvanized steel ducts of equivalent diameter.The radius ratio R/D for bends shall not be less than 2 where R is the centre line radius and D is the diameter of the flexible duct.

Flexible ducts shall be suitable for an opening temperature range of 18 degrees Celcius to 120 degree Celcius and shall comply with BS 476 Part 1,Section 2,Clause 7(Clause 1;surface of very low flame spread).

5.5Finish Painting

Upon completion of the installation and after all tests have been carried out to the satisfaction of the Engineer ,the plant ,equipment,supports etc. shall be examined and all priming coats damaged during erection made good.

Any plant or equipment ,ductwork ,etc., which is to be insulated ,shall have had the priming paint protection made good before the application of the insulation.After the above procedures have een carried out to the satisfaction of the Engineer ,the various surface shall be given the necessary preparation as recommended by the paint and insulation manufacturers and finish painted in colours to be agreed between the Contractor and Engineer,at a later date.

For the purposed of the specification ,however ,it shall be deemed that the contractor's tender price was based on the identification requirements for the various services detailed in Code of the Practice DW/161 Identification of Ductwork as published by the HVAC.

6.AIR INTAKES AND OUTLETS

Unless otherwise indicated fixed louvers on external walls will be fitted at air intake and outlet positions.A galvanized steel wire mesh screen of 20mm diamond mesh at 2mm diameter wire and complete with a a frame of galvanized steel rod with securing lugs or of flat iron shall also be fitted on the inner side of the louvers

7.FANS

7.1 General

Fans shall be capable of giving the specified performance when tested in accordance with BS 848.Although estimated values of the resistance to airflow of items of equipment may be indicated,this does not relieve the Contractor to the responsibility for providing fans capable of delivering the required air volume flow through the system.

The make and design of fans shall be approved by the Engineer and evidence supporting noise levels and fan efficiencies shall be provided.Where fans are supplied with noise attenuations,full details of the attenuations shall be given.

Belt driven fans shall be fitted with pulleys suitable for V-belts;pulleys of the taper locktype may be used for drivers upto 30KW output.Alternatively,and in any case above 30KW output,pulleys shall be secured to the fan and the motor shafts by keys fitted into machined keyways.Pulleys shall be keyed to the fan shaft in the overhung position.Keys shall be easily accessible so that they can be withdrawn or tightened and they shall be accurately fitted so that the gib head does not protrude beyond the end of shaft.

Machined bolts,nuts and washers only shall be used for the assembly of fans;all bearing surfaces for the heads of bolts or washers shall be count faced.Holding down bolts for fans and meters shall be square section under the head or be fitted with snugs to ptevent them from turning in the fan base plate when the nuts are tightened.

Any fan which is too large or too heavy for safe manhandling shall be provided with eyebolts or other lifting facilities to enable mechanical lifting equipment to be used.

7.2 Axial Flow Fans

Axial flow fans shall be of either the single stage type or the multi-stage contra-rotating type with each impeller mounted on an independent motor.Casing shall be rigidly constructed of mild steel stiffened and braced to obviate drumming and vibration.Cast iron or fabricated steel feet shall be provided where necessary for bolting to the base or supports.Inlet and outlet ducts shall terminate in flanged ringsfor easy removal.

The length of the fan(s) and motor(s) shall also terminate in flanges in order that the complete section may be removed without disturbing adjacent ductwork.Electrical connections to the motor(s) shall be through an external terminal box secured to the casing.Impellers shall be of steel or aluminium,the blades shall be secured to the hub or the blades and the hub shall be formed in one piece.The hub shall be keyed to a substantial mild steel shaft and the whole statically balanced.Blades shall be of aerofoil section.Shafts shall be carried in two bearings which may be backroller or sleeve type.Lubricators shall be extended to the outside of the casing.

Where axial flow fans are driven by a motor external to the casing the requirements for pulleys and for V-belt drives and guards shall be met.Unless otherwise indicated a guard is not required for any part of a drive which is within the fan casing.An access door of adequate size shall be provided.

Where axial flow fans of the bifurcated type are indicated the motors shall be out of the air stream.Motors may be placed between the two halves of the casing in the external air or may be placed within the fan casing provided that effective ventilation is given to the motor.Where hot gases or vapours are beings handled the motor and bearings shall be suitable for operation at the temperature they may experience.

8.DAMPERS

8.1 General

Sufficient dampers shall be provided to regulate and balance the system.Dampers on grills or diffusers shall be used for fine or secondary control.All dumpers shall be sufficiently rigid to prevent fluttering.Unless otherwise indicated,the air leakage past dampers in the fully-closed position shall not exceed 5% of maxium design air flow in the duct.All duct dampers except fire dampers and self-closing flaps shall be fitted with locking devices and position indicators.Dampers shall be generally in accordance with the appropriate HVAC Specification.

Each primary control damper shall be fitted with a non-corrodible label starting the actual air flow in metres cubed per second and the cross-sectional area.Alternatively,these figures shall be painted in avisible position on the adjoining ductwork or insulation.The position of the damper as set after final regulation and balancing be indelibly marked on the damper quadrant.

8.2 Butterfly dampers

Butterfly dampers shall each consist of two plate edge seamed,and of the same thickness of material as that from which the associated duct is made,and rigidly fixed to each side of a mild steel operating spindle,the ends of which shall be turned and housed in non-ferrous bearings.

8.3 Bifurcating dampers

Bifuracating dampers shall be of 2mm thick sheet of sizes for sizes up to 450mm square.For larger sizes the thickness shall be as indicated.Damper plates shall be rigidly fixed to square section mild steel spindles the ends of which shall be turned and housed in non-ferrous bearings.

8.4 Multi-leaf dampers

Multi-leaf dampers shall consist of two plates of material of the same thickness as the associated duct and rigidly fixed to each side of an operating spindle,the ends of which shall be housed in brass,nylon,oil impregnated sintered metal,PTFE impregnated or ball bearings.The ends of the spindle shall be linked such that one movement of the operating handle shall move each leaf an equal amount.An inspection door shall be provided adjacent to each multi-leaf damper.

On low velocity systems only,multi-leaf damper blades may be of a single plater,at least 1.6mm thick and suitably stiffened,and the blade linkages may be within the duct.Those dampers shall have bearings and inspection doors as specified above.

8.5 Damper Quadrants and Operating Handles.

Quadrantsand operating handles shall be of die-cast aluminium with the words ‘OPEN’ and ‘SHUT’ cast on the quadrants.Quadrants shall be securely fixed to the damper spindles and shall be close-fitted in the quadrants hubs to prevent any dumper movement when the damper levers are locked.

8.6 Self-closing dampers

Self-closing dampers shall be designed so as to prevent the minimum of resistance to airflow under running conditions,to take up a firm,non-fluctuating position under running condition and to give the tight shut-off whwn closed.They shall incorporate rubber stops to prevent rattling and to give a tight shut-off when closed.They shall incorporate rubber stops to prevent rattling.

8.7 Sliding dampers

Sliding dampers shall be provided only where indicated.They shall be of 2mm.Thick sheet steel for size up to 450mm square.For larger sizes the thickness shall be as indicated.They shall run in guides lined with felt.

8.8 Irish type dampers

Irish type dampers may be used in ducting upto 600mm,dia. Or 450mm square.The control shall be on the outside of the damper.The design shall be such that the leaves of the damper can be easily moved for adjustment.

9.GRILLES

9.1 Supply & Return Registers

Supply registers shall be manufactured from high grade,extruded Aluminium sections with lacquered finish and finishing shall be 32mm with beveled edges.

The registers shall have a front set of blades parallel to the short dimension,the blades being at 17mm centres and individually adjustable with opposed blade dampers.

9.2 Extract grilles

Extract grilles shall be similar to the Supply & Registers as described above with the exception that they have only one set of blades parallel to the long dimension.

9.3 Fresh Air Grilles

These shall be manufactured from sheet steel with steel fixing flanges and shall be galvanized after manufacture.An insect screen shall be fixed down stream

9.4 Diffusers

These shall be manufactured from high grade extruded sections with lacquered finish,beveled flanges and removable core.Fixing shall be by self-tapping screws though the duct into the neck of the diffuser.

9.5 Louvres

Discharge and Fresh air Intake louvers shall be manufactured from milds steel and be galvanized after manufacture. A screen shall be fixed to the back louvres.

10.ATTENUATION

10.1 General

Purpose made attenuators and sound absorbing material shall be designed to air flow,have adequate strength and cohesion to resist erosion by air flow and do not produce dust.They shall be free of odour and proof against ror,damp and vermin and shall comply with the requirements as to fire and smoke hazards.Adhesives shall be compatible with the sound absorbent material and should preferably be non-flamable.

Where sound absorbent material and/or special attenuators are indicated they shall either reduce the sound level to the space,due to the equipmen,to the specified value or shall give the specified sound level attenuation over the specified range of frequencies.Purpose made attenuators shall be tested in accordance with HVRA Labolatory Reort No.55(Code for the measurement of the performance of unit silencers).The insertion loss and generated noise level for each octave band and the pressure loss of the silencer shall b e stated.

Attenuators shall be suitable for internal air pressure of 100N/Meters squared,air stream temps of upto 40 degrees celcious and free from air steam erosion for velocities upto 25m/s.The mineral wool lining shall be rot,vermin and fire proof.Attenuator casing shall be pre-galvanized sheet steel with galvanized pre-drilled flanges.

10.2 Rectangular attenuators

These shall be rectangular in section with splitters forming air passages in parallel.The mineral wool lining shall be resin bonded.

10.3 Circular attenuators

Circular section attenuators will have acentral pod.The mineral wool lining shall be retained by expanded steel.The end flanges shall be match drilled to suit the fan which they are fixed to.

10.4 Acoustic lining

Where indicated on the contract drawings,the ductwork shall be acoustically lined.The lining shall consist of resin bonded mineral wool 25mm,thick fixed to the ductwork by a suitable adhesive.

11.INSTRUMENTS

11.1 General

The instruments,gauges etc ,detailed in this section shall be provided in addition to those associated with specific items of plate and detailed elsewhere,they shall be mounted in accessible positions and shall be easily read.

11.2 System Static Pressure Gauge

A system static pressure gauge shall be provided for the system.It shall consist of a small inclined manometer gauge similar to a filter gauge.The edge of the gauge shall be connected to the system and the other end shall be left open to the plant room but where fluctuation of the static pressure in the plant room may occur the gauge shall be connected across the main fan.Such fluctuations may be caused by wind pressure affecting large open air intakesto the plant room.

12 VIBRATION,NOISE AND SOUND INSULATION

12.1 Anti-Vibration Mountings

Fans,compressors,motors and any other vibraton-inducing equipment shall be isolated from the building structure by anti-vibration mountings which shall be compressed machinery cork,spring or rubber dampers or rubber/metal bearers as indicated.

12.2 Noise

The noise produced by the installation in the spaces served,in any adjacent buildings and in the air surrounding plant rooms shall be kept as low as possible.This shall be specially considered in the selection of fan motors,grilles and the internal finish and arrangements of extraction ducting.

Noise level information for fans based on octave analysis data,shall be stated.The reference level and the testing technique shall be stated.

The sound level in the spaces served ,due to the equipment shall comply with the recommended design criteria given in the IHVE Guide (Table 13.1 of 1965 Edition).The maximum sound pressure level due to ventilation system m ust not exceed value mentioned below measured by a reference value of 2 x 10 x 100000 N/meter squared transferred to a logarithm scale,and measured at any point 1.5 meters above the floor and 1.0meters from the walls.

The maximum sound pressure level measured at any point 4 meters from the extract point must not exceed 55Db

The maximum sound pressure level measured at any point 4 meters from fans must not exceed 60dB.

13 THERMAL INSULATION

13.1 General Description

All heated,cooled,and recirculated air ductwork shall be insulated.

Insulation shall be of 25mm thick expanded polystyrene sheet,or spray applied polyurethane foam to a uniform thickness of 25mm.Polystyrene shall be fixed so that the edges butt closely without gap and the insulation shall overlap at corners by the thickness of the insulation.The sheet shall be fixed by means of a suitable adhesive and plastic impingemet pines attached to the ductwork.

13.2 Ductwork in Plant Room

The insulation described above in Clause 5.1 above shall be finished by the application of a 15mm thick layer of hard setting finish.Insulation shall bevelled thick to angle of 45 degrees at all connecting ,access hatches and all other places where operation or maintenance is likely to cause the breaking of the insulation.

The insulation shall then be given a vapour sealing by the application of two coats of anti-condensation paint.

13.3 Ductwork External to Plant rooms

The insulation described in Clause 5.1 above shall finish by the application of two coats of bitumen paint..

14 ELECTRICAL EQUIPMENT AND WIRING

14.1 Scopes

The responsibility for electrical equipment and wiring shall be as defined as below:-

An on-off starter shall be provided and placed in the appropriate position for connection of the fans required the installation and within a time agreed with the Engineer fully detailed wiring diagrams for all connections to them shall be availed.

The installer shall be responsible for the accuracy of all wiring diagrams provided by him and for the correct internal wiring of all pre-wired equipment supplied.The installer shall reimburse the full cost of abortive or remedial work arising from any error in these aspects.

14.2 General

Unless otherwise indicated all electrical equipment and installation shall be suitable for use in ambient temperatures up to 40 degrees celsious and relative humidities up to 90%.For tropical climates,electrical equipment shall be suitable for use in the temperature and humidity as indicated;it shall be proof against atmospheric corrosion,including that of saline air where relevant,and materials shall not be susceptile to mould growth or attack by termite and similar hazards.

14.3 Electrical Motors

Electrical motors shall comply with BS 170 2048 or with BS 2613 and BS 3979 as appropriate.All motors shall have Class E insulation(BS2757)and can be continuously rated.

They shall be screen protected(BS2817) unless otherwise indicated.Under all normal conditions without being overloaded.All motors larger than 0.75kw output shall be three phase,for motors above 15kw output the type of motor and method of starting shall be such as to limit the starting and run-up currents to three times the rated full load current unless otherwise indicated.No motor shall run faster than 25 rev/s unless otherwise indicated.

15 INSPECTION,COMMISSION AND TESTING

15.1 General

Unless otherwise indicated tests shall be carried out in accordance with the appropriate BS or CP.Test certificates for works tests,site tests and tests required by BS shall be submitted in duplicate to the Engineer.

15.2 Testing

When an individual inspection or tests take place at outside the site of the works representatives of the Engineer will be required to present.

Unless otherwise indicated the contract shall include the cost of all tests,necessary instruments,plant supervision and labour both at work and on site.The accuracy of the instruments shall be demonstrated where so directed by the Engineer.

The site test shall be of at least six hours duration.Any defects of workmanship,materials and performance maladjustments or other irregularities which become apparent during the tests shall be rectified by the supplier at his expense and the tests shall be repeated at his expense to the satisfaction of the Engineer.

The supplier,installer's representative present at the sites tests shall be fully conversant with the operation of the thermostatc controls and shall be expected to explain the operation and safety controls forming part of the installation to the employer's representatives.

15.2.1 Site Tests

The installer shall supply all instruments and equipment necessary to carry out tests and shall arrange with other parties for the testing of associated equipment which may affect the performance of the plants installed under these works.

15.2.2 Testing Fans

All fans shall be charged with suitable lubricant and shall be tested upon completion of the auxiliary system erection to ascertain that the performance of each fan complies with the requirements of the specification.

15.2.3 Completion of Works-Balancing and Commissioning

Following the site tests and prior to handover ,Mechanical Ventilation or Air-Conditioning systems shall be balanced by means of grills ,dampers and other special controls installs so to give the required air flow rates and where applicable the required temperatures ,pressures and humidity conditions in all areas served by the said systems.

The complete system shall be balanced and commissioned as a whole.Sectional balancing and commissioning on any part of the system where this excludes final complete system balancing and commissioning shall not be accepted.

Tests volumes within ducts shall be within +5% of the design volumes ,and volumes at grills and diffusers shall be within +10% of the design volumes.

When the system has been balanced to the satisfaction of Engineer ,it shall be run under complete automatic control for 72 hours continuous operation to ascertain any faults in operation before acceptance and handover .Any faults discovered during this time shall be corrected and another test or tests of 72 hours duration shall be carried out to ensure satisfactory operation ,all at the expense of the Contractor.

During this phase ,particular attention shall be paid to:

(i) The maintenance of cleanliness of all plant and extraction systems during construction and ensuring that extraction systems are cleaned through as part of commissioning.

(ii)The protection of plant ,particularly sensitive or fragile items ,from the activities of other trades during construction and from dirt and mal operation during commissioning.

(iii)The protection of electrical equipment from damp during construction and commissioning.

19.0 CONTROL SYSTEM

Particular attention shall be paid to the following features:

(i)Satisfactory operation of any automatic or manually operated sequence to be used in the event of fire.

(ii)Safety in the event of failure and of sudden resumption of electricity supply.

(iii)Satisfactory operation of safety interlocks designed for the protection of personnel ,such as those associated with the high voltage electrically operated plant.

The following items shall be checked and/or tested and recorded on the site Test Certificate:-

(i)Set devised value of all control devices
(ii)Satisfactory operation of equipment protection devises
(iii)Satisfactory operation of all sequencing operations and alternate working selections and automatic or manual change-over of duplicate plant.

16 NOISE AND SOUND CONTROL

Sound reading level shallbe taken with a simple sound level meter using the 'A' scale weighting network.The spaces in which readings shall be taken shall be as agreed with the Engineer but will in general be the following:-

(i)plant rooms

(ii)Occupied rooms adjacent to plant rooms

(iii)Outside plant rooms facing air intakes and exhausts to assess possible nuisance to adjacent accommodation.If the adjacent accommodation is private residential building tests may be required at night.

(iv)In the space served by the first grille or diffuser after a fan outlet.

(v)In any space where,by the addition of special licensing materials or techniques of by classification of use,a low level of noise is clearly required.

Altrenatively,sound reading level shall be taken using a sound analyzer to give an octave band analysis of the ground spectrum and to pinpoint the frequency value of the peak sound levels.The spaces in which readings shall be taken shall be agreed with the Engineer but will in general e as detailed in paragraph above.

17 OPERATING AND MAINTENANCE INSTRUCTION

The contractor shall demonstrate and explain the pant and the method of starting,running and stopping to such staff as the Engineer shall nominate.

He shall provide three sets of operating and maintenance instructions which shall be enclosed in durable covers.The operating and maintenance instructions shall include:

(i)A brief outline of the operation of the plant.

(ii)Instructions on how to start and stop the plant,noting any safety and/or sequencing arrangements.

(iii)Details of required maintenance with suggested frequency of action.

(iv)Details of all lubricating oils and greases required and filter replacement.

(v)Details of each item of plant including the name and address of the manufacturer,type and model,serial number,duty and rating.

The operating and maintenance instructions shall be handed to the engineer not later than at the end of the commissioning period.

18 SPARE PARTS

The installer shall submit a priced list of any extra materials which he recommends should be purchased for the ventilating and Air Conditioning Plants and all associated equipment and control gears and extras not supplied as standard.He shall be required to give a guarantee that he will hold sufficient running stock of spare parts for the maintenance of the equipment.

GENERAL SPECIFICATIONS FOR AIR CONDITIONING SYSTEMS

19 SCOPE OF WORKS

The works to be carried out comprises of supply,delivery,installation ,setting to work,testing and commissioning of all materials and equipments called for in this specification and/or shown in the contract drawings.

The tenderer shall include for all appurtenances and appliances not particularly called for in this specification or on the contract drawing s but which are necessary for the completion and satisfactory functioning of the system.

No claim for extra payment shall be accepted from the contractor for non-compliance with the above requirements.
If the opinion of the tenderer there exists difference between the specification and the contract drawings,the tenderer shall clarify the difference with the engineer before tendering.

The Works to be installed under the contract shall comply with the Ministry of Public Works requirements for contract works under "GENERAL MECHANICAL SPECIFICATION"**20 CLIMATIC CONDITIONS**

The following climatic conditions apply at the sites of the works and all and materials and equipment used shall be suitable for these conditions:-

PARAMETERS	(CONDITIONS) NAIROBI CITY
Maximum mean outdoor dry bulb Temperature Minimum temperature Relative humidity Altitude Longitude Latitude Max.solar radiation occurs during the month of february	28degrees celcious 11.5degrees celcious 42%-94% 1666m ASL 36 degrees 49' E 01degrees 17'S

21 SYSTEMS DESIGN DATA

The air-conditioning systems are designed to maintain the following internal conditions with ambient conditions 28 degrees celcious DB and 55%RH

Internal Temperature	23+ or – 1degrees celcious
Relative Humidity	50 + or -10%

The equipment described here under covers the specific requirements of equipment to be used for this contractor work and shall be used in conjunction with the accompanying contract drawings.

It shall be deemed that the tenderer has based his tender on plant and equipment which is equal in performance to that stated within the specification.

22 SPLIT AIR CONDITIONING SYSTEM

The system shall be complete with

22.1 Indoor wall mounted cooling unit(Evaporator)

Each coil unit shall consist of a cooling coil,air circulating fan,fan-guard and a thermostatic expansion valve.A timer unit shall be mounted in the control panel both the de-frosting intervals and defrosting periods,both of which shall be variable.

The evaporator unit shall be of capacity as specified under the specific conditions,and shall be of the dry expansion type,and preferably of similar make as that of the condensing units.The unit shall be cassette type,high wall mounted or ceiling mounted as will be specified by the Engineer.

The coil shall be manufactured from seamless copper tubing with aluminium fins mechanically bonded to the tubes.

The panel shall be interlocked such,that on energizing the heater,the compressor,condenser and evaporator fan shall be de-energized and only re-energized when the heater is switched off by a evaporator mounted thermostat.A manual overriding switch shall by-pass the timer switch.

The air-circulated fan shall be manufactured from rigid aluminium sheet and finished in white casing.A drip tray with 25mm diameter connections shall be incorporated in the base of the casing.

The unit shall be complete with the following:-

a) 1 No.air purifying filter
b) Built in drain pump to automatically drain water
c) Refrigeration pipe work with flared conditions
d) Fixing brackets/wall mounting kit/ground mounting kit
e) Thermostat to control room temperature
f) High and low pressure units
g) Condensate discharge pipe work in Black PVC,15mm diameter
h) Service access valves
i) Voltage Surge Protector

The system shall be suitable for 240V,1-Phase,50Hz power supply

The split air-conditioning system shall be designed to maintain room inside temperature of 23+ or –C and relatively humidity of 50+ or – 10%

22.2 Outdoor Units

The door unit shall be installed and mounted on the wall on the wall using appropriate mounting brackets.They shall be complete with hermetically sealed compressors.Safety devices shall include overload/surge protection among others.

The unit shall be connected to power provided by others.It shall be connected to refrigeration piping and control wiring.It shall have adequate charge of refrigerator oil and R 407 refrigerant.

The air conditioning units shall be as York or approved equivalent and shall be provided with approval mounting brackets.

The Unit shall be complete with the following:

a)Casing constructed of 18 gauge zinc coated mild steel,zinc phosphate bonderized,coated with oven baked polyester paint and weatherized for outdoor installation.It shall have weep holes on base to allow ease of drainage.

b)Hemetically sealed compressor mounted to unit base with rubber isolated hold down bolts,uniform in oil and pressures and shall have internal overload protection.

c)Refrigeration pipe work with flared connections

d)Distributor with refrigeration control

e)Fixing brackets/wall mounting kit/ceiling mounting kit

f)Heat exchanger capacity controls

g)Precise inverter frequency controls

h)New oil returning system(refrigerant oil control system)

i)High and low pressure units

j)An innovation of installation with automatic address settings for indoor units with twin multiplex transmission system of no polarity

k)Condensate discharge pipework

l)Service access valves

m)Voltage surge protector

22.3 Refrigeration Piping

Refrigerant pipe work shall be approved copper tubing and fittings,and shall be properly sized in conformity with the system manufacturer specifications.Pipework shall be joined together by soldering/brazing and shall be complete with all necessary joints,reducers and accessories.

The Ozone friendly refrigerant flow shall be controlled with either a capillary tube or thermostatic expansion valve.Installation shall be carried out by competent and qualified craftsmen.The engineer may demand proof of qualifications and experience in installation of refrigeration systems.

Pipe work shall be tested for leaks after installation to the Engineers satisfaction.It shall be properly anchored,insulated and no vibration of pipes shall be allowed during the running of the systems.An electronic leak detector shall be used to test for leaks.

23 VARIABLE REFRIGERANT FLOW(VRF)SYSTEM

The VRF system shall be a dual aspect system(zone heating/cooling)with reduced energy and maintenance costs.The system shall be complete with flexible and user friendly central management system that will be integrated to building management system.The system shall be capable of more personalized and accurate calculations of energy consumption.The required capacity and the relating technical parameters for the indoor units shall be electronically relayed to the system management and outdoor unit.

23.1 Inverter Controlled Outdoor Unit

The three-way pipe outdoor units shall be installed and mounted on the 5^{th} floor sky garden using appropriate and approved anti-vibration mounting/base. They shall be complete with hermetically sealed compressors. Safety devices shall include overall/surge protection among others.

The air conditioning unit shall allow for maximum 48 indoor units of different capacity and types to be connected to a single refrigerant circuit. It shall have an outdoor unit capacity ratio of 50-130% with nominal cooling load as stated in the bill of quantities and capacity control in the range of 10-130% according to the indoor cooling load.

There shall be two outdoor units operating as duty and standby and connected to the same indoor units through control panel.

The unit shall be complete with the following:-

a)Casing constructed of 18 gauge zin coated mild steel,zinc phosphate bonderized,coated with oven baked polyester paint and weatherized for outdoor installation.It shall have weep holes on base to allow ease of drainage.It shall have permanently attached base rails with 3-way forklift access and lifting holes.

b)Hermetically sealed compresors mounted to unit base with rubber isolated hold down bolts,uniform in oil and pressures and shall have internal overload protection.
c)Advanced compressor oil management system.

d)Compct flow selector unit

e)TCC link:state-of-the-art connection bus system with automatically configured addressing and shall be Building management system(BMS)compatible.

f)Heat exchanger capacity controls.

g)Precise inverter frequency controls with intelligent power drive unit(IPDU)

h)New oil returning system(refrigerant oil contol system)

i)High and low pressure units

j)An innovation of installation with automatic address settings for indoor units with twin multiplex transmission system of no polarity.

k)Condensate discharge pipe work

l)Service access valves

m)Voltage Surge Protector

23.2 Indoor cooling unit(Evaporator)

Each coil unit shall consist of a cooling coil,air circulating fan,fan-guard and a thermostatic expansion valve.A timer unit shall be mounted in the control panel to both the de-frosting intervals and defrosting periods,both of which shall be variable.

The evaporator unit shall be of capacity as specified under the specified conditions,and shall be of the dry expansion type,and preferably of similar make as that of the condensing units.The unit shall be high static pressure ducted unit,cassette type,high wall mounted or ceiling mounted as it will be specified by the engineer.

The coil shall be manufactured from seamless copper tubing with aluminium fins mechanically bonded to the tubes.

The panel shall be interlocked such,that on energizing the heater,the compressor,condenser and evaporator fan shall be de-energized and only re-energized when the heater is switched off by a evaporator mounted thermostat.A manual overriding switch shall by-pass the timer switch.

The air-circulating fan shall be manufactured from rigid aluminium sheet and finished in white casing.A drip tray with 25mm diameter connections shall be incorporated in the base of the casing.

The unit shall be complete with the following:-

a)1 No. air purifying filter

b)Built-in drain pumps to automatically drain water

c)Refrigeration pipe work with flared connections

d)Fixing brackets/wall mounting kit/ground mounting kit

e)Thermostat to control tempera

f)High and low pressure units

g)Condensate discharge pipe work in Black PVC,15mm diameter

h)Service access valves

i)Voltage Surge Protector

j)Pulsed modulating valves(PMV)to permit linear variation of refrigerant flow in any circuit directly proportional to the thermal load.

The system shall be suitable for 240V,1-Phase,50Hz power supply.

23.3 Control Panel

Each system shall be provided for which a purpose made control panel fabricated from mild steel sheet of minimum SWG18 with a hinged door and then powder coated after manufacture.It shall be provided with an integral lock.It shall be complete with;

a)Isolator

b)Contractors

c)Controlling thermostat with temp range from -10 to +30degrees celcious

d)80mm dial thermometer with temp range from -10 to +30degrees celcious

e)Motor starters & current overload relays

f)MCBs

g)Phase failure relay with over hand under voltage protection

h)Timer switch for defrost control

i)Push buttons for start and stop

j)Audible and visual high temperature alarm with manual reset

The panel shall also have green light running indicators,red “door open”light and equipment circuit trip lights.

23.4 System Controls Unit

The control unit shall be installed in the building management services(BMS)room with electric wiring to all indoor and outdoor units.The electric conduits/wiring to be done to chief Electrical & Mechanical Engineer,MOPW standards.

Controls unit for each system shall incorporate complete to ensure continuous system services.Such controls shall include protection against any possible motor overload and overheat,central control and monitoring for all the indoor units,individual temperature setting for each indoor unit,group control,set lock for each indoor unit and shall have self diagnosis function(display system errors)

The control unit shall control the duty and standby outdoor units to work alternatively for 12 hours.This will be achieved by opening and closing of solenoid valves which will close or open the refrigerant pipes to achieve this operation.

The unit shall have a lock release to allow for control of the system by using wireless or wired remote control at the place where the indoor unit is installed.It shall also have a setup of a weekly and detailed schedule of the individual air conditioner.

The control unit shall have an open network controls designed for building management systems.It shall also have diagnostic software that will enable download of all operating parameters and instant analysis for commissioning and service.

The control system shall be complete with;

a)Weekly timer for a 7 day timer complete with day omit

b)Infrared wireless remote controller

c)Remote temperature sensor for all indoor units

d)Network/protocol adaptor kit to enable integration with artificial intelligence network

e)External master on/off control board

f)Error output control board

g)Power peak cut control board

h)Touch screen controller for full control of up to 64 indoor unit including electric billing

i)Intelligent server and software package to allow connection to touch screen controller

j)Energy monitoring interface

23.5 Testing and Commissioning Standards

The system shall be balanced to the satisfaction of the Engineer.It shall be run under complete automatic controls for 72hours continuous operation to ascertain any faults in operation before acceptance and handover.

Any faults discovered during this time shall be corrected and a further test or tests of 72hours duration shall be carried out to ensure satisfactory operation,all the expenses of the contractor .

All accessories/equipment have to be tested for capacity,efficiency,leakages and other human errors shall meet standards and specifications.

23.6 As-Built-Drawings and maintenance manuals

Once the air conditioning system has been tested and commissioned,drawings and maintenance manuals shall be provided.They shall be a true and accurate representation of what has been commissioned

23.6 Training

Adequate personell shall be trained to perform normal operations and routine maintenance of the air conditioning system.The number of personnel to be trained shall be specified for particular pool.

24 DUCTED AIR CONDITIONING SYSTEM

24.1 Packaged Air Handling Units

The air conditioning unit shall be ductable and self contained with nominal cooling load as described for the particular room,with reversible heating.The unit to be of vertical discharge.

The unit shall be encased in galvanized steel casing with polyester paint finish and shall be installed on a plinth provided by others,but the contractor shall mark in advance the exact dimensional position to the approval of the Engineer.

The whole system shall be complete with the following as will be required:

a)Hermetic compressor with crankcase heater and anti-recycle timer

b)Centrifugal fans with variable pulley-belt drive

c)Expansion valve

d)Washable filters

e)Filter dryers

f)Reversing valve

g)High and Low pressure cut-out

h)Unit circuit breaker

i)Direct expansion blower unit

j)Discharge plenum

k)Air inlet protective grille

The contractor shall also be responsible for the ducting work of the rooms as described in particular specification for mechanical ventilation,drainage of condensed water from the drain pan and provision of anti-vibration mountings.

SECTION- I

PARTICULAR SPECIFICATION

FOR

PORTABLE FIRE EXTINGUISHER AND

HOSE REEL

INSTALLATIONS

SECTION- I

PARTICULAR SPECIFICATION FOR PORTABLE FIRE EXTINGUISHER AND HOSE REEL INSTALLATIONS

CLAUSE NO.	DESCRIPTION	PAGE
6.1	General	I-1
6.2	Scope of Works	I-1
6.3	Water/CO_2 Extinguishers	I-1
6.4	Portable Carbon Dioxide Extinguishers	I-2
6.5	Dry Chemical Portable Fire Extinguisher	I-2
6.6	Air Foam Fire Extinguisher	I-3
6.7	Fire Blanket	I-3
6.8	Boosted Hose Reel System	I-4
6.9	Fire Hydrant Details	I-7
6.10	Stand pipe	I-8
6.11	Hose pipe	I-8

SECTION I

PARTICULAR SPECIFICATIONS FOR PORTABLE FIRE EXTINGUISHER

6.1 GENERAL

The particular specification details the requirements for the supply and installation and commissioning of the Portable Fire Extinguishers and Boosted Hose Reel System.
The Sub-contractor shall include for all appurtenances and appliances not necessarily called for in this specification or shown on the contract drawings but which are necessary for the completion and satisfactory functioning of the works.

If in the opinion of the Sub-contractor there is a difference between the requirements of the Specifications and the Contract Drawings, he shall clarify these differences with the Engineer before tendering.

6.2 SCOPE OF WORKS

The Sub-contractor shall supply, deliver, erect, test and commission all the portable fire extinguishers and Hose Reel which are called for in these Specifications and as shown on the Contract Drawings.

6.3 WATER/CO_2 EXTINGUISHERS

These shall be 9-litre water filled CO_2 cartridge operated portable fire extinguishers and shall comply with B.S. EN 3/BS 1449 and to the requirements of B.S.1004. Unless manufactured with stainless steel, bodies shall have all internal surfaces completely coated with either a lead tin, lead alloy or zinc applied by hot dipping. There shall be no visibly uncoated areas.

The extinguishers shall be clearly marked with the following:

a) Method of operation.

b) The words ‘WATER TYPE’ (GAS PRESSURE) in prominent letters.

c) Name and address of the manufacturer or responsible vendor.

d) The nominal charge of the liquid in imperial gallons and litres.

e) The liquid level to which the extinguisher is to be charged.

f) The year of manufacture.

g) A declaration to the effect that the extinguisher has been tested to a pressure of 24.1 bar (350 p.s.i.).

h) The number of British Standard ‘B.S’ 1004 or B.S. 1449.

6.4 **PORTABLE CARBON DIOXIDE FIRE EXTINGUSHERS**

These shall be portable carbon dioxide fire extinguishers and shall comply with B.S. EN 3/BS 1449 and B.S. 1004.

The body of extinguisher shall be a seamless steel cylinder manufactured to one of the following British Standards; B.S. 401 or B.S. 1288.

The filling ratio shall comply with B.S. 5355 with valve fittings for compressed gas cylinders to B.S.341. Where a hose is fitted it shall be flexible and have a minimum working pressure of 206.85 bar (3000 p.s.i.). The hose is not to be under internal pressure until the extinguisher is operated.

The nozzle shall be manufactured of brass gunmetal, aluminium or stainless steel and may be fitted with a suitable valve for temporarily stopping the discharge if such means are not incorporated in the operating head.

The discharge horn shall be designed and constructed so as to direct the discharge and limit the entrainment of air. It shall be constructed of electrically non-conductive material.

The following markings shall be applied to the extinguishers:-

a) The words “Carbon Dioxide Fire Extinguisher” and to include the appropriate nominal gas content.

b) Method of operation.

c) The words “Re-charge immediately after use”.

d) Instructions for periodic checking.

e) The number of the British Standard B.S. 3326: 1960 or B.S. 5423.

f) The manufacturers name or identification markings

6.5 **DRY CHEMICAL POWDER PORTABLE FIRE EXTINGUISHER**

The portable dry powder fire extinguishers shall comply with BS EN 3/BS 1449 and BS 1004. The body shall be constructed to steel not less than the requirements of BS 1449 or aluminium to BS 1470: 1972 and shall be suitably protected against corrosion.

The dry powder charge shall be non-toxic and retain it s free flowing properties under normal storage conditions. Any pressurizing agent used as an expellant shall be in dry state; in particular compressed air.

The discharge tube and gas tube if either is fitted shall be made of steel, brass, copper or other not less suitable material. Where a hose is provided it shall not exceed 1,060mm and shall be acid and alkali resistant. Provision shall be made for securing the nozzle when not in use.

The extinguisher shall be clearly marked with the following information

a) The word "Dry Powder Fire Extinguisher"

b) Method of operation in prominent letters.

c) The working pressure and the weight of the powder charge in Kilogrammes.

d) Manufacturers name or identification mark

e) The words "RECHARGE AFTER USE" if rechargeable type.

f) Instructions to regularly check the weight of the pressure container (gas Cartridge) or inspect the pressure indicator on stored pressure types when fitted, and remedy any loss indicated by either.

g) The year of manufacture.

h) The Pressure to which the extinguisher was tested.

i) The number of this British Standard BS 3465 or BS 5423: 1977.

j) When appropriate complete instructions for charging the extinguisher shall be clearly marked on the extinguisher or otherwise be supplied with the refill.

6.6 **AIR FOAM FIRE EXTINGUISHER**

These shall be of 9 litres capacity complete with refills cartridges and wall fixing brackets and complying with B.S. EN 3/BS 1449 and BS 1004 with the following specifications: -

Cylinder: **to B.S. 1449**

Necking: to be 76mm outside diameter steel EN 3A $2^{3}/_{4}$ X 8TPI female thread.

Head cap: to be plastic moulding acetyl resin.

CO2 Cylinder: to be 75gm P.V.C coated.

Internal Finish: to be polythene lining on phosphate coating.

External finish: to be phosphated - One coat primer paint and one coat stove enamel B.S 381 C.

6.7 **FIRE BLANKET**

The fire blanket shall be made from cloth woven with pre-asbestos yarn or any other fire proof material and to measure 1800 x 1210 mm and shall be fitted with special tapes folded so as to offer instantaneous single action to release blanket from storing jacket to BS 1721.

6.8 **BOOSTED HOSE REEL SYSTEM**

6.8.1 ***General***

The Particular Specification details the requirements for the supply, installation and commissioning of the hose reel installation. The hose reel installation shall comply in all respects to the requirements set out in C.O.P 5306 Part 1: 1976, B.S 5041 and B.S 5274. The System shall comprise of a pumped system.

6.8.2 ***Hose Reel Pumps***

The fire hose reel pumps shall consist of a duplicate set of multi-line centrifugal pumps from approved manufacturers. The pumps shall be capable of delivering 0.76 lit/sec at a running pressure of 2 bars.

The pump casing shall be of cast iron construction with the impeller shaft of stainless steel with mechanical seal.

6.8.3 ***Control Panel***

The control panel shall be constructed of mild steel 1.0mm thick sheet, be moisture, insect and rodent proof and shall be provided complete with circuit breakers and a wiring diagram enclosed in plastic laminate.

The pump shall be controlled by a flow switch therefore; the control panel shall include the following facilities:

(a) 'On' push button for setting the control panel to live.

(b) Green indicator light for indicating control panel live.

(c) Duty / Stand-by pump auto change over.

(d) Duty pump runs green indicator light.

(e) Stand-by pump run green indicator light.

(f) Duty pump fails red indicator light.

(g) Stand-by pump fails red indicator light.

(h) Low water condition pumps cutout with red indicator light.

The pumps are to be protected by a low level cut-out switch to prevent dry pump run when low level water conditions occur in the water storage tank.

6.8.4 ***Hose Reel***

The hose reel to the installation shall consist of a recessed, swing-type hose reel as Angus Fire Armour Model III or from other approved manufacturers.

The hose reel shall comply with B.S. 5274: 1975 and B.S 3161:
1970 and is to be installed to the requirements of C.P. 5306 Part 1: 1976.

The hose reel shall be supplied and installed complete with a first-aid non-kinking hose 30 meters long with a nylon spray / jet / shut-off nozzle fitted. A screw down chrome - plated globe valve to
B.S 1010 to the inlet to the reel is to be supplied.

The orifice to the nozzle is to be not less than 4.8mm to maintain a minimum flow of 0.4 lit / sec to jet.

The hose reels shall be installed at 1.5 meters centre above the finished floor level in locations shown in the contract drawings.

6.8.5 ***Pipe Work***

The pipe work for the hose reel installation shall be galvanized wrought steel tubing heavy grade Class C to B.S 1387: 1967 with pipe threads to B.S 21.

6.8.6 ***Pipe Fittings***

The pipe fittings shall be wrought steel pipe fittings, welded or seamless fittings conforming to B.S. 1740 or malleable iron fittings to B.S 143.

All changes in direction will be with standard bends or long radius fittings. No elbows will be provided.

6.8.7 ***Non-return Valves***

The non-return valves up to and including 80mm diameter shall be to B.S. 5153: 1974.

The valves shall be of cast iron construction with gunmetal seat and bronze hinge pin.

6.8.8 ***Gate Valves***

The gate valves up to and including 80mm diameter shall be non-rising stem and wedge disc to B.S 5154: 1974 with screwed threads to B.S. 21 tapes thread

6.8.9 ***Sleeves***

Where pipe work passes through walls, floors or ceilings, a sleeve shall be provided one diameter larger than the diameter of the pipe, the space between them to be packed with mineral wool, to the Engineer's approval.

6.8.10 ***Earthing***

The hose reel installation shall be electrically earthed by a direct earth connection. The installation of the earthling shall be carried out by the Electrical Sub- contractor.

6.8.11 ***Finish Painting***

Upon completion of testing and commissioning the hose reel installation, the pipe work shall be primed and finish painted with 2 No. coats of paints to the Engineer's requirements.

6.8.12 ***Testing and Commissioning***

The hose reel installation shall be flushed out before testing to ensure that no builder's debris has entered the system. The installation is to be then tested to one and half times the working pressure of the installation to the approval of the Engineer. Simulated fault conditions of the pumping equipment are to be carried out before acceptance of the System by the Engineer.

6.8.13 ***Instruction Period***

The Sub-contractor shall allow in his contract sum for instructing of the use of the equipment to the Client's maintenance staff. The period of instruction may be within the contract period but may also be required after the contract period has expired.

The period of time required shall be stipulated by the Client but will not exceed two days in which time the Client's staff shall be instructed on the operation and maintenance of the equipment.

6.09 **FIRE HYDRANT DETAILS**

(a) Hydrant body

The body of the hydrant shall be made of grey cast iron complying with the requirements of BS 750 having a tensile strength not less than that given for grade 14.

(b) Hydrant Valve

The valve shall be faced with suitable resilient material. The threaded part of the valve, which engages with the spindle, shall be of bronze.
Body seating for the valves shall be of copper alloy complying with the requirements of BS 750, or high tensile brass complying with the requirements of BS 2872 or BS 2874.
Turning the spindle cap in a clockwise direction when viewed from above shall close valves and the direction of opening shall be permanently marked on the gland.

(c) Spindle & Spindle Cap

The spindle note shall be either of the same material as the spindle, or of copper alloy complying with the requirements of BS/1400 either type LG 2 or type LG 4. It shall have a squared top formed to receive either a cast iron spindle cap.

The spindle shall be made of copper alloy complying with the requirements of BS 2874, either type CZ114 or type CZ115, and it shall have a threaded machined of trapezoidal form.

The spindle cap shall be of a cast iron secured to the spindle by on M12 hexagon socket set screw conforming to BS 4168.

(d) Hydrant outlet

The outlet flange of the hydrant shall have above nominal diameter 65mm, and shall be fitted with a screwed outlet – Both flanges shall be 50 mm conforming to BS 750
The screwed outlet shall be provided with a cap of cast iron or other suitable material.
The cap shall cover the outlet thread completely and shall be attached to the hydrant by a chain

The distance between the axis of the outlet and the nearest point on the spindle fitting Shall be not less than 100 mm. The screwed outlet shall be made of Copper alloy to BS 1400, type LG2G or DC BIC orCopper alloy to BS 2872, type CZ114 or CZ115, or Suitable spheroidal graphite iron to BS 2789 protected against corrosion accordance with CP 2008.

(e) Drain Boss

Each shall be provided with a suitable drain boss on the outlet side. This shall be located at the lowest practical point, which will permit the filling of self-operating a drilled drip plug.

(f) Jointing

The hydrants shall have machined joint faces through out and the fitting of adjoining parts shall be Such as to make sound joints, corresponding parts of hydrants of the same design and manufacture shall be interchangeable.

(g) Hydrant coating

The hydrant shall be coated in accordance to BS. 4164.

(h) Surface Box.

The clear opening of hydrant surface boxes at ground level shall not be less than 250mm x 380mm

The depth of frame shall normally be for boxes located on footpaths: 100mm for boxes located in roads: 125mm

(i) Markings

Surface box covers shall be clearly marked by having the words FIRE HYDRANT' in letter not less than 30mm high, or the initials F.H.' in letters not less than 75mm high cost into the cover.

(j) Surface Box Covers & Frames.

The surface box frames and covers shall be graded in accordance with 2.1. of BS 497:1967 and shall meet the loading test requirement also given in BS 497

(k) Testing

The hydrants shall be deemed to have undergone the necessary hydrostatic and flow test at time of manufacture Necessary test certificates from the manufacturer shall be needed. The test, to conform to BS 750: 1977:
Appendix a.1

6.10 **STAND PIPES**

One end of these shall have internal threads to couple with the 80mm diameter external threads of the screw down type fire Hydrant (BS750 type 2 hydrants) outlet. The other shall have 65mm diameter internal threads to couple with the interconnect or hose of the pump set

6.11 **HOSE PIPE**

Each cotton synthetic fibre rubberised fire hosepipe to be 25 metres long with 65mm diameter female instantaneous type connector.

SECTION J

BILLS OF QUANTITIES

AND

SCHEDULE OF UNIT RATES

SECTION J

BILLS OF QUANTITIES AND SCHEDULE OF UNIT RATES

CONTENTS

CLAUSE NO.		PAGE
1.	GENERAL NOTES TO TENDERERS……	J-1
2.	STATEMENT OF COMPLIANCE……	J-2
3.	BILLS OF QUANTITIES ……	J-3 to MECH/19
4.	SUMMARY PAGE……..	MECH/19

SPECIAL NOTES

1. The Bills of Quantities form part of the contract documents and are to be read in conjunction with the contract drawings and general specifications of materials and works.

2. The prices quoted shall be deemed to include for all obligations under the sub-contract including but not limited to supply of materials, labour, delivery to site, storage on site, installation, testing, commissioning and all taxes (**including 16% VAT**).

   In accordance with Government policy, the 16% VAT and 3% Withholding Tax **shall be deducted** from all payments made to the Tenderer, and the same shall be forwarded to the **Kenya Revenue Authority (KRA).**

3 All prices omitted from any item, section or part of the Bills of Quantities shall be deemed to have been included to another item, section or part there of.

4. The brief description of the items given in the Bills of Quantities are for the purpose of establishing a standard to which the sub-contractor shall adhere. Otherwise alternative brands of **equal** and **approved** quality will be accepted.

   Should the sub-contractor install any material not specified here in before receiving **written** approval from the Project Manager, the sub-contractor shall remove the material in question and, **at his own cost**, install the proper material.

5. The grand total of prices in the price summary page must be carried forward to the **Form of Tender for the tender to be deemed valid**.

6. Tenderers must enclose, together with their submitted tenders, detailed manufacturer's Brochures detailing Technical Literature and specifications on the equipment they intend to offer (As indicated in the Technical schedule).

1. Statement of Compliance

a) I confirm compliance of all clauses of the General Conditions, General Specifications and Particular Specifications in this tender.

b) I confirm I have not made and will not make any payment to any person, which can be perceived as an inducement to win this tender.

Signed: ……. *for and on behalf of the Tenderer*

Date: …….

Official Rubber Stamp: ……

BILL NO. 1

A) PRICING OF PRELIMINARIES ITEMS.

Prices will be inserted against item of preliminaries in the sub-contractor's Bills of Quantities and specification. These Bills are designated as Bill 1 in this Section. Where the sub-contractor fails to insert his price in any item he shall be deemed to have made adequate provision for this on various items in the Bills of Quantities. The preliminaries form part of this contract and together with other Bills of Quantities covers for the costs involved in complying with all the requirements for the proper execution of the whole of the works in the contract.

The Bills of Quantities are divided generally into three sections:-

Preliminaries – Bill 1

Sub-contractors preliminaries are as per those described in section C – sub-contractor preliminaries and conditions of contractor. The sub-contractor shall study the conditions and make provision to cover their cost in this Bill. The numbers of preliminary items to be priced by the Tenderer have been limited to tangible items such as site office, temporary works and others. However the Tenderer is free to include and price any other items he deems necessary taking into consideration conditions he is likely to encounter on site.
Installation Items – Other Bills
The brief description of the items in these Bills of Quantities should in no way modify or supersede the detailed descriptions in the contract Drawings, conditions of contract and specifications.
The unit of measurements and observations are as per those described in clause 3.05 of the section C.

(c) Summary

The summary contains tabulation of the separate parts of the Bills of Quantities carried forward with provisional sum, contingencies and any prime cost sums included. The sub-contract shall insert his totals and enter his grand total tender sum in the space provided below the summary.
This grand total tender sum shall be entered in the Form of Tender provided elsewhere in this document

SCHEDULE 1:

Bills NO. 1-PRELIMINARIES

ITEM	DESCRIPTION	QTY	UNIT	RATE	KSHS	CTS
1	Discrepancies clause 1.02					
2	Conditions of sub-contract Agreement clause 1.03					
3	Payments clause1.04					
4	Site location clause 1.06					
5	Scope of Contract Works clause 1.08					
6	Extent of the Contractor's Duties clause 1.09					
7	Firm price contract clause 1.12					
8	Variation clause 1.13					
9	Prime cost and provisional sum clause 1.14 (insert profit and attendance which is a percentage of expended PC or provisional sum.)					
10	Bond clause 1.15					
11	Government Legislation and Regulations clause 1.16					
12	Import Duty and Value Added Tax clause 1.17(Note this clause applies for materials supplied only. VAT will also be paid by the sub-contractor as allowed in the summary page)					
13	Insurance company Fees clause 1.18					
14	Provision of services by the Main contractor clause 1.19					
15	Samples and Materials Generally clause 1.21					
	SUB-TOTAL CARRIED TO PAGE J-6					

ITEM	DESCRIPTION	QTY	UNIT	RATE	KSHS	CTS
16	Supplies clause 1.20					
17	Bills of Quantities clause 1.23					
18	Contractor's Office in Kenya clause 1.24					
19	Builder's Work clause 1.25					
20	Setting to work and Regulating system clause 1.29					
21	Identification of plant components clause 1.30					
22	Working Drawings clause 1.32					
23	Record Drawings (As Installed) and Instructions clause 1.33					
24	Maintenance Manual clause 1.34					
25	Hand over clause 1.35					
26	Painting clause 1.36					
27	Testing and Inspection – manufactured plant clause 1.38					
28	Testing and Inspection – Installation clause 1.39					
29	Storage of Materials clause 1.41					
30	Initial Maintenance clause 1.42					
	SUB-TOTAL CARRIED TO PAGE J-6					

ITEM	DESCRIPTION	QTY	UNIT	RATE	KSHS	CTS
31	Attendance Upon Tradesmen, etc. (Insert percentage only) clause 1.58					
32	Local and other Authorities notices and fees clause 1.60					
33	Temporary Works clause 1.63					
34	Patent Rights clause 1.64					
35	Mobilization and Demobilization Clause 1.65					
36	Extended Preliminaries Clause 1.66(see appendix on page C- 24)					
37	Supervision by Engineer and Site Meetings Clause 1.67					
38	Allow for profit and Attendance for the above					
39	Amendment to Scope of Sub-contract Works Clause 1.68					
40	Contractor Obligation and Employers Obligation clause 1.69(see appendix page C- 24)					
41	Any other preliminaries;					
	Subtotal above Subtotal brought forward from page J-4 Subtotal brought forward from page J-5					
	TOTAL FOR BILL NO. 1- PRELIMINARIES CARRIED FORWARD TO PRICE MAIN SUMMARY MECH/19					

SECTION K

TECHNICAL SCHEDULE OF ITEMS TO BE SUPPLIED

CONTENTS

CLAUSE NO. PAGE

1. GENERAL NOTES TO THE TENDERER……K-1

TECHNICAL SCHEDULE

1. General Notes to the Tenderer

1.1 The tenderer shall submit technical schedules for all materials and equipment upon which he has based his tender sum.

1.2 The tenderer shall also submit separate comprehensive descriptive and performance details for all plant apparatus and fittings described in the technical schedules. Manufacturer's literature shall be accepted. Failure to comply with this may have his tender disqualified.

1.3 Completion of the technical schedule shall not relieve the Contractor from complying with the requirements of the specifications except as may be approved by the Engineer.

d) TECHNICAL SCHEDULE (MUST BE COMPLETED IN FULL)

ITEM No.	Description	Manufacturer	Country Of origin	Particulars
1	Indoor unit			
2	Outdoor unit			
3	Voltage Surge Protector			

SECTION L

SCHEDULE OF CONTRACT DRAWINGS

As will be issued by the Engineer during project implementation.