



Gujarat University

TECHNICAL SPECIFICATIONS

Tender No: GU/ESTATE/IAS/2016-17/03

**Tender Document
For**

**Extension of IAS Training Center and Other
Department at Gujarat University.**

AIR COOLED PACKAGED AND DUCTABLE TYPE SPLIT AIR CONDITIONING UNITS :

1.1 SCOPE

The scope of this section comprise the supply, erection, testing and commissioning of Air Cooled Packaged and Split Units conforming to these specifications and in accordance with the requirements of Drawings and Schedule of Quantities.

1.2 TYPE

The Package / Split Units shall consist of hermetically sealed Scroll compressor, motor, air cooled condenser, integral refrigerant piping and wiring, all mounted on a steel frame.

Indoor unit to be installed for Split Unit within building shall be housed in insulated cabinet consisting of cooling coil, blower with motor, filter & insulated drain pan.

The Air Cooled Packaged Unit shall consist of hermetically sealed Scroll compressor; motor, integral refrigerant piping and control panel duly wired to compressor and air cooled condenser all mounted on a steel frame. The Air cooled condenser with fan duly mounted on a common frame shall be installed on the wall openings with suitable angle iron / channel frame to be provided by contractor. The suitable starters, switches, power control cabling between Air Cooled Packaged Unit and Air Cooled Condenser shall be included by the contractor.

1.3 CAPACITY

The refrigeration capacity of Packaged Unit and Room Air Conditioners, split unit shall be as shown on Drawings and in Schedule of Quantities.

1.4 COMPRESSOR AND MOTOR

Compressor shall be hermetically Scroll, serviceable type and shall have dual pressure stat, and an operating oil charge. The motor shall be suction gas cooled and shall be sealed against dirt and moisture. The motor shall be suitable for $415 \pm 10\%$ / volts or $230 \pm 10\%$ volts, 50 Hz, A.C. supply.

1.5 REFRIGERANT PIPING AND CONTROLS

Refrigerant piping and fittings interconnecting compressor condenser shall be all copper and valves shall be brass / gunmetal construction.

1.6 CASING

The indoor & outdoor units shall be sectionalized / cabinet construction. Indoor units shall be consisting of fan section, coil

section, filter section, and drain pan. Outdoor unit shall consist of condenser coil, fan & compressor. In case of package units, the compressor shall be mounted within the indoor units and in case of split unit, the compressor shall be mounted with the outdoor units. Each section shall be constructed of thick sheet steel all welded / bolted construction, adequately reinforced with structural members and provided with sufficient access panels for proper lubrication and maintenance. Base panel shall be constructed of fabricated steel structure provided with an under frame suitably braced. Each unit shall include one piece drain pan constructed of 20 gauge galvanized sheet steel plate. Drain pan shall extend under coil and fan sections with drain connections. Removable panels in fan and coil sections shall provide access to all internal parts. Panels shall be internally lined with 2.5 cm thick fibreglass as per section "Insulation" for the thermal insulation and acoustic lining.

1.7 FAN MOTOR AND DRIVE

Fan motor shall be suitable for $415 \pm 10\%$ volts or $230 \pm 10\%$ volts, 50 Hz, A.C. Supply, Single phase, motors shall be provided with permanent capacitor. Motors shall be especially designed for quiet operation and motor speed shall not exceed 1440 rpm.

1.8 FAN

Fan wheels and housing shall be fabricated from heavy gauge steel. Fan wheels shall be of double-width, double inlet forward-curve, multi-blade type enclosed in a housing and mounted on a common shaft. Fan housing shall be made of die-formed steel sheets with stream-lined inlets to ensure smooth air flow into the fans, fan shaft bearing shall be oil/grease lubricated. All rotating parts shall be dynamically balanced individually, and the complete assembly shall be statically and hydraulically balanced. Fan speed shall not exceed 1000 rpm and maximum fan outlet velocity shall be 550 meters per minute.

1.9 COOLING COIL

Cooling coils shall be of fin and tube type having aluminium fins firmly bonded to copper tubes assembled in zinc coated steel frame. Face and surface areas shall be such as to ensure rated capacity from each unit and air velocity across each coil shall not exceed 100 meters per minute. The coil shall be pitched in the unit casing for proper drainage. Each coil shall be factory-tested at 21 Kg. per sq.cm air pressure under water. Tube shall be mechanically / hydraulically expanded for minimum thermal contract resistance with fins. The number of fins per cm. shall be 4 to 5.

1.10 VIBRATION ISOLATORS

The indoor and outdoor units shall be provided with ribbed rubber pad

vibration isolators.

1.11 PAINTING

Split units shall be factory finished with durable powder coated finish. Shop coats of paint that have become marred during shipment or erection shall be cleaned off with mineral spirits, then coated with enamel paint to match the finish over the adjoining shop-painted surface.

1.12 PERFORMANCE RATING

The unit shall be selected for the lowest operating noise level. Capacity rating and power consumption with operating points clearly indicated shall be submitted with the tenders and verified at the time of testing and commissioning of the installation.

2.0 SHEET METAL WORK -

AIR DISTRIBUTION SHEET METAL WORK AS PER IS -655

SCOPE:

The scope of this section comprises supply fabrication, installation and testing of all sheet metal ducts, supply, installation, testing and balancing of all grilles registers and diffusers, in accordance with these specifications and the general arrangement shown on the drawings.

DUCT MATERIAL:

All ducts shall be fabricated from galvanised steel sheet of the following thickness as indicated in schedule of quantities. Galvanised steel sheet shall conform to IS:277.

DUCTING:

The thickness of sheets, the bracing and other fabrication details shall be of generally in accordance with the details given here under or otherwise as shown on the drawings. The ducts shall be designed for a velocity of 6- 8 m/sec.

RECTANGULAR DUCT:

DIMENSION OF DUCTS	GI	TYPE OF BRACING
Upto 600	24	Gross Bracing
601 to 750	24	25x25x3 mm M.S angles bracing at 1200mm from joints
751 to 1000	22	25x25x3 mm M.S angles bracing at 1200mm from joints
1001 to 1500	22	40x40x3 mm M.S angle bracing at 1200mm from joints
1501 to 2250	20	40x40x3 mm M.S angle bracing at 600mm from joints or 40x40x3 mm M.S angle diagonal bracing
2250 and above	18	50x50x3 mm M.S angle bracing at 600mm from joints or 50x50x3 mm M.S angle diagonal bracing

All ducts shall be fabricated and installed in workmanlike manner, generally conforming to IS: 655 1993(Revised). Round exposed ducts shall be die-formed for achieving perfect circle configuration.

Ducts shown hatched on the drawings shall be acoustically lined/ with thermal insulation as described in the section insulation. Duct dimensions shown on drawings are overall sheet metal dimensions inclusive of the acoustic lining, where required.

Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made air tight.

All exposed ducts within conditioned spaces shall have slip joints & no flanged joints. The internal ends of slip joints shall be made in the direction of air flow. Exposed ducts, where required, shall be painted with two coats, of enamel paint of approved colour. Ducts and accessories within ceiling spaces, visible from air-conditioned areas shall be provided with two coats of mat black finish paint.

Changes in dimensions and shape of ducts shall be gradual. Curved elbows, unless otherwise approved, shall have a centre line radius equal to one and a half times the width of the duct. Air turns shall be installed in all vanes, arranged to permit the air to make the turn without appreciable turbulence.

Ducts shall be fabricated as per details shown on drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or angles, of ample size to keep the ducts true to shape and to prevent buckling, vibration or breathing.

All sheet metal connections, partitions and plenums required to confine the flow of air to and through the filters and fans, shall be constructed of 18 gauge GSS/16 gauge aluminum, thoroughly stiffened with 25mm x 25mm x 3mm angle iron braces and fitted with all necessary doors as required by the

Architect consultant to give access to all parts of the apparatus. Doors shall be not less than 45cm x 45cm in size.

All ducts shall be installed generally as per the drawing and in strict accordance with approved shop drawings to be prepared by the contractor.

The contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent, of these specifications and drawings. The work shall meet the approval of the supervisor in all its parts and details.

The contractor for beams, pipes, or other constructions in the building shall make all necessary allowances and provisions whether or not the same are shown on the drawings. Where necessary to avoid beams or other structural work, plumbing or other pipes, and/or conduits, the ducts shall be transformed, divided or curved to one side, the required area being maintained, all as approved or directed by the Consultant.

If a duct cannot be run as shown on the drawings, the contractor shall install the duct between the required points by any path available subject to the approval of the Consultant.

All duct work shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner. Each support and rod shall be painted with two coats of rust inhibiting red oxide primer & Black enamel paint.

Ducting over furred ceiling shall be supported from the slab above or from beams, after obtaining approval of the super visor. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling. All metal work is dead or furred down spaces shall be erected in time not to occasion delay to other contractors on the building.

Rat proofing consisting of 16 gauge galvanized weld mesh, with about 4 mesh per inch, shall be provided in supply air ducts at unit/Fan outlets, in return air openings of unit room wall, and above return air slits in conditioned spaces.

Where metal ducts or sleeves terminate in wood work, tight joints shall be made by means of closely fitting heavy flanged collars, where ducts pass through brick or masonry openings, wooden frame work shall be provided with heavy flanged collars on each side of wooden frame work, so that duct crossing is made leak-proof.

All ducts shall be totally free of vibration under all conditions of operation. Whenever duct work is connected to fans, air handling units or blower coil units that may cause vibrations in the ducts, ducts shall be provided with two flexible connections, located close to the unit, in mutually perpendicular directions. Flexible connections shall be constructed of fire resistant flexible

double canvas sleeve at least 15cm. long securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting duct work rigidly held by independent supports on both ends. The flexible connections shall be suitable for pressures at the point of installation.

Splitter dampers and air turning vanes shall be provided at all branches and outlets as indicated and as per consultant's specification.

All 22G & 24G ducts shall have MS angle iron flanges of 32x32 mmx 3mm thick & 20G & 18G with 40x40x5mm thick with 3mm thick/1" wide Rubber gaskets. GI Rivets & GI nut bolts shall be at a spacing of 4" only.

Ducts behind grilles will be painted black.

TOOLS AND TACKLES FOR SITE WORK:

The duct installation shall conform to SMACNA norms. For duct assembly and installation the suitable tools and tackles shall be used to give the required duct and speed of such tools shall include (but not restricted to the following)

- a) Electric Pittsburgh Seamer – used for closing Pittsburgh joints
- b) Electric Slitting shear – to make cut - outs
- c) Drilling machine with drill bits – for drilling holes in sheet metal work
- d) Hammer drill machine with drill bits – for drilling holes in building structures for anchor.
- e) Hoisting system – for lifting the duct assembly upto mounting heights.

INSTALLATION PRACTICE:

All ducts shall be installed as per tender drawing and in strict accordance with approved shop drawings to be prepared by the Contractor. The Contractor shall provide and neatly erect all sheet metal work as may be required to carry out the intent of these specified and drawings. The work shall meet with the approval of Owner's site representative in all its parts and details.

All necessary allowances and provisions shall be made by the Contractor for beams, pipes, or other obstructions in the building whether or not the same are shown on the drawings. Where there is interference/fouling with other beams, structural work, plumbing and conduits, the ducts shall be suitably modified as per actual modified as per actual site conditions.

Ducting over false ceilings shall be supported from the slab above, or from beams. In no case shall any duct be supported from false ceilings hangers or be permitted to rest on false ceiling. All metal work in dead or furred down spaces shall be erected in time to occasion no delay to other contractor's work in the building.

Where ducts pass through brick or masonry openings, it shall be providing with 25 mm thick appropriate insulation around the duct and totally covered with fire barrier mortar for complete sealing.

All ducts shall be totally free from vibration under all conditions of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provide with a flexible connection, located at the unit discharge. These ducting are to be used for clean room application all the ducting joints are to be sealed with RTV food grade silicon sealant.

Testing and Balancing:

After the installation of the entire air distribution system is completed in all respects, all ducts shall by test for air leaks.

Before painting the interiors of conditioned spaces, air distribution system shall be allowed to run continuously for 48 hours for driving away any dust or foreign material lodged within ducts during installation.

The entire air distribution system shall be balanced using a hotwire anemotherm. Measured air quantities at fan discharge and at various outlets shall be identical to or less than 5 percent in excess of those specified and quoted. Leakage in each air distribution system shall be identical to or no greater than 3 percent in excess of the total air quantity measured at all supply outlets served by the fan. Volume or splitter dampers shall make branch duct adjustments. Dampers shall be permanently marked after air balancing is complete so that these can be restored to their correct position if disturbed at any time complete air balance report shall be submitted to the supervisor for scrutiny and approval provided with completion documents.

FRESH AIR ARRANGEMENTS:

Aluminum powder coated fresh air intake louvers with damper will be provided to each of the ductable units. Fresh Air Dampers shall be of interlocking opposed blade louvers type. Blade shall be made of not less than 16 G. Galvanized sheet steel and edges covered with rubber gasket to provide our tight closure and shall be rattle free.

Wherever indicated in the Drgs. / quantified in BOQ will have Motorised Dampers linked to Ozone system as required. All units shall be connected to fire alarm panel and shall automatically switch off in case of fire.

3.0 GRILLES AND DIFFUSERS-

General

The grilles and diffusers shall be rated in accordance with ASHRAE standard 3672.

All grilles and diffusers shall have concealed fixing system and shall have quick release frame to facilitate cleaning.

All supply grilles and diffusers shall be mounted on substantial frame and shall be provided with soft rubber or felt joining ring inserted under the frame to prevent air leakage and the formation of condensate on the fitting,

All grilles and diffusers shall not be less than the size indicated; where no size is given they shall be capable of handling the air flows and distribution indicated without producing unacceptable air flow noise. The Contractor shall select the supply air grilles and diffusers to achieve good air distribution and adequate air movement in the conditioned space.

In order for the ceiling grilles and diffusers to match with the false ceiling layout pattern, the actual size of the grilles and diffusers shall be confirmed by the Architect/consultant before ordering.

For all grilles and diffusers which are smaller than the ceiling tile on which they are installed, they shall be located in the centre of the ceiling tile. The exact location of the ceiling grilles and diffusers shall be co-ordinate with other services. The Contractor shall confirm the exact location with the Architect/consultant before works commence.

Where grilles and diffusers are to be incorporated into false ceilings before any grilles or diffusers are installed into ductwork or fan coils, the Contractor shall ensure that the Building Contractor marks out the ceiling line on the adjacent plastered walls or columns and also indicates where ceiling tee bars line up or the ceiling joints occur in order that such datum can be worked to.

The finishing colour of the grilles and diffusers shall be approved by the Architect as different colours may be specified in different areas. The Contractor shall co-ordinate with the Building Contractor and other specialist Contractors especially the ceiling and electrical Contractor for the integration of the air diffuser into the ceiling and luminaire (for light troffer diffuser).

GRILLES

Grilles shall be of steel, aluminium, or as otherwise indicated. Steel grilles shall be protected against rusting and supplied in fully finished stove-enamelled or otherwise specified condition.

Each supply air grille shall have two sets of separately adjustable louvers, one set horizontal and one set vertical, and shall be complete with an opposed blade multi-leaf damper. Alternatively in lieu of the opposed blade multi-leaf damper a rhomboidal air controller may be provided; this air controller shall control both the volume of air passing and the distribution of air across the grille face. The louvers and the damper or air controller shall be adjustable from the front of the grille.

Return air grilles shall have either a single set of louver or bars (either vertical or horizontal) or a lattice, egg crate or expanded metal form.

Each return air grille shall be complete with/without an opposed blade multi-leaf damper or a rhomboidal air controller operable from the front as specified.

Where return air grilles are fitted for fan coil units, they shall be arranged such that the central core of the grille hinged and demountable for access to the filter for cleaning.

Mounting frames for these grilles shall include provision for fixing the filter in position.

DIFFUSERS

Diffusers shall be of steel or aluminium. Steel diffusers shall be protected against rusting and shall be stove enameled/powder coated for finished colour approved by the Architect. Diffusers shall incorporate an edge seal, diffusers mounted on ceilings shall have anti-smudge rings. Pan type diffusers shall be provided except where cone type diffusers are indicated,

Diffusers shall be provided with volume control dampers of the iris, flap or sleeve type which shall be adjustable from the front of the diffusers Where the length of a vertical duct to a diffuser is less than twice the diameter of the diffuser an equalizing deflector shall be fitted.

The design of the supply air diffuser shall be capable to induce adequate air movement and provide the throw to cover the entire air-conditioning space without causing air turbulence and cold draft.

linear diffusers shall be constructed of extruded aluminium section and include a control damper at the rear of the vanes giving volume control down to complete shutoff and operated from the face of the diffuser. Linear diffusers for supply air shall have adjustable blades to give directional control of air flow. The linear diffuser shall be capable of maintaining a horizontal discharge pattern at a turn down ratio down to 20% of the maximum specified air volume without air dumping.

The linear diffuser shall be complete with factory fabricated plenum with suitable inlet connection for flexible ductwork, The plenum and diffuser neck shall be constructed of galvanised steel sheets internally lined with 25 mm 48

kg/m glass cloth faced fiberglass insulation enclosed in galvanised perforated metal liner.

Where linear diffusers are mounted in a continuous line there shall be means of ensuring alignment between consecutive diffusers and of equalizing pressure behind the vanes. The dummy portion of the diffuser shall be internally covered by a demountable galvanized metal enclosure to block the view into the ceiling void from below.

The linear slot diffuser shall be constructed of extruded anodized aluminium, with multiple slot for the required air flow rate,

All the supply air grilles/diffusers will be provided with opposed blade volume control dampers fabricated from Al. anodized in matt black shade. The damper should be suitable for operation from front face of grille/diffuser. The Diffusers should have also removable core type fixing facility, constructed from the same material of the diffuser. The grilles / diffusers must be submitted to Architect / HVAC consultant / PMC / Client for prior approval before procurement and installation.

INSTALLATION-

A good quality expanded polyethylene /rubber of uniform thickness and width shall be used as gasket between flange joints. The gaskets shall be fixed by a suitable adhesive and holes made by passing a heated rod through.

All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees or angles of ample size to keep the duct true to shape and to prevent buckling, vibration or breathing. All the joints shall be made tight and all interior surfaces shall be smooth. Bends shall be made with radius not less than one half the width of the duct or with properly designed interior curved vanes where metal ducts or sleeves terminate in woodwork, brick or masonry openings, tight-flanged collars. Ducting over false ceiling shall be supported from the slab above or from beams.

In no case a duct shall be supported from the false ceiling hangers or to be permitted to rest on a hung ceiling.

All holes in concrete, masonry etc. made by contractor for fixing supports etc. Shall be made good and restored to original finish by him.

Air handling units and fans shall be connected to duct work by inserting at air inlet and air outlet a double canvas sleeve. Each sleeve shall be minimum 100mm long, securely bolted to duct and units. Each sleeve shall be made smooth and the connecting ductwork rigidly held in the line with unit inlet or outlet.

PAINTING-

Angle iron flanges, stiffeners, hangers and supports shall be painted with 2 coats of anti rust primer and those remaining uncovered shall be further painted with 2 coats of synthetic enamel paints of black colour.

JET NOZZLES :

The jet nozzles shall be made of heavy gauge aluminium. The supply air jet can be directed at an angle of 30 Deg. When the angle of roll is 360 Deg. The jet nozzles should include the sealing gasket for proper prevention of air leakage. If require it should have volume control damper also made from the aluminium. The final finish shall be either anodized or painted.

4.0 DAMPERS – GENERAL

The respective functions, types and general constructional requirements of dampers shall be in accordance with the HVCA ductwork specification unless otherwise indicated, sufficient dampers shall be provided to regulate and balance the system. Dampers on grilles or diffusers shall be used for line control only.

All dampers shall be of flanged type for connection to ductwork and shall be sufficiently rigid to prevent fluttering. Air leakage rate for dampers shall be tested according to EN 1751 Section 3 when the damper is in the closed position. For dampers installed for shut-off purpose, the maximum air leakage rate shall be tested according to EN 1751 Section 4.

LOW LEAKAGE DUCT DAMPER

Air volume control dampers shall be of the aerofoil, double skin, opposed blade type with low pressure drop and noise regeneration characteristics. Damper blades in rectangular ductwork shall not exceed 225 mm in width and 1500 mm in length. Blades shall be of hollow section constructed from the same material of the ductwork or of stainless steel encapsulating an internal double contoured stud longitudinal reinforcing bar, mounted on square section steel spindles. Bearings shall be of nylon material and the units shall be of low-leakage design by incorporation of synthetic trailing edge seals and a peripheral gasket which shall be tested according to BS 476. All manually and automatically operated dampers shall include a means for indicating externally the position of the blades. Manual dampers shall include a device for positioning and locking the damper blades. The positions of all dampers 'as-set' after final regulation shall be indelibly marked at the adjusting device.

Each air volume control damper in the ductwork shall be fitted with a non-corrodible label stating the actual air flow in m³/s when in the fully open

position, its overall cross sectional area, and the degree to which the damper has been closed in order to achieve the design or actual air flow.

Unless otherwise indicated, quadrants and operating handles shall be of die-cast aluminum or other material approved by the Architect with the words 'OPEN' and 'CLOSE' marked on the quadrant. Quadrants shall be securely fixed and the damper spindles shall be closely fitted in the quadrant hubs to prevent any damper movement when the damper levers are locked.

Access openings with readily removable air sealed covers shall be provided adjacent to all dampers. Subject to limitations of ductwork size the dimensions of access openings shall not be less than 300 mm x 300 mm and shall be located so as to afford easy access for inspection and maintenance.

INSPECTION & TESTING

All Pre / Fine filters shall be tested for type and routine test as per the requirement of BS:6540 / ASHRAE – 52-76.

5.0 INSULATION

ACOUSTIC INSULATION-

First 3-meter length of supply air duct shall be acoustically insulated with 12.5/25 mm thick rigid fiber glass of density 48 Kg. /Cu. M. and covered with tissue paper and 28 G perforated Aluminium sheets from the inside of the duct.

The inside surface for the ducts shall be covered with non-flammable adhesive, and provided with 22 gauge GI Channels 25 x 25 mm screwed back to back and fixed on the inside of duct, spaced not more than 60 cm centre to centre to form a frame work of 60 x 60 cms square. Cut panels 60 x 60 cms of resin-bonded fiberglass 12.5 mm thick shall be fitted in the squares.

These insulation panels shall be fixed to the sheet metal with cold setting adhesive compound. The inner most surface shall be covered with fiberglass tissue and 28 gauge perforated aluminium sheet having at least 15 percent perforations. The aluminium sheet shall be screwed to GI channels using cup washer and neatly finished to give true inside surface.

EXTERNAL INSULATION:

External duct thermal insulation as marked on the drawings shall be as follows: The outside of the duct surface shall be cleaned to make it free from dust. Fiberglass having density of 24 kg/m³ factory laminated with Aluminium foil on one side and self adhesive on the other side will be wrapped around the duct and 2" wide BOPP type applied on the joints horizontally & vertically.

The exposed duct shall be insulated with 50 mm thick "TF" quality expanded polystyrene with 85/20 grade hot bitumen and GI screw washer & GI diagonal wires. The insulation shall be covered with 12mm thick sand cement plaster.

Flanges will be insulated separately as above.

All external duct insulation will be carried out only after thorough inspection of all flanges, joints and taking of all collars and branches and supports.

All copper pipes will be insulated crosslinked polyethylene foil faced

The walls & ceiling of the AHU rooms shall be provided with acoustic lining as indicated in Bill of materials. Framework made out of GI press sections of 24 G to take care of insulation thickness to be fixed at 1000mm x 500mm interval. While fixing the insulation a minimum gap of 25mm from the wall/ceiling has to be allowed using proper cleats. The gap between frames shall be filled with 50mm thick fiberglass of density 24Kg./M.Cub with back up of 24G GI chicken wire mesh.

Entire surface shall then be covered with fiberglass tissue paper over that 24G perforated aluminium sheet to be fixed with proper fasteners.

The insulation will stop 75mm from the floor

FALSE CEILING INSULATION-

The false ceiling shall be insulated with 50 mm thick fiber glass slab of 16 Kg. / Cu. M. density. The fiber glass slab shall be wrapped in polyethylene bags.

PARTITION WALL / SLAB INSUALTION

The exposed roof shall be insulated with 50 mm thick "TF" quality expanded polystyrene with 85/20 grade hot bitumen and GI screw washer & GI diagonal wires. The insulation shall be covered with 36 G Aluminium Foil.

UNDER DECK ROOF INSULATION

The scope of this section comprises the supply and application of under deck insulation to roof .

The material used shall be expanded polystyrene (TF) or resin bonded fiber glass in mat form shall be used.

The EPS used shall conform to the following requirements:

- A. Density : Not less than 14kg/cum.
- B. 'K' value : Not greater than 0.025 kcal/hr/m² Deg C
- C. Water vapour : Not more than 13 Mg/Nh

The fiber glass used for insulation have a density of not less than 24Kg/cum.& 'K' value of not less than 0.033 W/ m² Deg C, at a mean temperature of 10 deg C.

The owners / consultants also reserve the right to require that the weights, dimensions, etc., of the materials supplied be measured and shown to conform to values specified

The insulation material used for insulating equipment shall be in the form of panels.

Notwithstanding the above specifications, however, the final choice of the material rests on the owners whose approval shall be obtained before the contractor places his order or brings material to site.

Samples of all insulation material specified in various forms, i.e., panels, masts, etc., shall be submitted by the successful contractor and approval obtained therefore. The Owner/ Consultants shall have the right to reject all supplies which do not conform to the samples so approved.

The insulation shall be applied as follows :

Clean the roof surface to make it free from dust and other materials.
Apply a thick coat of hot bitumen uniformly over the surface. Bitumen used shall be R 85/25 or 90/15

6mm dia Holes will be drilled at interval of every half meter

50x50mm pegs/spacers will be provided at every half meter interval with Nylon Rawl plugs & screws.

Flood coat of Bitumen of air blown grade 95/15 or 85/25 will be used at the rate of 1.5 to 2 Kg/m² to the expanded polystyrene.

The EPS will be stuck to the ceiling in the grid & cross G.I wires will be tied.

The fiber glass blanket shall be so applied such that the face incorporating the tissue is in contact with surrounding air while the fiber glass material shall be applied directly on to the external surface.

Cover the insulation material with 24G GI wire mesh between pegs & spacers by U-nails

Care should be taken to coordinate with false ceiling support, ducts, lights, cable tray, fire alarm, music system supports while doing the under deck insulation.

Damages occurred due to the supports will have to be patched up

6.0 REFRIGERANT PIPING

All refrigerant piping for the air conditioning system shall be constructed from soft seamless upto 19.1mm and hard drawn copper refrigerant pipes for above 19.1mm with copper fittings and silver-soldered joints. The refrigerant piping arrangements shall be in accordance with good practice within the air conditioning industry, and are to include charging connections, suction line insulation and all other items normally forming part of proper refrigerant circuits.

All joints in copper piping shall be sweat joints using low temperature brazing and or silver solder. Before joining any copper pipe or fittings, its interiors shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using nitrogen.

After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using nitrogen at pressure of 38Kg per sq.cm. Pressure shall be maintained in the system for 24 hours. The system shall then be evacuated to minimum vacuum if 700mm hg and held for 24 hours.

The air-conditioning system supplier shall be design sizes and erect proper interconnections of the complete refrigerant circuit.

The thickness of copper piping shall not be less than mentioned below:

Pipe Size in mm (OD)	Wall Thickness in mm	Insulation
thickness in m.m.		
a) 41.3	1.4	25
b) 38.1	1.3	25
c) 34.9	1.2	25
d) 31.8	1.1	25
e) 28.6	1.0	19
f) 25.4	1.0	19
g) 22.2	1.0	19
h) 19.1	1.0	19
i) 15.9	1.0	19
j) 12.7	0.8	13
k) 9.5	0.8	13
l) 6.4	0.8	13

The suction line pipe size and the liquid line pipe size shall be selected according to the manufacturers specified outside diameter. All refrigerant pipes shall be properly supported and anchored to the building structure using steel hangers with Pipe/Cable Tray, anchors, brackets and supports which shall be fixed to the building structure by means of inserts or expansion shields of adequate size and number to support the load imposed thereon.

To protect Nitrile rubber insulation of exposed copper piping from degrading due ultra violet rays & atmospheric condition, it shall be covered polished coating with at least two coats of resin and hardener (Make- poly bond company) above nitrile rubber insulation. Fiberglass tape shall be helically wound & coated with painted two coats of resin with hardner to give smooth & plain finish.

PIPE INSULATION

a. Refrigerant Pipe Insulation

The whole of the liquid and suction refrigerant lines including all fittings, valves and strainer bodies, etc. shall be insulated with 25mm /19mm /13 mm thick elastomeric nitrile rubber as specified above.

b. Drain Pipe Insulation

U-PVC Drain pipes carrying condensate water shall be insulated with 6 mm thick elastomeric nitrile rubber insulation.

For proper drainage of condensate, U Trap shall be provided in the drain piping (wherever required). All pipe supports shall be of pre fabricated & pre painted slotted angle supports, properly installed with clamps etc.

7.0 ELECTRIC WORK:

Electric Panel:

The licensed electrical contractor shall carry out the electrical work. Installation & testing of electrical work shall be as per IS:732 while earthing of electrical panel shall be as per IS:3043. The complete electrical work shall be carried out as per relevant rules of Indian Electricity board & local governing bodies.

The panel shall be fabricated from high quality 16-gauge sheet, stiffened and suitably reinforced. It shall be painted with seven-tank process and the final paint coat shall be stove enameled. The housing shall be of sectionalized construction. The space shall be provided for separate vertical bus droppers and cable alley of minimum 200 mm width for each panel section. The construction of the panel shall be such that it remains dust and vermin proof.

Motor feeders above 7.5 KW shall be provided with ammeters. Minimum size of power wiring shall be 2.5 mm sq. Cu / 4.0 mm sq. Al. Control wiring shall be done with 2.5 mm sq. stranded copper conductor PVC insulated wires. Indicating instruments shall be taut-band type only.

All overload relays shall be with built-in SPP. All spare contacts shall be wired up to terminal block.

For ease of cabling where ever it is possible circuit breakers and large isolating switches shall be positioned below the bus-bar chamber. To achieve a neat & symmetrical arrangement all meters and indicating lights shall be located adjacent or on the unit with which these are connected. Facility shall be provided for termination of all normal types of cables entering from above and clamps shall be provided to support the weight of cables. Necessary Nameplates shall be fixed on the panels to indicate the equipment of circuit controlled by the switches. All push buttons shall have 2 NO and 2 NC contacts.

Cabling & Earthing work:

The power wiring shall be suitable for 415V, 3ph, 50 Hz, 4 wire supplies. Wiring for motors shall be carried out in PVC sheathed and steel wire or tape armoured cable.

The control wiring shall be in PVC insulated and PVC sheathed, multi core, stranded copper cable (minimum 2.5 mm² Cu) with the required number of cores.

Power cables and wire shall be of copper or aluminium of 1100 V grade, control wires of copper 660 V grade ad shall conform to IS: 1554 / IS:694.

Cabling shall be carried on walls or in racks or in cable trays suspended from hangers or laid in trenches as required. Where more than one cable is running, proper spacing shall be provided to minimize the loss in current carrying capacity.

The radius of bends for cables shall not be less than the specified minimum radius by the manufacturer to ensure that no undue stress is caused to cable.

For cables passing through pipes, PVC/Neoprene rubber bushes shall be provided at the ends. For cables passing through floors or walls, pipe inserts shall be provided and opening shall be sealed.

Cables shall be terminated using weather proof double compression brass nickel plated cable glands and finned copper crimped lugs.

GI Class B type Heavy gauge conduit, metal saddles of approved type shall be used for conduiting. Bends and elbows shall be of inspection type where

required. All joints shall be watertight. Conduits shall be secured to the switches, junction boxes etc., by threaded couplers. Flexible PVC conduits shall be used for connections with vibrating equipment. Suitable means to isolate each motor in case of emergency shall be provided as per IS: 900

The main panel shall be connected to the main earthing stations by means of G.I. Strips as per Indian electricity rules and IS: 3043. All electrical equipment shall be provided with two separate earth connections. All earthing connections shall be visible for periodical checking.

All the equipment installations shall be tested in accordance with Indian Electricity Rules and IS:732 before commissioning. Test Report of a licensed electrical contractor shall be furnished in this regard.

MODE OF MEASUREMENTS:

Modes of measurement for payment of items of ducting and piping and their insulation shall be as follows:

DUCTING

Payment for ducting shall be on the basis of the external surface area of the ducting including all material and labour for installed duct.

The rate per Sq. mtr. of the external surface shall include flanges, gaskets for joints, bolts and nuts, duct supports and hangers, vibration isolation pads or suspenders, flexible connections, inspection doors, dampers, running vanes, straight vanes, and any other item which will be required to complete the external insulation and acoustic lining.

The external area shall be calculated by measuring the over all width and depth (including the corner joints) in the centre of the duct section from flange face to flange face in case of ducts length with uniform cross section. Adding up the areas of all duct sections will arrive at total area.

In case of taper pieces average width and depth will be worked out as follows:

W 1 : Width of small cross section

W 2 : Width of large cross section

D 1 : Depth of small, cross section

D 2 : Depth of large cross section

Average width : $(W1 + W2) / 2$

Average depth : $(D 1 + D 2) / 2$

Width and depth in the case of taper pieces shall be measured at the edge of the collar of the flange for duct sections fitted with angle iron flanges, otherwise, at the bottom of the flange where the flanges are of duct sheet.

For Circular pieces the diameter of the section midway between large and small diameters shall be measured and adopted as the mean diameter for calculating the surface area at the taper piece. Duct measurements for calculation of area shall be taken before application of insulation.

For the special pieces like bends, branches and tees etc., same principle of areas measurement. As for linear and outer periphery along the curvature angle of the piece shall apply.

PIPING:

Shall be measured in units of length along the centre line of installed pipes including all pipe fittings, flanges (with gaskets and nuts and bolts for jointing, unions, bends, elbows, tees, concentric and / or eccentric reducers, inspection pieces, expansion loops etc. The above accessories shall be measured as part of piping length along the centre line of installed pipes, and no special rates for these accessories shall be permitted.

The quoted unit rates for centre line linear measurements of piping shall include all wastage allowances, pipe supports including hangers, MS channel, wooden haunches, nuts and check nuts, vibration isolator suspension where specified or required, and cost of excavation, bending, back filling and finishing as required to complete the piping installation as per the specification. None of these items will be separately measured and paid for. However, all valves (gate/globe/check/balancing/purge/drain etc., strainers, orifice plates, thermometers, pressure gages shall be separately measured and paid as per their individual unit rates, which shall also include their insulation as per specifications.

Piping measurements shall be taken before application of the insulation. The cost shall also include any excavations and making masonry valve chamber with steel cover etc.

PIPE INSULATION:

Shall be measured in units of length along the centre line of the installed pipe, strictly on the same basis as the piping measurements described above.

The linear measurements shall be taken before the application of the insulation. It may be noted that for piping measurements, all valves, orifice plates and strainers are separately measurable and their quoted unit rates in piping section must include the insulation as required and as specified.

DUCT INSULATION / ACOUSTIC LINING:

This item is provided separately for various thickness and shall be paid for area basis of un-insulated duct. The area of the duct to be insulated shall be measured before application of insulation.

LIST OF ITEM TO BE PROVIDED BY OTHER AGENCIES

1. All civil work including AHU, PCC blocks for installing AHU. Foundations for Condensing Unit etc. opening in walls for duct, pipes and cables has to be done by air conditioning contractor through drill machine only. Closing and finishing will be done by other agencies.
2. F. C. and boxing where ever necessary.
3. Lighting in plant room and AHU room.
4. Single point electrical supply for erection and fabrication.
- 5.. Lockable storage space for storage purpose.
6. Floor drain in each package/AHU room.

INFORMATION TO BE FURNISHED BY THE TENDERER ALONG WITH THE TENDER

Air Cooled Package units with Different Capacity & Specifications

Package units with Specifications

A. COMPRESSOR

1. Make & Type - model No.
2. Overall dimension
1. Weight and size of foundation
2. Suction Temperature C
3. Discharge Temperature C
4. Capacity at operating conditions
5. Maximum capacity available
6. R P M
7. Refrigerant quantity
8. Minimum capacity (% of full load capacity)
9. BHP at operating conditions & at max. Capacity
10. Operating pressure
11. Recommended motor sizes for operating & max capacity

B. AIR COOLED CONDENSER

1. Manufacturer
2. Model No.
3. Type of tube
4. Tube material
5. Tube Dia mm
6. Tube surface area M²
7. Tube thickness
8. No. of tubes

C. FAN SECTION

1. Type of fan
2. Air quantity M^3 / hr
3. Total pressure mm.
4. Fans speed RPM (normal / critical / maximum)
5. Fan motor HP (connected / consumed)
6. Fan efficiency
7. Drive efficiency
8. Total efficiency
9. Outlet velocity FPM
10. Fan dia mm.
11. Material of construction
12. Static pressure MM WG
13. Bearings (type / make)

D. COOLING COIL

1. Coil fin and tube material and fin spacing mm.
2. Grand total heat capacity Kcal / hr.
3. Air quantity through coil
4. Entering air temperature DB
5. Entering air temperature WB
6. Leaving air temperature DB
7. Leaving air temperature WB
8. Pressure drop mm Air side
9. Face area m^2
10. Rows deep

E. FILTER SECTION

1. Manufacturer
2. Gross filter area M^2
3. Velocity through filter FPM.
4. Pressure drop WG(initial)
5. Maximum pressure drop WG

6. Efficiency
7. Filter media
8. Frame work material

F. PIPES AND FITTINGS (REFRIGERANT)

1. Manufacturer
2. Class
3. Material

G. VALVES (REFRIGERANT SIDE)

1. Manufacture
2. Type (Ball / Butterfly)
3. I. S. I. marked
4. Pressure drop

H. ELECTRIC MOTORS

(Note: Submit the following data for Compressor, AHU, Blower and motors separately)

1. Manufacture
2. Model No. & frame size
3. Rated output H. P.
4. Range of working voltage
5. Rated speed RPM
6. Full load current amps.
7. Class of insulation
8. Temperature
9. Effi. & P. F. at 100 % & 75 % load with each motor
10. Static & dynamic load
12. Degree of protection
14. Starting torque

I. INSULATION (Thermal / Acoustic / Underdeck / False ceiling)

1. Manufacture
2. Material of virgin nature
3. 'K' value at 10^o C means temperature
4. Thickness
5. Density
6. Fire retardant property

STRIKE OUT WHICHEVER IS NOT APPLICABLE

4. FACTORY ACCEPTANCE TEST FOR ALL BOUGHT OUT ITEMS

Client, his consultant and their authorized representative shall have the right to inspect and test or get inspected and tested the goods at the works of the Seller or its sub suppliers any time during manufacture and prior to dispatch and to inspect within a reasonable time after arrival of goods at the ultimate destination and during and after erection, testing and commissioning. The goods shall not be deemed accepted until after the said inspection, testing and commissioning and signing of the Acceptance Certificate. Failure to make any inspection of or payment for or acceptance of goods shall in no way impair client right to reject non-conforming goods or to avail itself of any other remedies to which client may be entitled, notwithstanding client knowledge of the nonconformity, its substantiality in the case of its discovery. In the event of failure of Seller to remove the rejected goods within the time allowed, client shall have the right to dispose of the same at the seller's risk and cost. During the time the rejected goods lie with client awaiting removal by the seller, they will so lie at the seller's risk. All goods rejected by client after receipt at the destination shall be removed by the seller within a reasonable time allowed by client, not exceeding 30 (thirty) days at seller's expense and risk.

The Seller will permit client Inspectors, Consultant and their authorized representatives free access during normal working hours to his works, godown, storage or loading spot etc. and will give them all necessary assistance to perform their task including free use of all accessories, testing and control instruments. The seller shall ensure that the same facilities are granted by his sub-suppliers.

Unless specifically stated to the contrary in the order, all expenses relevant to the preparation and performance of testing, inspection and preparation of any test reports or certificates shall be borne by the Seller EXCEPT for the salaries, fees, travelling, lodging and boarding expense of the Consultant's / client's representatives. However, if the visit duration of UCJ / client's representatives is extended for the reasons not attributable to UCJ / client, the cost of the extended period of visit shall be borne by the seller.

The sellers shall carry out tests related to performance tests as described in the specifications and specified in the order. All such performance tests shall be at supplier costs. Supplier shall also provide all the tests certificates and documents as demanded by the Inspector for his satisfaction that the order has been executed as per PO specifications. All such certificates, documents in original shall be submitted to the Client before dispatch of material. The goods shall be

dispatched from suppliers shop only after written confirmation from clients / or its authorized representative.

The contractor shall consider all cost towards inspection of goods by consultant / EIC at factory / manufacturers works prior to shipping for 2 persons. (travelling (Air / 1st AC) / stay etc complete)

5. SAFETY CODE

1.0 Suitable scaffolds shall be provided for workmen for all work that cannot safely be done from the ground, or from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used an extra labour shall be engaged for holding the ladder and if the ladder is used for carrying materials as well suitable footholds and handhold shall be provided on the Ladder and the ladder shall be given an inclination not steeper than 1/4 to 1 (1/4 horizontal and 1 vertical).

1.1 Safe means of access shall be provided to all working platform and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 meters in length. Width between side rails in a rung ladder shall in no case be less than 30 cm. for ladders upto and including 3 meters in length. For longer ladders this width shall be increased at least 6 mm. for each additional 30 cm. of length. Uniform step spacing shall not exceed 30 cm.

Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites shall so stacked or placed as to cause danger or inconvenience to any person or the public. The contractor shall provide all necessary fencing and lightest to protect public from accidents and shall be bound to bear expenses of defense of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and costs which may be awarded in any such suit, action or proceedings to any such person or which may with the consent of the contractor be paid to compromise any claim by any such person.

1.2 Demolition: Before any demolition work is commenced and also during the process of the work:-

a) All roads and open areas adjacent to the work site shall either be closed or suitably protected.

b) No electric cable or apparatus, which is liable to be a source of danger over a cable or apparatus used by operator, shall remain electrically charged.

c) All practical steps shall be taken to prevent danger to persons employed, from risk or fire or explosion or flooding. No floor, roof, or other part of a building shall be so overloaded with debris or any materials as to render it unsafe.

1.3 All necessary personal safety equipment as considered adequate by the Engineer-in-charge shall be available for use of persons employed

on the site and maintained in a condition suitable for immediate use; and the contractor shall take adequate steps to ensure proper use of equipment by those concerned.

- a) Those engaged in handling any material, which is injurious to eyes, shall be provided with protective goggles.
- b) Those engaged in welding works shall be provided with welder's protective shields.
- c) Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.
- d) The contractor shall not employ male or female labour below the age of 18 years.

1.4 When work is done near any place where there is risk of drowning, all necessary equipment shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

15 Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following:

- a)
 - i. These shall be of good mechanical construction, sound material and adequate strength and free from patent defects and shall be kept in good repair and in good working order.
 - ii. Every rope used in hoisting or lowering materials or as a means suspension shall be of durable quality and adequate strength, and free from patent defects.
- b) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years shall be in charge of any hoisting machine including any scaffold winch or give signals to operator.
- c) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or lowering or as means of suspension, safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with safe working load. In case of a hoisting machine having a variable safe working load, each safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or of any gear referred to above in this paragraph shall be loaded beyond safe working load except for the purpose of testing.

- d) In case of a departmental machine, safe working load shall be notified by the Engineer-in-charge. As regards contractor's machines the contractor shall notify safe working load of each machine to the Engineer-in-charge whenever he brings it to site work and get it verified by the Engineer-in-charge.
- 1.6 Motors gearing, transmission, electric wiring and other dangerous parts of hoisting appliances shall be provided with efficient safeguards; hoisting appliances shall be provided with such means as will reduce to the minimum risk of accidental decent of load adequate precautions shall be taken to reduce to the minimum risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energized, insulating mats working apparel such as gloves, sleeves and boots as may be necessary, shall be provided. Workers shall not wear any rings, watches and carry keys or other materials, which are good conductors of electricity.
- 1.7 All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in a safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities shall be provided at or near places of work.
- 1.8 These safety provisions shall be brought to the notice of all concerned by display on a notice board at a prominent place at the work spot. Persons responsible for ensuring compliance with the safety code shall be named therein by the contractor.
- 1.9 To ensure effective enforcement of the rules and regulations relating to safety precautions, arrangements made by the contractor shall be open to inspection by the Engineer-in-charge or his representatives and the Inspecting Officers.
- 1.10 Notwithstanding the above conditions 1 to 14 the contractor is not exempted from the operation of any other Act or Rule in force.
- 1.11 If the height at which the contractor is working is more than 12 feet then the staff should wear safety helmet and tie himself with softy belt, client/ architect have all right to ask the contractor to stop wire if the safety condition are not fulfilled.

6. TESTING OF INSTALLATION

7.0 SCOPE

This chapter describes the details of tests to be conducted in the completed internal electrical installations, before commissioning.

7.1 GENERAL

7.1.1 Tests

On completion of installation, the following tests shall be carried out:-

- 1) Insulation resistance test.
- 2) Polarity test of switch.
- 3) Earth continuity test.
- 4) Earth electrode resistance test.

7.1.2 Witnessing of tests

Testing shall be carried out for the completed installations, in the presence of and to the satisfaction of the Engineer-in-charge by the contractor. All test results shall be recorded and submitted to the Department.

7.1.3 Test instruments

All necessary test instruments for the tests shall be arranged by the contractor if so required by the Engineer-in-charge.

7.2 INSULATION RESISTANCE

7.2.1 The insulation resistance shall be measured by applying between earth and the whole system of conductors, or any section thereof with all fuses in place, and all switches closed, and except in earthed concentric wiring, all lamps in position, or both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure, provided it need not exceed 500 volts for medium voltage circuits. Where the supply is derived from a three wire D.C, or a polyphase A.C. system, the neutral pole of which is connected to earth either directly or through added resistance, the working pressure shall be deemed to be that which is maintained between the phase conductor and the neutral.

7.2.2 The insulation resistance shall also be measured between all the conductors connected to one pole, or phase conductor of the supply, and all the conductors connected to the neutral, or to the other pole, or phase conductors of the supply with all the lamps in position and switches in "off" position, and its value shall be not less than that specified in sub-clause 16.2.3.

7.2.3 The insulation resistance in mega ohms measured as above shall not be less than 12.5 mega ohms for the wiring with PYC insulated cables,

subject to a minimum of 1 mega ohm.

- 7.2.4 Where a whole installation is being tested, a lower value than that given by the formula, subject to a minimum of 1 mega ohm, is acceptable.
- 7.2.5 A preliminary and similar test may be made before the lamps etc. are installed, and in this event the insulation resistance to earth should not be less than 25 mega ohms for the wiring with PVC insulated cables, subject to a minimum of 2 mega ohms.
- 7.2.6 The term "outlet" includes every point along with every switch, except that a switch combined with a socket outlet, appliance or lighting fitting is regarded as one outlet.
- 7.2.7 Control rheostats, heating and power appliances and electric signs may, if required, be disconnected from the circuit during the test, but in that event the insulation resistance between the case or frame work, and all live parts of each rheostat, appliance and sign, shall be not less than that specified in the relevant Indian Standard Specifications, or where there is no such Specification, shall be not less than one mega ohm.

7.3 POLARITY TEST OF SWITCH

- 7.3.1 In a two wire installation, a test shall be made to verify that all the switches in every circuit have been fitted in the same conductor throughout, and such conductor shall be labeled or marked for connection to the phase conductor, or to the non-earthed conductors of the supply.
- 7.3.2 In a three wire or a four wire installation, a test shall be made to verify that every non-linked single pole switch is fitted in a conductor which is labeled, or marked for connection to one of the phase conductors of the supply.
- 7.3.3 The installation shall be connected to the supply for testing. The terminals of all switches shall be tested by a test lamp, one lead of which is connected to the earth. Glowing of test lamp to its full brilliance, when the switch is in "on" position irrespective of appliance in position or not, shall indicate that the switch is connected to the right polarity.

7.4 TESTING OF EARTH CONTINUITY PATH

The earth continuity conductor, including metal conduits and metallic envelopes of cables in all cases, shall be tested for electric continuity. The electrical resistance of the same along with the earthing lead, but excluding any added resistance, or earth leakage circuit breaker, measured from the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not

exceed one ohm.

7.5 MEASUREMENT OF EARTH ELECTRODE RESISTANCE

7.5.1 Two auxiliary earth electrode, besides the test electrode, are placed at suitable distance from the test electrode (see figure 14). A measure current is passed between the electrode 'A' to be tested and an auxiliary current electrode 'C', and the potential difference between the electrode 'A' and auxiliary potential 'B' is measured. The resistance of the test electrode 'A' is then given by:

$$R=V/I$$

Where,

R - Resistance of the test electrode in ohms,

V - Reading of the voltmeter in volts.

I - Reading of the ammeter in amps.

7.5.2 (i) Stray currents flowing in the soil may produce serious errors in the measurement of earth resistance. To eliminate this, hand driven generator is used.

(ii) If the frequency of the supply of hand driven generator coincides with the frequency of stray current, there will be wandering of instrument pointer. An increase or decrease of generator speed will cause this to disappear.

7.5.3. At the time of test, the test electrode shall be separated from the earthing system.

7.5.4 The auxiliary electrodes shall be of 13 mm diameter mild steel rod driven upto 1 m into the ground.

7.5.5 All the three electrodes shall be so placed that they are independent of the resistance area of each other. If the test electrode is in the form of a rod, pipe or plate, the auxiliary current electrode 'c' shall be placed at least 30 m away from it, and the auxiliary potential electrode 'B' shall be placed mid-way between them.

7.5.6 Unless three consecutive readings of test electrode resistance agree, the test shall be repeated by increasing the distance between electrodes A and C upto 50 m, and each time placing the electrode B midway between them.

7.5.7 On these principles, "Megger Earth Tester", containing a direct reading ohm-meter, a hand driven generator and auxiliary electrodes are manufactured for direct reading of earth resistance of electrodes.

7.6 TEST CERTIFICATE

On completion of an electrical installation (or an extension to an installation), a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in

the prescribed form as given in Appendix 'E' in addition to the test certificate required by the local Electric Supply Authorities.

7. FORM OF COMPLETION CERTIFICATE

I/We certify that the installation detailed below has been installed by me/us and tested and that to the best of my/our knowledge and belief it complies with Indian Electricity Rules, 1956, as well as the C.P.W.D. General Specifications of Electrical Works 2004.

Electrical installation at _____

Voltage and system of supply _____

1. Particulars of work:

a) No.	Internal Electrical Installation	Total Load:	Type or system of wiring
--------	----------------------------------	-------------	--------------------------

- i) Light point
- ii) Fan point
- iii) Plug point
 - a) 3 pin 5 Amp.
 - b) 3 pin 15 Amp.

b) others

Description	Hp/KW	Type of Starting
-------------	-------	------------------

- | | | |
|------------|------|--|
| a) Motors: | i) | |
| | ii) | |
| | iii) | |

b) Other plants:

c) If the work involves installation of overhead line and/or underground cable.

d) i) Type & description of overhead line.

ii) Total length and no. of spans.

iii) No. of street lights and its description.

b) i) Total length of underground cable & its size.

ii) No. of joints: End joint:

Tee joint:

St. through joint:

- II) Earthing
 - i) Description of earthing electrode.
 - ii) No. of each electrodes.
 - iii) Size of main earth lead.

- III) Test results:
 - a) Insulation resistance
 - i) Insulation resistance of the whole system of Conductors to earth Mega ohms
 - ii) Insulation between the phase conductor and neutral

Between Phase R and neutral	-	- Mega ohms
Between Phase Y and neutral	-	-Mega ohms
Between Phase B and neutral	-	-Mega ohms
 - iii) Insulation resistance between the phase conductors in case of polyphase supply.

Between Phase R and Phase Y -	-	Mega ohms
Between Phase Y and Phase B -	-	Mega ohms
Between Phase B and Phase R -	-	Mega ohms

 - a. Polarity test

Polarity of won linked single pole branch switches.

 - b. Earth continuity test

Maximum resistance between any point in the earth continuity conductor including metal conduits and main earthing
.....Ohms

 - c. Earth electrode resistance

Resistance of each earth electrode

 - i) - - - - Ohms

- ii) - - - - Ohms
- iii) - - - - Ohms
- iv) - - - - Ohms

d. Lighting protective system

Resistance of the whole of lighting protective system to earth before any bonding is effected with earth electrode and metal in/on the structure.....

Signature and name of the Contractor

8. SPECIAL CONDITIONS OF CONTRACT

9.0 GENERAL

The complete Electrical Installation shall be carried out in strict accordance with the regulations of the electricity supply authority, Institution of Electrical Engineers, ISI Standards, fire Insurance Company insuring the building and national code of practice.

The standard conditions of contract are meant to amplify the specifications, schedule of quantities and drawings and the more stringent of the above shall apply should there be any ambiguity or inconsistency. The contractor should report the same to the Architect/Consultant and obtain clarification before submitting his tender.

All Equipments, cables etc. shall be adequately rated to suit the climatic conditions experienced in this country.

Clause in this specification shall apply equally throughout.

9.1 ORDERING

As soon as possible after the contractor receives written notification of the acceptance of his tender he shall order all the materials and equipment required to complete the contract. He shall submit to the consultant the detailed summary of all the orders placed, providing the details about the name of Supplier/Vendor, make of equipment, date of order and forecast of delivery date at site.

9.2 STANDARD OF MATERIALS

When the material and equipment is specifically described named in the specifications, it is so named or described for the purpose of establishing a standard of materials and workmanship to which the contractor must adhere. The Contractor must quote with the material as listed in the make of materials list attached later in the document. The Contractor may submit with his tender a list indicating any alternative make of material that he proposes to install. Before installing such a make the contractor shall take permission from the consultant. All materials condemned by the consultant as not approved for use are to be removed from the premises and suitable material shall be delivered and installed in their place at the expense of the Contractor. If alternatives are not offered during the tender stage then the contractor will be deemed to have submitted his tender based on all materials and equipment specified or shown on the drawings and therefore no alternative manufacturer or supplier of such material and equipment specified or shown will be considered after the contract is

awarded if however the material or equipment specified or shown on the drawing is not available due to any genuine reason. The contractor shall prior to order get the written approval of the consultant for the particular material/equipment.

The Contractor shall be responsible for the safe custody of all material and shall insure them against theft damage by fire earthquake etc. A list of materials and equipment together with a sample of each shall be submitted to the consultant as directed by him within 30 days of the award of the contract.

All materials required for the works shall be new and the best of their respective kinds and shall be of uniform pattern. All materials shall be suitable for use in temperatures of 50°C with comparative humidity.

The protective finishes detailed as follows must be provided on all materials and apparatus used on this contract to ensure that no deterioration is caused by the local climatic conditions.

All materials shall be inspected by the Contractor to ensure that finishes are in accordance with this specifications.

- A. The interior fittings in all distribution boards and control units shall be properly painted.
- B. All holes in distribution boards and similar equipment shall be blanked off to protect from dust and vermin where ventilation is necessary holes are to be neatly covered.
- C. All cable entry holes on switchgears and similar equipment shall be fitted with PVC/Rubber Bushings.

The material supplied by the client or other agencies shall be properly inspected by the contractor before accepting so that any damage thereafter is the liability of the contractor.

9.3 WORKMANSHIP

The workmanship and method of installation shall confirm to the best standard practice. All work shall be performed by skilled tradesman to the satisfaction of the Consultant/Architects. Helpers shall have qualified supervision.

Any work that in the opinion of the consultant does not confirm to the best standard practice shall be removed and reinstated at the Contractor's expense permits certificates and licenses must be held by all tradesman for the type of work in which they are involved where such permits certificates and licenses exist under government legislation.

9.4 PROCEDURE

Throughout all stages of work the contractor shall maintain a close liaison with the consultant and with all other contractors involved in the work.

Site work shall commence immediately with the start of building work and shall proceed expeditiously in harmony with the building work so as not to delay the latter in any way. All plant to be supplied and work to be done under this specification shall be manufactured and executed in the manner set out in this specification or where not so set out the reasonable satisfaction of the consultant and all the contractor's works on site shall be carried out in accordance with the such reasonable directions as the consultant may give.

The contractor in the interest of the work shall furnish a bar chart based on the chart furnished by the civil contractor stating all the starting and completion dates clearly in the format that consultant approves or in the format of the civil bar chart.

The contractor shall also furnish the time chart showing the material procurement marking the ordering date and the delivery date of the material on site. In case of delay in delivery of material at site the contractor may be asked to furnish proper reason for the delay.

The contractor if at all feels necessary shall attach the drawing schedule requirements with the tender documents.

9.5 PERMITS

The Contractor shall obtain all necessary permits prior to work commencement for the excavation of cable trenches etc. in the areas where it is suspected that existing services are present the contractor shall carry out excavation work by hand. He shall also obtain the necessary permits from the respective authorities prior to working on major items of the switchgear. All application permits shall be made in writing with a copy to the consultant.

9.6 TEMPORARY AND TRIAL USAGE

It shall be understood and agreed that temporary and trial usage by the employer of any device, machinery, apparatus, equipment or any other work or materials supplied under this contract before final completion and written acceptance of the item by the employer it is further understood and agreed that the employer shall have privilege of such temporary and trial usage as soon as the contractor shall claim

that the said work is completed and in accordance with the drawings and specifications and to the manufacturer's instructions and for such reasonable length of time as the consultant shall deem suitable for making a complete and thorough test of the apparatus or system under test.

No claim for the damage will be made by the contractor for the injury to or breaking of any parts of the works which have been placed under test whether this damage has been caused by weakness, flaw or inaccuracy of structural parts or by defective material or workmanship of any kind whatsoever.

9.7 CLEANING

Before operating any of the systems the contractor shall clean out all rubbish and dirt upon completion of the contract the contractor shall ensure that all items of plant are left in a clean and tidy condition.

9.8 SETTING OUT OF WORKS

The specification and schedule of rates shall be considered as part of this contract and any work materials shown on the schedule and not called for in the specifications or vice-versa shall be executed as if specifically called for in both.

The Contractor at his own expense shall set out all his hardworks and take all his measurements and dimensions required for the erection of his materials on site making and modifications in detail to the consultant before proceeding and must allow in his tender for all such modifications and for the provision of any sketches or drawings related there to.

The position of all DB's Panels, Cable routes, fixtures, Wiring Systems, Service Outlets and control Switches shown on the drawings are to be assumed as being correct for the purpose of tendering final positions of these must be agreed with the consultant before installation.

The data given here in and on the drawings is as exact as could be secured but its complete accuracy is not guaranteed. The drawings are for the guidance of the contractor, exact locations, distances and levels will be governed by the site conditions.

9.9 AS BUILT DRAWINGS / SHOP DRAWINGS

Contractor shall make all necessary shop drawings indicating conduit / cable tray routes / qtys / sizes; cable schedule, circuiting details etc complete before starting the works and get approval of consultant / EIC.

At the completion of the works and before issue of the certificate of virtual completion, the contractor shall submit to the consultant 4 sets (HARD AND SOFT FORMAT) of layout drawings drawn at approved scale indicating the complete wiring system as installed. These drawings must provide the following minimum information :

- A. Run and size of conduits, inspections, junction and pull boxes.
- B. Size of conductors in the conduits.
- C. Location and rating of sockets and switches controlling the light and power outlets.
- D. Location and details of distribution boards, mains, switches, switchgear, main panel and other particulars.
- E. A complete wiring diagram, as installed and schematic drawings showing all connections in the complete electrical system.
- F. Location of outlets, junction boxes, sizes of various conduits for telephones.
- G. Location of all earthing stations, routes, sizes of all earthing conductors, manholes, layout of earth link strips, etc.
- H. Layout and particulars of all cables.
- I. Necessary drawings with prints for approvals from local / govt. authorities.

Above indicates the general requirement. However, contractor must include all information desired by the client and Architects/Consultants in the final as built documents. Guidance for the preparation of as built document shall be had from the consultant.

9.10 MANUFACTURER'S INSTRUCTIONS

Where manufacturer's have furnished specific instructions, relating to the materials used in this job for covering, paints etc which are not specifically mentioned in this documents, manufacturer's instructions shall be followed.

9.11 GUARANTEE.

At the close of the work and before issue of the final certificate of virtual completion. The contractor shall furnish written guarantee indemnifying the Architect/Consultant against defective materials and workmanship for a period as mentioned in the schedule of fiscal aspects. The contractor shall hold himself fully responsible for reinstallation or replacement, free of cost to client the following :

- A. Any defective work or material supplied by the Contractor.
- B. Any material or equipment damage or destroyed as a result of defective workmanship by the Contractor.

9.12 SAFETY OF MATERIAL

The Contractor shall provide proper and adequate storage facilities to protect all materials and equipment, including those issued by the owner against damage from any cause whatsoever.

9.13 COMPLETION CERTIFICATE

On completion of the Electrical Installation a certificate shall be furnished by the Contractor counter signed by the licensed supervisor, under whose direct supervision the installation was carried out. The certificate shall be in the prescribed form as required by the local authority. The contractor shall be responsible for getting the Electrical installation inspected and approved by the local authorities connected.

9.14 ENGINEER AND FOREMAN

The Contractor shall employ a competent fully licensed, qualified full time electrical Engineer and foreman to direct the work of Electrical Installation in accordance with drawings and specification. The foreman shall be available full time on site to receive instruction from Architect/Consultant or his nominee in the day to day activities throughout the duration of the contract the foreman shall correlate the progress of work in connection with all relevant requirements of the supply authorities.

9.15 LIASIONING WITH LOCAL SUPPLY COMPANY

The contractor shall be responsible for all the liaisoning work with the supply company. However, all the technical assistance required for the same may be furnished by the consultant. The contractor has to fill the necessary forms and submit test reports so as to ensure that the supply is available in time. The contractor shall prepare necessary drawings for the approval of the concern government departments and has to get the necessary permissions for supply and D.G. sets etc.

9.16 SPECIFICATIONS AND SCHEDULE

The specification and schedule of rates shall be considered as part of this contract and any work or materials shown on schedule and not called for in this specifications or vice versa shall be executed as if specially called for in both. The drawings indicate the extent and general arrangement of the fixtures, controlling switches, wiring system etc. and are essentially diagrammatic. The drawing indicates the points of termination of conduit runs and are suggestive of the routes to be followed.

9.17 SUPERVISION

Supervision shall be by a competent person experienced in the nature of the work to be undertaken. This person shall be available on site for the full period of works. The Engineer may demand at any time during the contract the replacement of the contractors personnel who fails to satisfy this requirement of competent.

9.18 TOOLS AND EQUIPMENTS

The Contractor shall provide all necessary Jointing Equipment, tools, Portable power tools, test equipment etc which will be required to carry out the Electrical work. All the zarri work, except in unavoidable circumstances, shall be done with a zarri cutter.

This includes all heavy duty equipments such as Cranes, lorries, etc. for site delivery and fixing.

The contractor must have minimum following instruments :

- 1) 1000 / 500 V Meggar.
- 2) Clip on meter.
- 3) Earth tester.
- 4) Lux meter.
- 5) Zarri Cutter.
- 6) Multi Meter.
- 7) Drill machine upto 25 mm dia.
- 8) Ladders suitable for 30 ft. and above.
- 9) All safety equipments like helmet, safety rope etc.
- 10) Complete set of spanners, screw drivers etc.

9.19 SITE STORAGE

The contractor shall be responsible for the safe storage of materials on site. This includes ensuring that all equipment is handed to the client in sound undamaged order.

The Contractor shall be responsible for safe storage of materials on site, and liable for their replacement. The Contractor would be required to maintain a watch man on site on this shall remain Contractors Choice.

9.20 SPARES

The Contractor shall prepare a schedule of manufactures recommended for spares for one year maintenance.

9.21 OPERATING AND MAINTENANCE MANUALS

The Contractor shall furnish two sets of operating manuals which shall include services maintenance instructions and circuit diagram for each item of equipment.

9.22 SITE CONDITIONS

The Contractor shall take all necessary action to acquaint himself fully with site conditions. Any conditions at tendering stage will not be accepted.

After the contract is awarded the Contractor shall acquaint himself fully with existing services and obtain all necessary information to avoid any damage to the services during excavation etc.

9.23 LABELS AND NOTICES

On all switchgear identification name plates shall be fitted these will identify the substation and/ or out going ways. The labels shall be made on indestructible non deteriorating material with lettering engraved in black or white background except where otherwise specified. Fixing shall be by means of rivets or screws in addition to any adhesive. all labels shall be English/Hindi /mother language as directed by the Consultant. All pillars and mini feeder pillars in addition to identification labels shall have each way identified by a label to the same specification fitted in the feeder pillar. An indestructible "Danger 415 volts" plates should be fitted externally with a double flush danger signal. The letters to be 12 MM height minimum in signal red.

In addition each distribution board shall have a typed chart detailing particulars of the circuits controlled which shall be fixed to the inside of the door. The details shall include the circuit load, description, the type

and rating of the protection device, and the cable size. A sheet of transparent rigid plastic shall be used to completely cover the chart to prevent damage.

9.24 PACKING AND RECEIPT OF MATERIAL.

The contractor shall take every possible measure including appropriately strong packing, proper supervision of loading and off loading and proper transportation by the most suitable route to ensure the safe delivery to site of plant and equipment. The Contractor shall keep at site up-to-date record of all materials received and fully annotated with details of the carrier and condition of equipment on arrival.

9.25 RECORDING OF WORK

The contractor shall keep a diary and a set of drawing recording the progress of the works and details of all instruction received. These shall be available for the consultant upon request. The contractor's site representative will submit a written report every two weeks outlining the progress of the work including work completed to date. The review of the work completed and the bar chart submitted shall be done weekly and the difference in the two shall be submitted to the Consultant specifying the reasons for the difference.

On completion of work the contractor has to submit detailed reconciliation statement of all electrical materials. The loss of material shall be recovered at prevailing market rate for the material supplied by the client or other agency.

The contractor shall take permission from the employer before he takes all the unused material from the site on completion of work.

9.26 MARKING OUT

Routes and positions of systems, and positions of all electrical equipment shall be marked out by the contractor and approved by the Engineer before such items are installed.

These items shall be installed in the positions shown on the drawings, but reasonable variations may be made on site with the consent of Engineer.

9.27 FIXING

Screws fixing brick concrete or similar materials which necessitates plugging shall be made using steel woodscrews into plugs in rotary drilled holes.

Items of switch fuse gear, cable racks and trays etc. shall be fixed using corrosion resistant steel bolts fitted with expanding collars, e.g. 'Anchor Fastner' set into rotary drilled holes of the correct size all such bolts shall be provided with one number wide flange washer and one heavy spring washer.

9.28 CONTRACTORS RATES

The Contractors rates must be included the cost of transportation of materials to the site. All taxes such as sales tax, Excise and Octroi etc. and the fixing or placing in position for which the items of work is intended to be operated.

The contractor shall quote in English, in words and figures, the amount tendered by him in the Form of Schedule of rates forming part of the tender document in such a way that interpolation is not possible. The amount for each item shall be worked out and entered and requisite totals given for all items. The tendered amount for the work shall be entered in the Tender and duly signed by the tenderer.

The contractor shall include in rates quoted all expenses (travelling / lodging / boarding) for inspection of goods at manufacturers workshop for two persons from client / consultants office.

If some discrepancies are found between the rates in words and figures or the amounts shown in the tender following procedure shall be followed :

- a) When there is difference between the rates in figures and words, the rate in words shall be taken as correct.
- b) When the rate quoted by the tenderer in figures and words, tallies, but the amount is incorrect, the rate quoted by the tenderer shall be taken as correct.
- c) When it is not possible to ascertain the correct rate, in the manner prescribed above, the rate as quoted in the words shall be adopted.

The contractor shall be liable to furnish the rate analysis for the rates quoted by them, if the architect/consultants find the rates to be non workable and ask for the analysis.

Labour rates not quoted for the items / or rates for extra items shall be decided 15 days prior to the start of the work as per the procedure listed in schedule of fiscal aspects. However, looking to the urgency of the work, if it is required to execute the item without the settlement of rate, then the rate for the same item will be finalised before making the payment.

9.29 ARCHITECTS / CONSULTANTS DECISIONS

Matters not covered by the specification given in the contract as a whole shall be covered in the relevant ISI codes. If such codes for a particular subject have not been framed, the decision of the Architect/Consultant shall be final.

The work shall be carried out under the direction and supervision of the architect / consultant or their representative at site who shall guide the representative of contractor from time to time. On acceptance of the tender, the contractor shall intimate the name of the representative who would be supervising the construction and would be responsible for taking instructions for carrying out the work.

The Architects / consultants or their representative at site shall have access to the workshops of the successful tenderer so as to ensure themselves of the quality of material and workmanship.

The Architects / Consultants decision with regard to the quality of material and workmanship will be final and binding any material rejected by the Architect / Consultant shall be immediately removed by the contractor.

9.30 DEFECTS LIABILITY PERIOD

This period of 12 months, shall be in force from the date of "Virtual completion" and minor defects if any shall be corrected / rectified within 24 hours and major defects within 3 days which shall develop during this period. However, if the same are not rectified by the Contractor within the period mentioned above the clients with the concurrence of the Architects shall get the work done at the risk and the cost of the Contractor.

9.31 OCCUPYING PART AREAS

If the owner wants to occupy areas in part, the Contractor shall have to complete the work of these areas in consultation with the owner and handover the same to the employer without affecting any of the clause of the contract agreement.

9.32 TEMPORARY WIRING

Whenever any temporary wiring is done, it has to be done so that all precautions for safety are taken and temporary wiring shall be done so that, it is not hazardous to anybody. Any accident due to temporary or permanent wiring or installation shall be the responsibility of the contractor and compensation shall be paid by the contractor to all the concerned.

9.33 DEPOSITS AND PAYMENTS

Earnest Money Deposit along with Security Deposit, as specified in schedule of fiscal aspects, has to be deposited with the employer in the form of draft in the name of the client, for the fulfilment of contract. Besides EMD and security deposit, retention money at the rate of 5% of the value of each bill but up to maximum of 2.5% of the contract value shall be deducted (cash) from each running bill.

On the Architects certificate of virtual completion of the works, the contractor would be paid 50% of the above mentioned amount and the remaining 50% will be released after the rectification of the defects, if any, pointed out during the defects liability period.

The contractor can have mobilization advance of 5% of the contract value against Bank Guarantee of the same amount till the defects liability period expires. The mobilization advance will be deducted at the rate of 20% (of the mobilization advance) from each running bill till total deductions are done. 75% of the value of the contract shall be raised by contractor in parts as running bills the value of which shall not be less than 15% of the contract value. 10% of the contract value shall be paid on commissioning of the installation. 10% of the contract value shall be paid on submission of as built drawings, test certificates and Final Bill.

For the material to be procured by the contractor please refer to the mode of payment sheet attached in the document.

LIST OF APPROVED MAKES

Sr. No.	COMPONENT	APPROVED MAKE
1	FLOAT GLASS	MODI GUARD/INDOASAHI/ SAINT GOBAIN
2	RESIN BASED ADHESIVE	FEVICOL/VAMICOL/BLUE COURT
3	PIN UP BOARD	SINTATEX/ALKOSIGN
4	SS/CHROME COATED HARDWARE	EBCO/DOREST/ARKAY
5	LAMINATE	FORMICA/DECOLAM/MERINO GREEN LAM/ASIS/SUNMICA
6	VENEER	GREEN/CENTURY/NATURAL
7	ALUMINIUM ALLOY EXTRUDED SECTION	HINDALCO/INDALCO
8	POST FORM BOARD	MERINO/FORMICA/SUNMICA
9	LOCKS	GODREJ/DORSET
10	PIVOTS, HANDLE BARS ETC	DORMA/DOREST
11	PRE LAMINATED PARTICLE BOARD	NOVAPAN/KITLAM/MERINO
12	PLAIN FALSE CEILING	GYPROC (SAINT GOBIN) OR AS APPROVED BY CONSULTANT GYP STEEL ULTRA - WITH COMPANY SECTION / SPECIFICATIONS ONLY- IT SHALL BE EXECUTED BY COMPANYS AUTHORISED APPLICATOR & CERTIFICATE FROM THE COMPANY SHALL BE ATTACHED WITH FINAL BILL
13	GRID FALSE CEILING	GYPROC (SAINT GOBIN), ARMSTRONG OR AS APPROVED BY CONSULTANT WITH COMPANY SECTION / SPECIFICATIONS ONLY- IT SHALL BE EXECUTED BY COMPANYS AUTHORISED

- APPLICATOR & CERTIFICATE FROM THE COMPANY SHALL BE ATTACHED WITH FINAL BILL
- 14 ACOUSTIC PANELLING WITH FABRIC FINISH
- ARMSTRONG, SAINT GOBIN OR AS APPROVED
BY CONSULTANT WITH COMPANY SECTION / SPECIFICATIONS ONLY- IT SHALL BE EXECUTED BY COMPANYS AUTHORISED APPLICATOR & CERTIFICATE FROM THE COMPANY SHALL BE ATTACHED WITH FINAL BILL
- 15 ACOUSTIC PANELLING WITH LAMINATE FINISH
- ARMSTRONG, SAINT GOBIN OR AS APPROVED
BY CONSULTANT WITH COMPANY SECTION / SPECIFICATIONS ONLY- IT SHALL BE EXECUTED BY COMPANYS AUTHORISED APPLICATOR & CERTIFICATE FROM THE COMPANY SHALL BE ATTACHED WITH FINAL BILL
- 16 WOOD-EXTERNAL WOOD
- STEAM BEACH, TEAK WOOD OR AS APPROVED BY CONSULTANT 1ST QUALITY IMPORTED, 95% IN EVEN COLOR WITHOUT KNOTS, JOINTS & BEND WOOD
- 17 WOOD-INTERNAL WOOD
- MARANDI 1ST QUALITY IMPORTED,

		95% IN EVEN COLOR WITHOUT KNOTS, JOINTS & BEND WOOD OR AS APPROVED BY CONSULTANT
18	TEAK WOOD FOR TABLE TOP	TEAK WOOD OR AS APPROVED BY CONSULTANT 1ST QUALITY IMPORTED, 95% IN EVEN COLOR WITHOUT KNOTS, JOINTS & BEND WOOD
19	MOLDING/BENDING	STEAM BEACH, TEAK WOOD OR AS APPROVED BY CONSULTANT 1ST QUALITY IMPORTED, 95% IN EVEN COLOR WITHOUT KNOTS, JOINTS & BEND WOOD
20	PLY WOODS & BLOCK BOARD	
	a. BLOCK BOARD	SAMRAT/CENTURY SAINEK/ARCHED CLASSIC PLY
	b. PLY WOOD	SAMRAT/CENTURY SAINEK/ARCHED CLASSIC PLY
21	FINISH	
	a. POLISH	ASIAN MELAMINE/MRF MELAMINE
	b. PAINTS	ASIAN PAINTS/ICI/NEROLAC
22	ROLLAR BLIND	VISTA/AROLEX/MARVEL
23	CARPET	UNITEX/ROSETTA/BAJAJ
24	PVC FLOORING	WONDER FLOOR/POLY FLOOR/TUSKER

LIST OF APPROVED MAKES

Sr. No.	COMPONENT	APPROVED MAKE
<u>ELECTRICAL MAKE LIST</u>		
1	Rigid PVC Conduit & Accessories	1.5 mm thick Rigid PVC Conduit. Precision Plastic, polycab, Vraj, Nihir
2	Copper Conductor PVC Coated Flexible Wires.(FRLS)	RRKabel, Lapp, Finolex
3	Switched & Accessories :Modular Type	MK, Legrand, ABB-cheiron, Crabtree
4	Switchgears - A.C. 23 duty	Schneider, Legrand, C&S
5	HRC FuseS	Schneider, Legrand, C&S
6	MCBs 10 KA ('C' Series) & MCCBs / ELCB etc.	Legrand, Schneider, MK-Honeywell
7	Distribution Boards	Same as of MCBS' make
8	Telephone wires	Delton, Finolex, Havells,
9	PVC insulating tape	Steelgrip, Anchorgrip
10	PVC armoured Cables	1.1 KV as per ISI 1554. Avocab, polycab, RPG, Finolex, RR kable
11	Cable Glands	HMI, 3-D, Dowells, Comet.
12	Cable Lugs and Sockets	Dowells, 3-D, Ismal
13	Connectors	Wago, Connectwell, Technoplast
14	Batton / Angle Holder / Ceiling rose	Anchor, Precision, Vito
15	Heavy Duty pipe (6 kg/sq.cm)	Polycab, Jyoti, Precision Plastic

Industries

16	Steel Wire reinforced PVC flexible Hose	Flexi-hose
17	PVC Junction Box	Sintex /Clipsal / Hansal / Schneider
18	Exhaust Fan	Havells,Usha, Crompton
19	Ceiling Fan	Havells,Usha, Crompton, Orient
20	LED Lighting Fixtures	Syska, Crompton, Ensave
21	Fluorescent Lamp	Phillips, Crompton, Wipro,OSRAM
22	Telephone Tag Block	Krone
23	Computer Data Cable / Patch Cord	Systimax, Legrand, Schneider
24	Information Outlets	Systimax, AMP, D-link, Molex
25	Indicating Lamp (LED Type)	Siemens / Technik / L & T
26	Meters	Indo asian, HPL, L & T Legrand, Elmeasure
27	Selector Switch	Kaycee / Siemens/L & T /Jainson/ Salzer
28	Contactora	Siemens /GE / Merlin Gerin /L & T
29	Time Switch / Timer	Legrand / Merlin Gerin / L & T
30	Push Button	Siemens / Technik
31	Capacitor (APP Type)	Havells,Matrix, Epcos L & T
32	Rack	Maruti, Epsilon, Rital
33	Projector	Panasonic, Hitachi, EPSON-EB575 WI
34	Speaker	JBL, Bosch, Boss

HVAC MAKE LIST

1	PACKAGE UNITS	DAIKIN / BLUE STAR / VOLTAS /HITACHI /PANASONIC
2	MOTORS	ABB / CROMPTON / SIEMENS / HMM BHARAT BIJLI / KIRLOSKER
3	AIR HANDLING UNITS	CITIZEN / ZECO / JPC/ NUTECH / ETHOS
4	INSULATION	
a.	EXPANDED POLYSTYRENE	BEARDSSELL / MODIFOAM /COOLINE
b.	NITRILE	A-FLEX / ARMAFLEX / PARAMOUNT / SUPERLON
c.	CCCL	TROCELENE / PARAMOUNT / SUPERLON
5	CONTROLS / MEASUREMENT / INSTRUMENTS	
a.	THERMOSTATS & CONTROLLER	HONEYWELL / STEAFA / SAUTER / JOHNSON / SIEMENS
b.	HUMIDISTATS	HONEYWELL / PENN / JOHNSON / SIEMENS
c.	THERMOMETERS	H. GURU / TEDDINGTON
d.	EXPANSION VALVES	SPORLAN / DANFOSS
e.	HP / LP SWITCHES	RANCO / DANFOSS
f.	GRILLES / DIFFUSERS /NOZZLES	DYNACRAFT / COSMOS / RAVI STAR / AIR PRODUCT
6	DUCTING SHEETS	SAIL / NIPPON / NATIONAL/ ESSAR/JINDAL
7	FAN	PUNKER / KRUGER / NICOTRA
8	CUSHY FOOTS MOUNTS	DUNLOP / DYNA / POLUBOND RESISTOFLEX

The successful tenderer shall have to use the makes from above in consultation with the CLIENT AND/OR ITS ARCHITECT.

HOWEVER THE EMPLOYER HOLDS THE RIGHT TO ADD / DELETE ANY OR ALL THE ITEMS MENTIONED ABOVE.

DATE :.....

SIGNATURE :.....

STAMP / SEAL OF THE COMPANY

SIGNATORY :.....