Section 1

Special Conditions of Contract

1. General :

These are special conditions to the contract and intended for the same.

2. Scope of works :

The general character and the scope of work to be carried out under this contract is illustrated in drawings, specifications and the schedule of the quantities. The contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the owner's site representative. The contractor shall furnish all labor, materials and equipment as listed under the schedule of quantities and specified otherwise, transportation and incidentals necessary for supply, installation, testing and commissioning of the complete air conditioning system as described in the specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the drawings/documents as being furnished or installed. But which are necessary and customary to be performed under this contract. The central air conditioning and ventilation system shall comprise of the following :

a) Supply and installation of the air cooled Ductable type unit including indoor and outdoor units.
b) High wall ,cassette type split Units.
c) Refrigerant piping including insulation and the all accessories for split units.
d) Exhaust fans for mechanical ventilation.
e) Supply Air/Return air registers and diffusers.
f) Vibration isolation for HVAC equipments
g) Automatic Controls and instruments.
h) Wiring and earthing for various refrigeration, air-conditioning and mechanical ventilation equipment control wiring and interlocking.
i) Cutting holes, chases and the likes through all types of non structural walls and finishing for all type of wall crossings, including sealing, framework, fire proofing, providing sleeves, cover plates, making good structure and finishing to an approved standard.
j) Balancing, testing and commissioning of the entire HVAC and mechanical ventilation installations.
k) Test report, list of recommended spares, as installed drawings, operation and maintenance manuals for the entire HVAC installations.
l) Training of owner's staff.

3. Associated Civil Works:

Following civil works associated with HVAC installations shall be excluded from the scope of the contract. These shall be executed by other agencies and under direct supervision of the air-conditioning contractor.

i. PCC foundation for OD units.
ii. Supply and fixing of GI/wooden frames for fixing the grilles in masonry walls.
iii. Supply and fixing of GSS frames for mounting of grilles/diffusers in false ceiling /boxing.
iv. Thermal Insulation of terraces above air-conditioned area exposed to sun.

4. Project Execution and management:

The contractor shall ensure that senior planning and execution personnel from his organization are assigned exclusively for this project. They shall have minimum 10 years experience in this type of installations.

For quality control & monitoring of workmanship, contractor shall assign at least one full time engineer who would be exclusively responsible for ensuring strict quality control ,adherence to the specifications and ensuring top class workmanship for the air-conditioning installation.
The contractor shall arrange to have mechanized and modern facilities for transportation of materials to the place of installation for speedy execution of work.

5. Performance Guarantee :

The Contractor shall carry out the works in accordance with the drawings, specifications, schedule of the quantities and other documents forming part of the contract. The contractor shall be fully responsible for the performance of selected equipment (installed by him) at the specified parameters and for the efficiency of the installations to deliver the required end results. The contractor shall guarantee that the HVAC system as installed shall maintain the inside conditions in the air-conditioning spaces as described. The guarantee shall be submitted in the performa sheet. Complete set of architectural drawings are available in the architect/Consultants office and reference may be made to same for any detail or information. The contractor shall also guarantee that the performance of various equipment individually, shall not be less than the quoted capacity actual power consumption shall not exceed the quoted rating, during testing and commissioning handling over and guarantee period.

6. Bye Laws and Regulations :

The installations shall be in conformity with the by-laws and regulations and standards of the local authorities concerned, in so far as these become applicable to the installations. But if these specifications and drawings call for a higher standard of material and /or workmanship than those required by any of the above regulations and standards then these drawings and specifications shall take precedence over the said regulations and standards. However if the drawings and specifications require something which violates the bye-laws and regulations, then the bye-laws and regulations shall govern the requirement of the installations.

7. Fees and permits :

The contractor shall obtain all permits/licenses and pay for any or all fees required for inspection, approvals and commissioning of their installations.

8. Drawings :

The HVAC drawings listed herewith , which may be issued with tenders are diagrammatic only and indicate arrangement of various systems and the extent of works covered in the contract. These drawings indicate the points of supply and termination of services and broadly follows the routes to be followed. Under no circumstances shall dimension be scaled from the drawings. The architectural/interior drawings and details shall be examined for exact location of the equipment, controls, grilles and diffusers.

The contractor shall follow the tender drawings in preparation of his shop drawings and for subsequent installation work. He shall check the drawings of other trades/services to verify spaces in which his works shall be installed.

Maximum headroom and space conditions shall be maintained at all points. Where head room appears inadequate the contractor shall notify architect/consultant/owner's site representative before proceeding with the installations. In case installation is carried out without notifying the works shall be rejected and the contractor shall rectify the same at his own cost. The contractor

shall examine all the architectural, structural, plumbing , electrical and other services drawings and check the as built works before starting the work , report to the owners site representative of any discrepancies and obtain clarification. Any changes found essential to coordinate his work with other services and trades, shall be made with prior approval of architect/consultant/owner's site representative without additional cost to the owner. The data given in the drawings and specifications as exact as could be procured , but its accuracy is not guaranteed.

9. Technical Datas :

Each tenderer shall submit along with his tender ,the technical data for all items listed in the indicated format. Failure to submit complete data with the tenders may result in summary rejection of the tender.

10. Shop Drawings :

10.1 All the shop drawings shall be prepared on computer through Auto cad system based on the architectural drawings, site measurements and interior designers drawings. All heat load calculation shall be done using the latest version of HAP/Trace 600 only within two weeks of the award of the contract, contractor shall furnish for the approval of the architect /consultant two set of detailed shop drawing of all equipment and material including the layouts of the OD unit locations, Detailed ducting drawing showing exact location of supports, flanges, bends, tee connections, reducers, guide vanes, silencers, distribution grids, Volume control dampers, collars, grilles, diffusers, detailed piping drawing showing exact location and type of supports, valves, fittings etc. acoustic lining and external insulation details for ducts, pipe insulation etc. Electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations. These shop drawings shall contain all information required to complete terminations. These shop drawings shall contain all the information required to complete the project as per specifications and as required by the Architect/Consultant/Owners site representative. These drawings shall contain details of constructions, size arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/material/works and progressive cumulative totals from other related drawings to arrive at a variation in quantity statement at the completion of all shop drawings. Minimum 7 sets of drawings shall be submitted after final approval along with their floppies.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer strictly from the manufactures listed in Appendix and quoted by tenderer in technical data part of Appendix .

When the Architect/Consultant makes any amendment in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated along with check prints for approval. The contractor shall submit further 7 sets of the shop drawings

When the Architect/Consultant makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with amendments duly incorporated along with check prints for approval. The contractor shall submit further seven copies of shop drawings to the owners site representative for the exclusive use of the owner's site representative and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession the approved shop drawing for the particular material/equipment/installations.

10.2 Shop drawings shall be submitted for approval four weeks in advance of planned delivery and installation of any material to allow Architect/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in works due to his

failure to produce shop drawings at the right time in accordance with the approved programme.

10.3 Manufacturers drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labelled, indicating the specific services for which the material /equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data for general nature shall not be accepted.

10.4 Samples of all materials like grilles, diffusers, controls, insulation, pre-molded pipe section, control wires etc. shall be submitted to the owners site representative prior to procurement. These will be submitted in 2 sets of approval and retention by owners site representative and shall be kept in their site office for reference and verification till the completion of the project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further
Installations.

10.5 Approval of shop drawings shall not be considered as a guarantee of measurement or that of a building dimension. Where drawings are approved said approval doesn't mean that the drawings supercede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirements to furnish material and perform as required by the contract.

10.6 Where contractor propose to use an item or equipment other than that specified or detailed on the drawing which requires any redesign of the structure, partitions , foundations, piping, wiring or any other apart of the mechanical ,electrical and architectural layouts ,all such redesign and all new drawings and detailing required therefore shall be prepared by the contractor at his own expenses and gotten approved by the architect/consultant/owners site representative. Any delay on such account shall be at the cost and consequences to the contrcator.

10.7 HVAC contractor shall prepare coordinated service shop drawings based on the drawings prepared by electrical, plumbing & low voltage contractors to ensure adequate clearances are available for installation of service for each trade.
Where the work of the contractor has to be installed in close proximity to or will interfere with the work of other trade he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the owner's site representative , the contractor shall prepare composite working drawings and sections at a suitable scale, not less than 1:50 ,clearly showing how his work is to be installed in relation to work of the other trades. If the contractor installs his works before coordinating with other trades or so to cause any interference with work of other trades he shall make all necessary changes without extra cost to the owner.

10.8 Within four weeks of the approval of the relevant shop drawings the contractor shall submit four copies of a comprehensive variation in quantity statement and itemized price list of recommended (by manufacturer) imported and local spare parts and tools covering covering all the materials/equipment in the contract. The project manager shall make recommendation to owner for acceptance of anticipated variation in contract amounts and also advise Owner to initiate action for procurement of spare parts and tools at the completion of project.

11. Quite Operation and Vibration Isolation :

All equipment shall operate under all conditions of load without any sound and vibration which is objectionable in the opinion of the owner's site representative.
In case of rotating machinery sound or vibration noticeable outside the room in which it is installed or annoyingly noticeable inside its own room shall be considered objectionable. Such condition shall be corrected by the contractor at his own expenses. The contractor shall guarantee that the equipment installed shall maintain the specified NC levels.

12. Accessibility :

The contractor shall verify the sufficiency of the size of the shaft openings, clearances in cavity walls and suspended ceiling for proper installation of his ducting and piping. His failure to communicate insufficiency of the same. The contractor shall locate all equipment which must be serviced ,operated or maintained in fully accessible positions. The exact location and size of all access panels required for each concealed damper ,valves or other devices requiring attendance shall be finalized and communicated in sufficient time to be provided in the normal course of work. Failing this the contractor shall make all necessary changes and repairs at his own expenses. Access panel shall be standardized for each piece of equipment/device/accessory and shall be clearly nomenclatured /marked.

14. Materials and equipment :

All materials and equipment shall conform to the relevant Indian standards and shall be of the approved make and design. Makes shall be strictly in conformity with the list of approved manufactures as per Appendix III.

15. Manufactures Instructions :

Where manufacturer has furnished specific instructions relating to the material/equipment used in this project ,covering points specially not mentioned in these documents, such instructions shall be followed in all cases.

16. Electrical Installations :

The electrical work related to air-conditioning services , shall be carried out in full knowledge of ,and with complete coordination of contractor . The electrical installation shall be in total conformity with the control wiring drawings prepared by the contractor and approved by the architect /consultant .All air-conditioning equipments shall be connected and tested in the presence of an authorized representative of the contractor.

The air-conditioning system shall be commissioned only after the contractor has certified in writing that the electrical installation work for air-conditioning services has been thoroughly checked, tested and found to be totally satisfactory and in full conformity with the contract drawings ,specifications and manufacturers instructions . It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirement s of the electrical installation work for air-conditioning services ,lies solely with the contractor.

17. COMPLETION CERTIFICATE :

On completion of the electrical installation for air-conditioning, a certificate shall be furnished by the contractor , counter signed by the licensed supervisor ,under whose direct supervision the installation was carried out .This certificate shall be in the prescribed form as required by the local authority .

The contractor shall be responsible for getting the entire electrical installation for air-conditioning system duly approved by the local authorities concerned and shall bear expenses, if any in connection with the same.

18. BALANCING , TESTING AND COMMISIONING

Balancing of all air and water systems and all tests as called for the specifications shall be carried out by the contractor through a specialist group, in accordance with the specifications and ASHRAE guidelines and standards. Performance test shall consist of three days of 10 hrs each operation of each season .Witness testing of major equipment at factory with two personnel from owners/ consultant shall be included .

The results for summer , monsoon and winter air conditioning in quadruplicate ,shall be submitted for scrutiny .Four copies of the certified manufacturers performance curves for each piece of equipment ,highlighting operational parameters for the project ,shall be submitted along with the test certificates. Contractors shall also provide four copies of record of all safety and automatic control settings for entire installation .

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the owners site representive. All tests shall be carried out in presence of the representatives of the architect/consultant and owner's site representative.

19. COMPLETION DRAWINGS

Contractor shall periodically submit completion drawings as and when work in all respects is completed in a particular area . These drawings shall be submitted in the form of two sets of floppies/CD's and four portfolios (300 x 450mm) each containing complete set of drawings on approved scale indicating the work as installed .These drawings shall clearly indicate complete plant room layouts ,location of wiring and sequencing of automatic controls ,locations of all concealed piping ,valves, controls, dampers, wiring and other services .Each portfolio shall also contain consolidated control diagrams and technical literature on all controls. The contractor shall frame under glass , in the air-conditioning plant room , one set of these consolidated control diagrams.

20. Operating Instructions & Maintenance Manual :

Upon completion and commissioning of part HVAC system the contractor shall submit a draft ccopy of operating instructions, maintenance schedules and log sheets for all system and equipment included in this contract.This shall be supplimentary to manufacturers operating and maintenance manual. Upon approval of the draft the contrcator shall submit four complete bound set of typewritten operating instructions and maintenance manuals. One each for retention by consultant and the clients representative and two for owners operating personnel. These manuals shall also include basis of design ,detailed technical data for each piece of equipment as installed ,spare parts manual and recommended spares for 3 years period of maintenance of each equipment.

21. On Site Training :

Upon completion of all works and all tests, the contractor shall furnish necessary operator's labor and helpers for operating the entire installation for a period not less than two weeks of ten hours each to enable the owners staff get aquainted with the operation of the system. During this period the contractor shall train the owners personnel in the operation, adjustment and maintenance of all equipment installed.

22. Maintenance during defects Liability Period :

22.1 Complains :

The contractor shall receive calls for any or all problems experienced in the operation of the system under this contract, attend to these within four hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

22.2 Repairs :

All equipment that require repairing shall be immediately serviced and repaired. Since the period of mechanical maintenance runs for two years concurrently with the defects

liability period ,all replacement parts and labor shall be supplied promptly free of charge to the owner.

23. Uptime Guarantee :

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the defects liability period gets extended by a month for every month having shortfall . In case of shortfall beyond the defects liability period the contract shall get extended by a month for every month having the shortfall and no reimbursement shall be done for the extended period.

The contractor shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all temperature , pressure, humidity, power consumption starting and stopping times for various equipment, daily service rendered for the system alarms, maintenance records of unusual observations etc.
Contractor shall also submit preventive maintenance schedule.

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the owners site representative / consultant's review. This should include the type of service planned to be offered during the defects liability period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the management.

The tenderer shall include a list of such project where such an operation assistance has been provided.

24. Operation and Maintenance (Optional) :

Contractor may be required to carry out the HVAC installation for a period of two years from the date of commissioning and handing over of the entire system, i.e. during the defects liability period . Further he may also be required to carry out operation and all inclusive maintenance of the entire system for a period of three years beyond the defects liability period. Cost of such proposal shall be quoted separately as per the BOQ.

25. Operation Contract :

i) 24 hours a day, year round
ii) All standby equipment to be operated as per mutually agreed program.
iii) Proper entry and upkeep of relevant log books.
iv) Maintain complaint register. Submit weekly reports.
v) Proper housekeeping of all areas under the contract.
vi) Prepare daily consumption report and summary of operation.

26. Terms of Payment :

i) Monthly at the end of the month on pro-rata basis.

27. All inclusive maintenance Contract :

a) Routine preventive maintenance schedule to be submitted.
i) Schedule to cover manufacturers recommendations and/or common engineering. practice (for all plant and machinery under the contract)
ii) Plant and history card giving full details of equipment and frequency of check and overhaul.
iii) Monthly status report.

iv) Entire HVAC installation to be painted in fourth year (from commissioning) before the expiry of operation and maintenance contract.

b) Uptime during maintenance Contract :

i) 98% uptime of all system under contract.
ii) Uptime shall be assessed every month and in case of shortfall during any month the contract shall be extended by a month.
iii) There shall be no reimbursement for the extended period.
iv) Breakdown shall be attended within ten hours of reporting.
v) Spare compressor/motor assembly shall be made available within seven calender days in case of total breakdown/burnout.

c) Manpower :

i) Adequate number of persons to the satisfaction of the owner's site representative shall be provided including relievers.
ii) Statuary requirements of EPF, ESIC and other applicable labor legislations to be complied with : and monthly certificate to that effect be submitted.
iii) Duty allocation and roaster control shall be contractors responsibility.
iv) No overtime shall be paid by the owner for reasons whatsoever.

d) Shutdowns :

i) Routine shutdowns shall be permitted only during winter season.
ii) Contractors shall be at liberty to carry out routine maintenance as and when required but with due permission of the Owner's representative.

28. Power requirement :

The contractor shall submit with their tender ,the requirement of power at each of their equipment/system wise/floor wise/section wise.

End of Section

SPECIFICATIONS

Section 2

SYSTEM DESIGN DATA

1. General :

The system design , basis of design, requirements and other relevant data are outlined in this section. The detailed specifications and specific requirements are outlined in the subsequent sections.

2. Location:

The proposed AIIMS store is coming up at Delhi.

3. Scope of works :

The work proposed under this tender includes providing and fixing air-conditioning and ventilation systems and all incidental works for this clean room project..

Providing and fixing at site all main equipment associated with air-conditioning and ventilation for the above.

To execute all incidental work at site including material supply at site associated with the system asked in the specifications.

Nature of such works will be ceiling suspended type ductable splits, high wall units including the indoor, outdoor units, sheet metal ductwork, air distribution devices viz. grilles and diffusers , copper piping and its insulation , drain piping etc., incidental civil works, incidental electrical works ,cable , control panel etc. at site for all manufactured items at works and also items fabricated at site.

Routine Testing, pressure testing of fabricated components, commissioning of complete plant at site.

Performance Testing at site of complete air-conditioning, air-cooling and ventilation system / installations at site.

4. System Design :

Basis of Design :

Site Location	:	Delhi
Geographic Location	:	28º35' N (Latitude)
	:	
Altitude	:	216 metres from MSL
Daily Range	:	29º F

Outside Conditions :

Summer :	*DB*	*WB*
	43.3° C/110 F	23.9 ° C (75 F)
Monsoon :	*DB*	*WB*
	35.0° C (95 F)	28.3° C (83F)
Winter :	*DB*	*WB*
	7.2 ° C (45F)	*5 ° C (41F)*

Inside Conditions :

Summer & Monsoon :	*DB*	*RH*
	24 +/-1° C	not exceeding 60%

Exposed Glasses: All glasses exposed in sun shall have suitable shading devices / Venetian blinds.

Lighting Load : 2 W per Square Ft.

: All the exposed roof/ceiling to be insulated with 50mm thick EPS/ or Equivallant. (By others)

Toilet Ventilation : Exhaust Air 8-10 air changes per hour

5 Other Data :

5.1 Estimated Air-conditioning Requirements :

Based on the above area wise details and the estimated heat loads requirements are summarised as below :

A) Basement Floor :

Sr.No.	Area Description	Area ft2	TR
1.	Waiting area	2090	19.48
2.	Medicine store	1920	12.53
3.	Office area	204	1.65

Air conditioning System Design :

The air conditioning of above areas shall be done with the help of ductable split units and high wall splits as per the cooling requirements and as shown in the drawings and as per the capacities required.

End of section

Section 3

AIRCOOLED DX TYPE SPLIT UNITS WITH INDOOR AND OUTDOOR UNITS

1.1 Scope

The scope of this section comprise the supply, erection testing and commissioning of air cooled dx type split unit system conforming to these specifications and in accordance with the requirements of drawing and schedule of quantities.

1.2 Type

Units shall be air cooled DX type consisting of indoor and outdoor units and refrigerant piping as shown in the drawings.Compressor installed in outdoor units shall be equipped with hermatically sealed scroll Compressors for higher reliability, improved life, better backup and duty cycling purpose.

Both indoor units and outdoor units shall be factory assembled ,tested and filled with first charge of refrigerant before delivering at site.

1.3 OUT DOOR UNIT

This section deals with supply installation testing commissioning of outdoor units confirming to specification and suitable duty. The type, capacity and size of indoor units shall be as specified in detailed Bill Of Quantities.

1.4 Heat exchanger

The heat exchanger shall be constructed with copper tubes mechanically bonded to aluminum fins to form a cross fin coil.

1.5 REFRIGERANT CIRCUIT

The refrigerant circuit shall include liquid & gas shut off valve and a solenoid valve at condenser end. he equipment must have in built refrigerant stabilization control for proper refrigerant distribution.

All necessary safety devices shall be proved to ensure the safety operation of the system.

1.6 SAFETY DEVICES

All necessary safety devices shall be provided to ensure safe operation of the system.

Following safety devices shall be part of outdoor units: high pressure switch, fuse fan drive overload protector. fusible plug, over load relay, overload protection for inverter.

1.7 INDOOR UNIT:

This section deals with supply installation testing commissioning of various type of indoor units confirming to general specification and suitable the duty selected. The type, capacity and size of indoor units shall be as specified in detailed Bill Of Quantities.

End of section

Section 4

Sheet Metal Work & Air Distribution

1. Scope :

The scope of work shall include supply, fabrication and installation of site fabricated G.I. sheet metal duct as shown in the relevant duct drawing, testing at site, loading & unloading of G.I. sheets at site, and shifting the G.I. sheets and other hardware from site stores to exact location inside the office complex. The packing shall be suitable for marine transportation purpose and all other natural disasters and the same shall be transported to respective office warehouses to achieve a guaranteed commercial operation of the same to the entire satisfaction of client.

2. Materials

Ducts shall be made of either galvanized steel sheets or aluminum sheets. The galvanized steel sheet shall confirm to IS: 277 – 1977 Aluminum shall be of grade SIC of B-3 as specified in IS: 177 – 1974.

Thickness of sheet shall be as per the table given below:

Maximum Side (mm)	Thickness (mm)	
	Galvanized Steel Sheet	Aluminum Sheet
Up to 750 mm	0.63	0.80
751-1500	0.80	1.00
1501-2250	1.00	1.50
2250-2500	1.20	
Plenums and Ducts above 2500	1.60	

- The bracing shall be as per ISS 655-1964. Supports for ducts at 2.4m distance apart up to 2250/1.2m distance apart for larger ducts.
- Ducts shall be rectangular in cross section and fabricated in accordance with the following table :

Maximum Side of Duct (mm)	**Minimum Thickness of Sheet (mm/SWG)**	**Transverse Joints**	**Reinforcement**	**Hanger Rod Dia (mm)**
Up to 400	0.63 (24 SWG)	25mm pocket/s slip	Cross Break	8
401 to 750	0.63 (24 SWG)	25mm pocket/s slip	25 X 25 X 4.2 Girth angle @ 1000 mm c/c	8
751 to 900	0.80(22SWG)	38x38x4.2	25 X 25 X 4.2 Girth	8

		Companion Flanges	angle @ 1000 mm c/c	
901 to 1500	0.80(22SWG)	38x38x4.2 Companion Flanges	38x38x4.2 Girth angle @ 760 mm c/c	10
1501 to 2250	1.00(20SWG)	38x38x4.2 Companion Flanges	38x38x4.2 Girth angle @ 760 mm c/c	10
2250 and above	1.25(18 SWG)	50x50x4.2 Companion Flanges	50x50x4.2 Girth angle @ 610 mm c/c	12
Plenums	1.25(18 SWG)	50x50x6.4 Companion Flanges	50x50x6.4 Girth angle @ 610 mm c/c	12

Girth angles and companion flanges shall be mitered and welded at corners and riveted to duct sheets at 75mm centers. Flanged joints shall be made with 9.5-mm GI bolts spaced at 1.5cm centers and provided with 4.2mm rubber or 6.0mm. All joints and seams shall be rendered airtight. All duct seams and joints to be sealed with silicon sealant to stop supply air leakage. Duct panels are not to be cross-broken if insulated. Longitudinal seams shall be inside groove of Pittsburgh type. All ducting supports, bracing and framework shall be painted with 2 coats of epoxy primer and 2 coats of epoxy paint min. (50 microns).

3. Accessories:

- All dampers, except where shown, shall be louver dampers having multiple opposed blades type or with parallel blades of airfoil construction. The construction of the dampers shall be robust and tight fitting. They should be made from 18 gauge galvanized sheets. The depth should be minimum of 150mm and flanges of 40mm. Blades shall be connected with a suitable linkage for operation by an extending by an extending lever, which shall have a locking quadrant with positions of the damper indicated on it. Dampers and their operating device shall be made robust, easily operable and accessible through suitable access doors in the ducts.
- Dampers shall be provided in ducts at every branch supply or return air duct connections whether or not indicated on the drawings for the proper volume control and balancing the system.
- Where shown, splitter dampers shall be installed. This damper consists of double thickness airfoil blade hinged on the downstream edge. The operating lever shall extend outside the duct and insulation with an airtight hub and locking arrangements. The thickness of the damper blades shall be the same as the duct in which they are installed but not less than 1.5mm thickness.
- Fire dampers shall be motorized / solenoid type wherever specified shall be provide in the ducts to minimize spreading of fire through ducts, i.e. points where duct passes fire (rated 1 ½ hrs. or more) wall or slab. Fire dampers shall be 230mm – deep and face area as required. The outlet casing of the damper shall be fabricated out of 12 gauges M.S. sheet duly epoxy painted with two coats. The louvers shall be provided with smooth pivoted linkage, tripping mechanism of steel bar with heavy-duty spring assembly and provision of motor. The louvers to be arranged to pivot and hold in an open position and can be closed by an electrically operated motor. The damper is used in conjunction with a smoke alarm system. The entire

assembly shall be duly epoxy primer of 2 coats (epoxy paint) or aluminum spray painted. The dampers shall be designed for automatic as well as manual tripping.

- Motors shall be rated for fire damper (spring to close power to open) operation and shall be suitable for outdoor installation (IP55). Fire dampers are closed on a signal from the fire control module. Module supply and wiring by fire control contractor.
- Motorised dampers should be single flap dampers with 18 gauge construction with Belimo or Equivalent make spring return type. Opening time should be more than 75secs. And closing time should be 30secs. The power shall be given from the electrical panel and will be routed through the unit.
- 300mm X 300mm access panels with gasket neoprene and stud bolt type shall be provided near lower dampers/ splitters dampers and fire damper. All main ducting work shall be accessible throughout using tight fitted hinged access doors. Doors shall be cemented sponge rubber gaskets of 6mm thickness. Felt is not acceptable. In the case of insulated ducts with access doors, the same shall be properly insulated, such that it can be operated without damaging the duct insulation and there should be no condensation either on the access doors or on the ducts when he plant is running.

4. Installation Guidelines

- The duct fabrication and installation shall generally confirm to IS 655-1963.
- All ducts shall be supported from the concrete slab or beams. Duct supports shall be fixed through the use of two anchor fasteners for each leg. The anchor fasteners shall be of approved make. If ducting is supported from steel structure, Beam Clamps shall be provided. In no case shall the duct be supported from the false ceiling hangers or be permitted to rest on a hung ceiling.

- Transverse joints shall be provided with rubber gaskets (6mm thk.) of nonflammable type. Use of felt shall not be permitted.
- Wherever the ducts are acoustically lined, the duct size shall be increased by the thickness of the duct lining.
- The contractor shall provide and neatly erect all sheet metal work as per the specifications and drawings. This work ,in all its parts and details, shall meet with the approval of the Engineer
- The contractor shall make all necessary allowances and provisions for beams, pipes or other obstructions in the ducting, whether or not the same has been shown in the drawings. Wherever necessary to avoid beams or other structural works, plumbing or other pipes / conduits, the ducts shall be transformed, divided or curved to one side as approved or directed by the Engineer. However the required cross-sectional area shall be maintained.
- All metal work shall be done in dead or furred down spaces so as not to cause any delay to other contractors on the building.
- If a duct cannot be installed as shown in the drawings, the contractor shall install the duct between the required points by any path available subject to the approval of the Engineer and Architect.
- All ducts shall be rigid and shall be adequately supported with standing seams, tees or angles of ample size wherever required to keep the ducts true to shape, prevent buckling, vibration and breathing.
- All duct joints shall be tightly fitted using rubber gasket of nonflammable type and all interior surfaces shall be smooth. Bends shall be made with radius not less than one-half of the width of the duct or with properly designed interior curved vanes. Two vanes shall be spaced such that the aspect ratio of each of the individual elbows formed by the vane will be about five to one.

- All sheet metal connections, partitions and plenums required to confine the flow of air to and through the filters and fans, shall be constructed from 16G galvanised iron thoroughly stiffened with 25mm X 25mm angle iron braces and fitted with all necessary doors as required to give access to all parts of the apparatus. Doors shall not be less than 46 cm X 71cm. Sheet Metal connections to indoor units shall be flexible, double thickness fiberglass cloth or equivalent nonflammable material of 100mm long.
- Where metal ducts or sleeves terminate in woodwork, brick or masonry openings tight joints shall be made by the means of closely fittings heavy flanged collars.
- Resistoflex or similar vibration isolation material of 6mm thickness shall be provided between ducts and duct support.
- Where ductwork is connected to rotating equipment duct such as fans, air handling units (indoor unit of split/package system), the connections shall be made with double thickness nonflammable flexible material, 100mm long.

5. Grilles and Diffusers:

- **Supply Air Side Wall Outlets**
- Wherever specified in the B.O.Q. shall be in Aluminum construction.
- **Double Deflection Grilles:**
- Wherever specified in the B.O.Q. shall be in Aluminum construction. Aluminum double deflection grills for supply air shall be provided with vertical and horizontal adjustable bars and an approved blade damper adjustable from the front face of the grille. The grilles will be powder -coated in a shade as given in the schedule of finishes of this handbook.

- **Fixed Bar Linear Grilles**

  Fixed bar grilles will be in extruded aluminum construction. Bars shall be fixed in position using vertical tie bars. Bar spacing shall not exceed 12mm and the grilles shall have 60% free area. Deflection angle of the bars shall be 0. The grilles will be powder coated in a shade as per the owner/architect. Irrespective of grille finish, vertical tie bars shall be powder coated in Matt black. Supply air outlets shall be provided with volume control dampers to be installed in the duct collar. Dampers shall be in black Matt powder coated finish. Where required by the Architects/Consultants, the grilles shall be provided with a margin on all sides. Supply air outlets shall be provided with end closure pieces for the supply portion of the grille. The end closure pieces shall not come to the grille face.
- Continuous grilles shall butt with hairline joints and be provided with interlocking splines.
- All return air grilles shall be similar and equal to the above as determined by consultants.
- All exhaust air grilles shall be similar and equal to the supply air grilles specified above.

6. Ceiling Outlets:

Square / Rectangular Diffusers:

Shall be of aluminum construction wherever specified in the BOQ. Corners of inner and outer cores shall be assembled to provide precise mitered corners. Supply air diffusers shall be provided with multi blade butterfly dampers. Damper flaps shall be provided with

a nylon worm gear assembly for ease of operation. Diffusers will be powder -coated in a shade as approved by client/Architect. Diffuser shall be half step down type.

7. Guidelines for Installation of Grilles/Diffusers

Installation of the grilles/diffusers shall be done by the air conditioning contractor irrespective of the type/model of false ceiling systems .The diffusers will have to be individually suspended from the duct and aligned to match the ceiling line level. In case gypsum or any other false ceiling system, all wooden frames, rectangular or circular for supply/return/exhaust air diffusers will be provided by the Air conditioning contractor.

All air outlets/return air inlets in the same room shall be of the same size unless otherwise specified.

Grilles and diffuser samples must be submitted to the consultants for prior approval before procurement and installation.

End of Section

Section 5 Insulation

1. **General:**

The Insulation of refrigerant piping, drain piping, ducting etc. shall be carried out as per specifications given below :

2. **Materials**

The materials to be used for insulation shall be as follows. Unless some other material is specifically mentioned elsewhere.

2.1 **Duct Insulation**

The insulation for duct shall be carried out from closed cell polyethylene having a K value of .034 W/(M.K) at mean tempreture of 23 degree centigrade . and a density of not less less than 33 Kgs /m3. Water vapour permeability 4000μ and above. Fire rating class I/O as per British standard BS 476 part VII/- - 1997 building regulation. Approval of sample to be obtained in writing prior to execution.

2.1 Other Insulation:

2.2.1 The material for acoustic treatment of ducts. Rooms. Roofs etc. shall be resin bonded fibre glass. As described earlier. Conforming to I.S. 8183 of 1976. The density of fibre glass shall be 32 Kg/cub.m and the material shall be in the form of rolls of uniform density. The k value at 10 degree centigrade. Shall not be less than .028 kcal/mhr/ C.

Wherever insulation is to be carried out inside the duct. Fibre tissue is to be installed and contractor to ensure that no fibres of insulation material get mixed up with supply /return air.

2. Drain Piping :

3.1 Insulation of drain piping shall be carried out using 6 mm thick insulation tube of closed cell nitrile rubber having a K value of 0.034 W/(M.K) at mean temperature of 10 degree centigrade and a density of not less than 80 Kg/m3.

3.2 Installation :

3.2.1 The piping shall be thoroughly cleaned with a wire brush and rendered free from all rust and grease.

3.2.2 Cut insulation tube longitudinally and put on pipe and seal the joints with adhesives and Aluminium tape (as approved by the manufacturers)

4. Refrigerant Piping :

Suction line of the refrigerant shall be insulated with 19/13 mm insulation as specified.

5. Ducting :

5.1 The ducts shall be insulated with the insulation sheet as follows :

5.2 Duct Insulation thickness shall be as follows :

Duct in conditioned space - 9 mm thick

6. Accoustic Lining :

6.1 The acoustic lining shall consist of 25/50 mm resin bonded glass wool of density 32kg/m3 then it shall be covered by 0.5 mm perforated aluminium sheet having 3 mm perforation at 6 mm centers.

6.2.1 The duct surface shall be cleaned from inside.

6.2.2 Then the insulation shall be fixed inside the duct.

6.2.3 The insulation shall be coverted with RP tissue paper.

6.2.4 The insulation shall then be covered with 0.5 mm perforated Al sheets.

6.2.5 The sheet and the insulation shall be secured to the duct by means of cadmium plated bolts,nuts and washers.The end shall be completely sealed off so that no insulation material is exposed.

End of section

Section 6

Tests at site

1 General

The Contractor shall perform all inspection and tests of the air conditioning and ventilation systems as a whole and of components individually as required, under the supervision of the Engineer, in accordance with the provisions of the applicable 'ASHRAE' standards or approved equal, and as per Site requirements.

2 Piping System

a) In general, pressure tests shall be applied to piping only before connection of equipment and appliances. In no case shall piping, equipment or appliances be subjected to pressures exceeding their test ratings.

b) Tests shall be completed and approved before any insulation is applied.

c) After tests have been completed, the system shall be drained and cleaned of all dust and foreign material. All strainers, valves and fittings shall be cleaned of all dirt, fillings and debris.

3 Duct Work

a) All branches and outlets shall be tested for air quantity, and the total of the air quantities shall be within plus three percent (5%) of fan capacity.

b) Volume dampers and splitter dampers shall be tested for proper operation.

4 Balancing and Adjustment

All air handling ventilation equipment, duct work and outlets shall be adjusted and balanced to deliver the specified air quantities indicated, at each inlet and outlet, on the drawings. If these air quantities cannot be delivered without exceeding the speed range of the sheaves or the available horse power, the Engineer shall be notified before proceeding with the necessary rectification and balancing of air distribution system.

5 Electrical Equipment

a) All electrical equipment shall be cleaned and adjusted on Site before application of power.

b) The following tests shall be carried out:

1) Wire and Cable continuity tests.

2) Insulation resistance tests, phase to phase, phase to earth, and

phase to neutral on all circuits and equipment, using a 500 Volt meggar.

3) The earth resistance between conduit system and earth must not exceed half (0.5) OHM.

4) The phase rotation tests.

5) Operating tests on all protective relays to prove their correct operation before energising the main equipment.

6) Operating tests on all starters, circuit breakers, etc.

6 Performance Tests

a) The installation as a whole shall be balanced and tested upon completion, and all relevant information, including the following shall be submitted to the Engineer in charge/consultant.

i) Computed capacity of each air-conditioning unit.

ii) Air volume passing through each unit, ducts, grille, etc.

iii) Differential pressure readings across each filter, fan and coil, and through each condenser.

iv) Electrical current readings, in amperes of full and average load running, and starting, together with name plate current of each electrical motor.

b) Daily records shall be maintained of hourly readings, taken under varying degrees of internal heat load and use and occupation, of wet and dry bulb temperatures, upstream 'ON-COIL' of each cooling coil. Also, suction temperatures and pressures for each refrigerating unit and the current and voltage drawn by each machine.

c) Any other reading shall be taken which may subsequently be specified by the Engineer/consultants.

7 Miscellaneous

a) The above tests are mentioned herein to provide amplification but not by way of limitation, to the provisions of Conditions of Contract and Specification. Duration of the tests shall be not less than 120 continuous hours. These tests shall be carried out, in summer as well as in monsoon and winter period, during the defects liability period.

b) The date for commencement of all tests listed above shall be subject to the approval of the Engineer and in accordance with the requirements of this Specification.

c) The Contractor shall provide the skilled staff and all necessary instruments, and carry out any test of any kind on a piece of equipment, apparatus, part of system or on a complete system, if the Engineer requests such a test for determining specified or guaranteed data, as given in the Specifications or on the Drawings.

d) Any damage resulting from the tests shall be repaired and/or damaged material replaced, all to the satisfaction of the Engineer.

e) In the event of any repair or any adjustment having to be made, other than normal running adjustments, the tests shall be void and shall be recommenced after the adjustment or repairs have been completed.

f) The Contractor shall inform the Engineer when such tests are to be made, giving sufficient notice, to enable the Engineer to be present.

g) Complete records of all tests shall must be kept by the contractor, and 3 copies of these and all location drawings shall be furnished to the Engineer/consultants.

f) The Contractor may be required to repeat the test as required, should the ambient conditions at the time, in the opinion of the Engineer, not give sufficient and suitable indication of the effect and performance of the installation as a whole, or of any part, as required.

End of section

Section 7

Mode of Measurement

1 General

This specification covers measurement of various items/materials at site.

2 Unit Prices in the Schedule of Quantities

The item description in the Schedule of Quantities is in the form of a condensed resume. The unit price shall be held to include every thing necessary to complete the work covered by this item in accordance with the specifications and drawings. The sum of all the individual item prices shall represent the total price of the installation ready to be handed over.

The unit price of the various items shall include the

All equipment, machinery, apparatus and materials required as well as the cost of any tests which the consultant may request in addition to the tests generally required to prove quality and performance of equipment.

All the labour required to supply and install the complete installation in accordance with the specifications.

Use of any tools, equipment, machinery, lifting tackle, scaffolding ladders etc. required by the contractor to carry out his work.

All the necessary measures to prevent the transmission of vibration.

The necessary material to isolate equipment foundations, from the building structure, wherever necessary and suggested by the Engineer.

Storage and insurance of all equipment apparatus and materials.

The Contractor's unit price shall include all equipment, apparatus material and labour indicated in the drawings and/or specifications in conjunction with the item in question, as well as all additional equipment, apparatus, material and labour usual and necessary to complete the system even though not specifically shown, described or otherwise referred to.

3 Measurements of Sheet metal ducts, grilles/diffusers, etc.

a) Sheet Metal Ducts

All duct measurements shall be taken as per actual outer duct surface area including bends, tees, reducers, collars and other fittings. Gaskets, nuts, bolts vibration isolation pads, vanes are included in the basic duct items of the B.O.Q.

The unit of measurements shall be the finished sheet metal surface area in metre squares. No extra shall be allowed for overlaps.

All the guide vanes, deflectors access panels, splitter dampers within the duct work shall be considered as part of the duct and nothing will be paid extra on this account.

The unit duct price shall include all the duct hangers, supports and `Hilti' metallic fasteners as well as any materials and labour required to complete the duct frame.

b) Box Dampers

Box dampers wherever shown or required in ducts shall be measured as per finished inside cross-sections and paid as per the calculated are in sq.m.

c) Grilles/Diffusers

All measurements of grilles/diffusers shall be the nominal outlet size excluding the outer flanges.

The square or rectangular grilles/diffusers shall be measured in plain sq.m.

All round diffusers shall be measured by their diameters in centimetre.

All linear diffusers shall be measured as per actual length in meters.

4 Measurements of Piping, Fittings, Valves, Fabricated Items

a) Pipe

(Including Water Piping, Oil Piping, L.P. Gas Piping, Air Piping, Vacuum Piping, etc.)

All pipes shall be measured in linear meter (to the nearest Cm.) along the axis of the pipes and rates shall be inclusive of all fittings e.g. tees, bends, reducer, elbows, hanger support bracket, etc. Deduction shall be made for valves in the line.

The rate quoted shall be inclusive of cutting holes, `Hilti' metallic fasteners and inclusive of all items as specified in specifications and Schedule of Quantities.

Rates quoted shall be inclusive of providing and fixing vibration pads and wooden pieces, wherever specified or required by the Engineer-in-Charge.

Flexible connections, wherever required or specified shall be measured as part of straight length of same diameter, with no additional allowances being made for providing the same.

The length of the pipe for the purpose of payment will be taken through the centre line of the pipe and all fittings (e.g. tees, bends, reducers, elbows, etc.) as through the fittings are also presumed to be pipe lengths. Nothing extra whatsoever will be paid for over and above the fittings. For valves and flanges, section 1.16.3.2 below applies:

c) Structural Supports

Structural supports including supports fabricated from pipe lengths for pipes shall be measured as part of pipe line and hence no separate payment will be made. Rates shall be inclusive of hoisting, cutting, jointing, welding, cutting of holes and chases in walls, slabs or floors, painting supports and other items as described in specifications, drawings and schedule of quantities or as required at site by Engineer-in-Charge.

5 Painting

Painting of all pipes, supports, valves and fittings shall be included with the cost of these items. Nothing extra shall be paid for this work.

Painting of grilles/diffusers, tanks and equipment wherever required shall be in the cost of these items.

6 Insulation

Measurement of insulation for vessels, piping, equipment and ducts shall be made over the bare uninsulated surface area of the metal.

a) Pipes

The measurements for insulation of piping shall be made in linear meters through all valves, flanges, and fittings. Pipes/bends shall be measured along the centre line radius between tangent points. If the outer radius is R1 and the inner radius is R2, the centre line radius shall be measured as (R1+R2)/2. Measurement of all valves, flanges and fittings shall be taken in running metre of pipe line as if they are also pipe lengths. Nothing extra over the above shall be payable for insulation over valves, flanges and fittings in pipe line/routings. Fittings that connect two or more different sizes of pipe shall be measured as part of the larger size.

b) Ducts

The measurements for insulation of ducts shall be made in actual square meters of bare uninsulated duct surface.

In case of bends the area shall be worked out by taking an average of inner and outer lengths of the bends. Measure-ments for damper, flanges, fittings shall be for the surface dimension for the connecting duct. Nothing extra over the above shall be payable for insulation over dampers, flanges and fittings in duct routing.

d) Accessories Insulation

The unit of measurement for accessories such as expansion tank, pumps, chiller heads etc. shall be of uninsulated area in square meters. In case of curved or irregular surfaces, measurements shall be taken along the curves. The unit insulation price shall include all necessary adhesives, vapour proofing and finishing materials as well as additional labour and material required for fixing the insulation.

e) Acoustic Duct Lining

In case of acoustic lining of air ducts, measurements of the bare inside duct surface in square metre, shall be final for billing purpose.

The insulation/acoustic treatment shall include cost of battens/sections, supports, adhesives,vapour proofing, finished tiles/boards/sheets as well as additional labour and materials required for completing the work.

f) Roof and Wall Insulation and Acoustic Treatment

The unit of measurement for all underdeck roof insulation wall insulation, wall/roof acoustic panel shall be the acoustic uninsulated area of walls, roofs, to be treated, in square metres.

The insulation/acoustic treatment shall include cost of battens supports, adhesives, vapour proofing, finished boards/sheets as well as additional labour and materials required for completing the work.

g) Acoustic Baffle Boxes (wherever required)

The unit of measurement shall be the exposed inside face of the acoustic baffle boxes in square meters.

The unit price shall include all hold fasts, nuts, bolts connecting the size of wall opening and making it good as well. Any additional materials and labour to fabricate and fix the boxes.

End of Section

Section 8 :

LIST OF BUREAU OF INDIAN STANDARD CODES

IS:277-1992	-	Galvanised steel Sheet (plain & corrugated)
IS:544-1985 (Reaffirmed 1996)	-	Dimension for pipe Threads
IS:778	-	Valves (gate/globe/check type)
IS:655-1963	-	Metal Air Ducts
IS:13095-1991	-	Butterfly Valves
IS:659-1964	-	Air-conditioning (safety codes)
IS:1239-1990/92	-	Mild Steel Pipes
IS:325	-	3 phase induction motor
IS:822	-	Code of procedure for inspection of welds
IS:900	-	Code of practice for installation and maintenance of motors
IS:6392	-	Steel Pipe Flanges
IS:1822	-	Motor starters for voltage not exceeding 650 Volts
IEC	-	Relevant Sections
IS:996	-	Single phase small A.C. Motors
IS:4894-1987	-	Centrifugal Fans
IS:1554(I)	-	PVC Insulated (heavy duty)electric cables for working Voltage upto and including 1100 Volts
IS:8623-1993	-	Bus Bar Trunking System
IS:8828-1996 & IEC898-1995	-	Miniature Circuit Breakers
IS:9537-1981 Part II	-	Rigid steel conduit for electrical wiring
IS:10810-1989	-	Method of Test of Cables
IS:13947-1989	-	Circuit Breakers
IS:13947-1993	-	Switches,disconnectors,fuse combination units
IS:139-1993(Part IV)	-	Contactors & Motor Starters
Duct Fabrication standards		-SMACNA
ASHRAE Handbooks	-	Application 1995
	-	fundamentals 1997
	-	System & equipment 1996
	-	Indoor Air Quality 62-1982

End of section

Section 9 :

LIST OF APPROVED MAKES FOR HVAC EQUIPMENT AND MATERIALS

Sr.No.	Datails of the Items	Manufacturer's name
1.	Airconditioning units:	Voltas/Blue Star/Hitachi/Daikin/Carrier
2.	Inline Exht Fans :	Systemaire/Ostberg/Caryaire
3.	Copper Ref Pipe :	Rajco/Shreeshyam pipes/Mandeo
4.	G.I.Sheets :	Sail/TATA/Bhushan
5.	CPVC Pipes :	ASTRAL
6.	Grilles /Diffusers :	Caryaire/Ravistar/AirmasterMapro
7.	Nitrile rubber insulation :	Eurabatax/Armacell/Totaline
8.	Flexible duct connection :	Airflow/Pyroguard
9.	Gaskets :	Neoprene rubber
10.	Fire damppers/VCDs :	Caryaire/Conaire/Mapro
11.	Power Cables :	ICC/Skytone/polycab/kalinga
12.	Control cables :	Grandlay/Batra henlay/Polycab
13.	Duct insulation :	Paramount/Supreme/Armacell
14.	Fire Dampers/VCDs :	Caryaire/Tristar/Conaire
15.	Fiberglass :	UP Twiga/Owens corning/Kimmco
16.	Control Panel :	Tricolite/EAPL/KEPL
17.	Electric motors :	ABB/Crompton/Kirloskar/GEC
18.	MCCB/MCB :	L&T/Schneider/MDS
19.	Starters :	L&T/Siemens
20.	Auxilliary relays/Contactors:	L&T/Siemens
21.	Terminal Block :	Elmex
22.	Timer :	L&T/English Electric/Siemens
23.	Indicating Lamps/Selector Switches :	L&T /Siemens
24.	Vibration Isolators :	Resistoflex/Dunlop
25.	HVAC installation agencies :	Fairair Engineers/Luftcare Services/Goldline ac services

End of section

Section 10:

LIST OF HVAC DRAWINGS

Sr.No,	Description	Drawing No.
1.	HVAC System layout at Ground Floor	-AIIMS/HVAC/01

End of section