

CENTRAL DRUG RESEARCH INSTITUTE
NEW CENTRAL DRUG RESEARCH INSTITUTE CAMPUS
SITAPUR ROAD, LUCKNOW

TECHNICAL SPECIFICATIONS

OF

PRECISION AIR CONDITIONING SYSTEM

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FOR

PRECISION AIR CONDITIONING SYSTEM

INDEX

S. NO.	DESCRIPTION / SECTION	PAGE NO.
1	System Design Data (Section 1)	1-2
2	Scope of work (Section 2)	3-4
3	System Descriptions (Section 3)	5
4	Performance Guarantee (Section 4)	6
5	Main Equipments & their Materials specifications (Section 5)	7-10
6	Other Equipments & their Materials specifications (Section 6)	11-13
7	Inspection, Testing & Commissioning (Section 7)	14-19
8	Schedule of Technical Data (Section 8)	20-23
9	List of Approved makes (Section 9)	24
10	List of BIS Codes, (Section 10), (Appendix-I)	25-27
11	Precision Air Conditioning Tonnage Load, (Section 11)	28
12	List of tender Drawings – only soft copy (Section 12)	29

Section 1.0

SYSTEM DESIGN DATA

1.1 General

The work comprises of Design, Supply, Installation and Testing & successful Commissioning of Precision Air Conditioning System for buildings described elsewhere in this specifications, on item rate contract basis, in the new Central Drug Research Institute (CDRI), built up in approx. 61 Acres area in Lucknow. The system design basis is outlined in this section. The detailed specifications and specific requirements are outlined in the subsequent sections.

1.2 Location

The proposed buildings for New Central Drug Research Institute are under construction at approx. 14 Kms from Lucknow (U.P.) on Lucknow - Sitapur Road, within Municipal limits of Lucknow.

Site location : Lucknow
Geographical location : 26.52 Deg (N)
Altitude : 111 M above mean sea level

The buildings are completely enclosed consisting Special Equipment laboratory & Computer Hub.

1.3 Buildings / Areas where Precision Air Conditioning is to be done

The Precision air-conditioning system shall be designed for following specified area as follows:

Special Equipment & Plant (03) (G+1) [Ground Floor]

Floor to Floor height of all buildings is 4.2 Mtr.

1.4 BASIS OF DESIGN

1.4.1 Outdoor Design Conditions

Based on the past experience & CBRI Climatological and Solar Data for Lucknow, the out door design conditions for various seasons have been considered as follows:

Ambient Conditions:

	DB		WB		RH
	(°C)	(°F)	(°C)	(°F)	
Summer	42.8	109	26.1	79	26%
Monsoon	34.4	94	28.3	83	64%
Winter	8.9	48	6.1	43	67%

1.4.2 Indoor Design Conditions

Indoor design conditions for Centrally Air Conditioned spaces shall be:

Special equipment plant

DB : 20°C ± 1°C (68°F ± 2°F)
RH : ≤ 50%

1.5 Duty Cycle : 24 Hours operation per day

1.6 Noise Level Design Criteria

Noise Level Design criteria in various areas (Special Equipment lab):

Sr. No.	Area Name	Acceptable Noise Level
		(dBA)
1	Labs	65-70

1.7 Refrigerant Used : R-407c

1.8 Grilles material Used & Hardware : Aluminium Grilles & Brass Hardware.

1.9 False Flooring Height : 400 mm

Section 2 SCOPE OF WORK

2.1 Scope of Work

The scope of work included in this tender shall include (but not limited to) Design, Supply, inspection, delivery at site, installation, testing & successful commissioning and handing over to CDRI of Precision Air Conditioning System for the buildings specified as per Technical specifications elsewhere and also CPWD's General Specifications , on item rate contract basis. All designs and documents shall be approved by EPI.

Providing and fixing at site all equipments associated with Precision Air Conditioning system listed under the technical specifications.

To execute all incidental work at site including materials supply at site associated with Precision Air Conditioning system indicated in the Technical specifications. Nature of such works will be supply, installation, testing & commissioning of Indoor cooling, outdoor condensing unit, fixing grilles, refrigerant piping etc., associated electrical engineering work, power / control cables, control panel etc.

Any other item not mentioned in this specification, BOQ, description of item/system but required to complete that item/system will be in the scope of work of contractor without any extra cost.

Routine testing, Summer, Rainy or Monsoon & Winter season testing, pressure testing of fabricated components, commissioning of complete Precision Air Conditioning system.

Performance testing at site of complete Precision Air Conditioning system as per various technical requirements as stipulated in performance testing clause.

Power supply of 3 ph, 415 volts, 50Hz AC shall be provided at one point in main power panel for group testing & commissioning of complete Precision Air Conditioning system after erection is completed. Further distribution including cabling, earthing cable trays etc. shall be in Precision Air Conditioning Contractor's scope. However, the contractor shall make his own arrangement for power required during construction, fabrication etc.

The equipment shall be suitable to operate on 415 Volts 3 phase, 4 wires, 50 Hz. A.C. supply with a variation of $\pm 10\%$ in Volts and $\pm 5\%$ in frequency respectively. The supply for illumination and single-phase equipment shall be 230 Volts A.C.

2.2 The Precision Air Conditioning system Contractor's scope of work shall include all items of work as per these specifications, drawings, terms and conditions of contract etc. as briefly described in Schedule of Quantities. This shall include, but not be restricted to the following:

A) Supply, Installation, Testing & Successful commissioning of the following :

- a. Precision Air Conditioning units (Indoor cooling unit & Air Cooled Outdoor Condensing unit) with motors and Drives etc.
- b. Insulation for Refrigerant Piping.
- c. Supply air grilles / Diffusers, GSS frame for mounting of Floor grilles / diffusers in false flooring.
- d. False Flooring
- e. Floor Insulation
- f. Under deck Insulation
- g. Foundation bolts, Grouting, Vibration Isolators, Base Frames etc. for mounting the outdoor condensing unit, indoor Cooling Unit and other equipment.

B) Other activities:

- a. Balancing of the entire Precision Air Conditioning installation.
- b. All Minor Masonry, Carpentry and Civil works such as cutting opening in Masonry Walls, Internal Partitions, RCC Slabs etc. for Pipes and Cables and making them good the same to match existing works / décor shall be done by the Contractor, wherever asked for by the Engineer-in-Charge.
- c. All other works associated with above items as per specifications, drawings and conditions of contract except those specifically excluded.
- d. Drainage pipe from unit to drain sump.
- e. Cleaning of site & handing over the works.
- f. Test reports, list of recommended spares, as-installed drawings, operation and maintenance manual for the entire Precision Air Conditioning installation.
- g. Training of Owner's Staff.

Section 3 SYSTEM DESCRIPTION

Supply of microprocessor based single /double - skinned Precision Air conditioning Top/ Bottom suction indoor unit. Outdoor condensing unit shall comprise air-cooled condenser with fan. Indoor unit shall consist of filter section, P-I-D Controller, Electrical Power switch board, multi-rows deep copper cooling coil with aluminium fins, Dehumidification cycle, modular panel cabinet construction, cabinet insulation, fan section with dynamically balanced centrifugal fans with a motor and drive, humidifier, High technology scroll compressor, accessible refrigeration control. The price shall be inclusive of Sequential Controller for Auto Sequencing of units and NIC Cards for BMS Connectivity.

Outdoor air cooled condensing unit shall be installed on the roof of the buildings. Special Equipment lab building is 2 storeys (Ground Floor & First floor only). Each indoor cooling unit will have individual corresponding outdoor air cooled condensing unit.

False Flooring shall be provided for all the areas where Precision Air Conditioning units shall be installed. Precision Air Conditioning units shall be top / bottom discharge type having supply of air through grilles placed with false floor.

Precision Air Conditioning system has been designed to maintain inside conditions of $20^{\circ}\text{C} \pm 1^{\circ}\text{C}$ and $\text{RH} \leq 50\%$ year round for the CDRI Special Equipment Lab situated in Lucknow.

Section 4 PERFORMANCE GUARANTEE

4.1 Performance Guarantee

The contractor shall guarantee that the Precision air conditioning system shall maintain the design inside temperature within $\pm 1^{\circ}\text{C}$ tolerance and the relative humidity shall not exceed the specified limit, as indicated in this specification.

The contractor shall guarantee that the capacity of various components as well as the whole system shall not be less than the specified.

The contractor shall ensure, that the system shall be free of vibrations and disturbing sounds and shall be within limits as described elsewhere in this specification and as specified in relevant IS or, as per ASHRAE Standard.

- 4.2** The successful tenderer shall review the design and design requirements & submit his design for achieving the conditions prescribed in this document. If any variation, irrespective of whether such variation are intended to be executed by other agencies employed by the Client/ EPI, have any bearing on the performance of this Contract, the same shall immediately be brought to the notice of Engineer-in-charge by the Contractor in writing. In any case the Contractor shall have to guarantee for due and proper performance of the works agreed to be so erected for a period of 12 months from the date of completion of work against defective.

The Air-Conditioning installation shall be designed and guaranteed to maintain specified conditions as indicated in other sections of these specifications and drawings read in conjunction with statutory requirements.

It is the sole responsibility of Contractor to obtain all the necessary approvals from the statutory authorities, prior to, during or after installation as and when required, if any. All tests specified hereinafter and witnessed/ approved by the Engineer-in-Charge, may be deemed to be invalid at the option of Engineer-in-Charge, if the requisite, final and unconditional approvals from the concerned statutory authorities are not obtained by the Contractor.

On completion of erection, the contractor shall thoroughly clean all the equipment, inspect and check the entire installation for correctness and completeness and furnish a detailed report of all components of the installation to Engineer-in-charge. The contractor shall also inspect and check the services required by him and provided by other agencies employed by the Client, and confirm the completeness and correctness of such services to the extent necessary.

4.3 Test data

The Precision Air Conditioning system shall be tested as per parameters given elsewhere and complete test data shall be furnished on prescribed data sheet.

Section 5 Main Equipments & their materials specification

5.1 DX Type Air Cooled Precision air condition Units

The room air-conditioning system shall be a floor discharge unit designed specifically for high sensible heat ratio applications such as Special Equipment labs.

Each unit shall be capable of providing sensible cooling capacities at rated ambient temperatures with adequate airflow. Each unit shall be capable of providing actual cooling capacity as mentioned in the schedule of quantities.

The system shall contain Scroll compressor, Evaporator, Humidifier, Condenser and an Thermostatic / Electronic Expansion valve, all of which shall be contained within the cabinet of the unit.

5.2 Cabinet Construction

The frame shall be constructed of Galva bond steel & shall be Single/double skin type. Frame should be design in such a way that Noise level will be in the given range and panel are fitted in such a way to service from the front would be easy for the service point.

5.3 Filtration

The filter chamber shall be an integral part of the system and withdraw able from the front of the unit. The filter should be of 5 micron filtration Capacity & efficiency level should be above 90%.

5.4 Fans

The fan section shall be designed for an external static pressure of 25 Pa. The fans shall be located downstream of the evaporator coil and be of the forward /backward curved centrifugal type, double width, double inlet and statically and dynamically balanced to G6.3DIN ISO 1940 part I. Each fan shall be separately driven by a high efficiency electric motor. The assembly of the whole fan section has been designed to facilitate all servicing requirement.

5.5 Humidifier

Humidification shall be provided by boiling water in a high temperature polypropylene steam generator. The steam shall be distributed evenly into the bypass airstreams of the environment control system to ensure full integration of the water vapor into the supply air without condensation. The humidifier shall have an efficiency of not less the 1.3 kg/kw and be fitted with an auto flush cycle activated on demand from

themicroprocessor control system. The humidifier shall be fully serviceable with replacement electrodes. Wastewater shall be flushed from the humidifier by the initiation of the water supply solenoid water valve via a U-pipe overflow system. Drain solenoid valves will not be used.

5.6 Electrical Heating

The electric heating elements shall operate at a heat density level not exceeding 60 kW/m². The low watt density elements shall be of finned tubular steel construction finished in high temperature paint. The heating circuit shall include dual safety protection through loss of air and manual reset high temperature controls.

5.7 Scroll Compressor

The compressor shall be of the high efficiency complaint scroll design with an E.E.R. (energy efficiency ratio) of not less than 3.25) at ARI rating conditions. The compressor shall be charged with mineral oil and designed for operation on **R407c**. Each compressor shall have internal motor protection and be mounted on vibration isolators.

5.8 Refrigeration Circuit

The refrigeration system shall be of the Single circuit direct expansion type and incorporate hermetic scroll compressors, complete with crankcase heaters. Cooling steps shall be a maximum of 50% of total unit cooling capacity for one and two compressor models. The system shall include a manual reset high pressure control; auto reset low temperature switch, thermostatic / electronic expansion valve, high sensitivity refrigerant sight glass, large capacity filter drier and charging/access ports in each circuit. Each refrigeration circuit shall include rigidly mounted isolation valves in the discharge and liquid lines to aid servicing and installation (air cooled units only).

5.9 Evaporator Coil

The evaporator coil shall be A-shape coil (for down flow) incorporating draw-through air design for uniform air distribution. The coil shall be constructed of rifled bore copper tubes and louvered aluminum fins, with the frame and drip tray fabricated from heavy gauge aluminum. All metal parts in contacts with condensate shall be the same material to prevent electrolytic corrosion. The drip trays shall ensure the collection of condensate and be accessible for cleaning

5.10 Dehumidification

Dehumidification function shall operate only when actually required, without reduction in the airflow rate and ensure uniform air distribution & Avoids sudden variation in supply air & room air temperature.

5.11 Remote Air Cooled Condenser

The air-cooled condenser shall be the low profile, weatherproof type incorporating high efficiency, direct drive, external rotor motors with axial blade fans. The condenser shall be constructed from heavy-duty aluminums and corrosion resistant components. Heavy duty mounting legs and all assembly hardware shall be included. Condensers shall be suitable for 24-hour operation and be capable of providing vertical or horizontal discharge. The condenser shall be fully factory wired and require a 230-volt I phase 50 Hz electrical services.

5.12 Fan Speed Control Condenser

The condenser fans shall be directly driven by 4 pole 1210 rpm 230 volt 50 hz electric motors with an IP54 enclosure rating and class F insulation. The motor shall be equipped with permanently sealed ball bearing and high temperature grease. The motors shall be speed controlled to ensure stable operating conditions from -5°C to 45°C ambient by a factory fitted, direct acting pressure actuated fan speed controller. The control system shall be complete with input isolation switch, transducers and pressure switches.

The high performance heat exchanger shall include mechanically expanded crosshatched copper tubes and louvered aluminum form maximum heat transfer. The coil shall be finished in a high temperature modified epoxy coating (kirbykote) to offer increased protection in aggressive environments. The coil shall be have maximum of 3 rows and 472 fins per meter and the face velocity shall not be more than 2.91 m/s.

5.13 Unit Size

The unit shall require front access (600 mm) only for routine service and installation work.

5.14 Unit Controller

The unit controller shall be microprocessor based and include a large .LCD backlit graphic display for clear visibility of text and graphics. The display and control buttons shall be accessible from the unit front without removing any external panels. The controller shall feature ISP (In-system-Programming) technology to support program upload via a PC.

Control strategies shall be P-I-D with dew point compensation for accurate temperature and humidity control. A selection of return or supply air control shall be provided to suit the application. The controller shall have a user-friendly menu driven interface with supporting help screens and shall use multi protocol data communications. Access to the controller settings to prevent against unauthorized access. In normal operating mode screen shall display unit number, temperature and relative humidity set points and actuals, graphs, time, date and operating status. Dynamic icons identify the system-operating mode. A 48-hour real time log of temperature and humidity data shall be retained by the control system. All parameters and data shall be protected in memory by an onboard battery. An EIA-232 communications interface shall provide the capability of remote monitoring with the option of EIA-485 interface on 2 or 4 wire connection.

5.15 **Control**

The control system shall allow programming of the following conditions:

- Temperature set point
- Humidity Set point
- High Temperature Alarm
- Low temperature Alarm
- High Humidity Alarm
- Low Humidity Alarm

The control system shall include the following settable features:

- Unit identification number.
- Startup Delay, Cold start Delay and Fan Run on timers
- Sensor Calibration.
- Remote shutdown & general Alarm management
- Compressor Sequencing.
- Return temperature control.
- Choice of Modulating output types.

5.16 **Alarms**

The microprocessor shall activate an audible, visual and general alarm in the event of any of the following conditions:

- High Temperature
- Low Temperature
- High Humidity
- Low Humidity
- Loss of Air
- High Pressure
- Low Pressure
- Humidifier Low Water
- Water Under Floor
- Spare Alarm 1 and 2 (Customized text)

The unit shall also incorporate the following protections:

- Single phasing preventors.
- Reverse phasing
- Phase imbalancing
- Phase failure
- Overload tripping (MPCB) of all components

Section 6 Other Equipments & their materials specification

6.1 FLOOR INSULATION

Floor shall be insulated by 9 mm thick Elastomeric Nitrile Rubber of density 40 Kg/m³ and k value 0.034 W/m.k at 0° C mean temperature. Floor insulation shall be provided only Special Equipment Lab. Building alongwith adhesives etc.

Determine the size of the insulation material sheet required for insulation. Cut the material to the measured size with sharp knife and straight edge. Ensure that the cuts are as accurate as possible with smooth edges to ensure full contact with mating sheets when bonded together. Do not stretch sheets and always apply smooth skin surface facing out. The surface to be insulated should be thoroughly clean, dry, oil free and unheated to ensure proper adhesion. The joints should be covered with the aluminium tape of approved make.

6.2 UNDER DECK INSULATION

Underdeck (ceiling of exposed roof) shall be insulated by 19 mm thick Elastomeric Nitrile Rubber of density 40 Kg/m³ and k value 0.034 W/m.k at 0° C mean temperature. Underdeck insulation shall be provided for Special Equipment Lab. Building alongwith adhesives etc. for roof of conditioned areas exposed to sun.

Determine the size of the insulation material sheet required for insulation. Cut the material to the measured size with sharp knife and straight edge. Ensure that the cuts are as accurate as possible with smooth edges to ensure full contact with mating sheets when bonded together. Do not stretch sheets and always apply smooth skin surface facing out. The surface to be insulated should be thoroughly clean, dry, oil free and unheated to ensure proper adhesion. The joints should be covered with the aluminium tape of approved make.

6.3 FLOOR GRILLES

The extruded aluminium grilles shall be able to with stand live load of Equipment. The outer frame shall be made of 30 mm x 18 gauge flat and louvers shall be 25 x 25 mm aluminium construction . The outer size of the grille shall be approx. 600 x 600 mm or 300 mm x 300 mm (actual size as per false floor frame). The volume control damper shall be constructed out of aluminium.

6.4 **FALSE FLOORING**

Preparing the floor and providing and fixing antistatic cementitious false floor tiles on stringers and pedestals as per the specifications given below. All steel rectangular stringer system having pre-punched holes at both ends to ensure correct alignment with pedestal heads should be applied for maximum stability.

6.4.1 **SPECIFICATIONS OF GROUND FLOOR ACCESS FLOOR TILE**

Supply, installation, testing & commissioning of imported Steel Cement Cavity Access floor Tile.

Specification of Panel/Tile:

Tile Size	- 600mm x 600mm tile
Point Load	- 440 kg
Rolling Load	- 450 kg
Uniform Dis. Load (UDL)	- 2100 Kg. per M ²

- Finish** : High Pressure Laminate finish with gray colour special coating on tile for weather protection.
- Tile** : All steel construction & cavity filled with epoxy mix cement. Top plate 1.20, Bottom plate 1.00mm of steel with gray color coated on a continuous line having 64 round embossing to the bottom plate with 100 spot welding to weld top & bottom plate. Total thickness of tile 35 / 36mm & PVC beading on all the edges of the tile .
- Pedestal** : All steel constructions & silver Zinc plated 25mm Dai pipe pedestal with bottom plate of 100mm x 100mm x 2mm thick. Top plate of 75mm x 75mm x 3mm thick with threaded bolt & 2 nuts (10mm each) for leveling adjustment & locking.
- Stringer** : 575 x 25 x 20 mm square tube of 1.5 mm GI fixed on the top of pedestal to make grid for strength & noise reduction .

Pedestal Fixing: using epoxy adhesive or with screw / anchor fastener.

Note: **Special feature of the Product:**

1. Tile should be proper backing & covering material along with the edges to protect it from moisture.
2. Fire proof as per British Standard 476 part 4:1970 for panel-non combustible material.
3. Fast & accurate installation.
4. Meeting international loading standard (a) CISCA OF USA (b) MOB OF UK
c) SJ/T-10769 OF CHINA.

6.4.2 SPECIFICATIONS OF FIRST FLOOR ACCESS FLOOR TILE

Supply, installation, testing & commissioning of imported Steel Cement Cavity Access floor Tile.

Specification of Panel/Tile:

Tile Size	- 600mm x 600mm
Point Load	- 250 kg
Rolling Load	- 250 kg
Uniform Dis. Load (UDL)	- 1050 Kg. per M ²

Finish : High Pressure Laminate finish with gray colour special coating on tile for weather protection.

Tile : All steel construction & cavity filled with epoxy mix cement. Top plate 0.70, Bottom plate 0.70mm of steel with gray color coated on a continuous line having 64 round embossing to the bottom plate with 100 spot welding to weld top & bottom plate. Total thickness of tile 35mm & PVC beading on all the edges of the tile .

Pedestal : All steel constructions & silver Zinc plated 19mm Dai pipe pedestal with bottom plate of 100mm x 100mm x 2mm thick. Top plate of 75mm x 75mm x 3mm thick with threaded bolt & 2 nuts (10mm each) for leveling adjustment & locking.

Stringer : 575 x 25 x 20 mm square tube of 1 mm GI fixed on the top of pedestal to make grid for strength & noise reduction .

Pedestal Fixing: using epoxy adhesive or with screw / anchor fastener.

Note: Special feature of the Product:

1. Tile should be proper backing & covering material along with the edges to protect it from moisture.
2. Fire proof as per British Standard 476 part 4:1970 for panel-non combustible material.
3. Fast & accurate installation.
- 4 Meeting international loading standard (a) CISCA OF USA (b) MOB OF UK
d) SJ/T-10769 OF CHINA.

Section 7 INSPECTION, TESTING AND COMMISSIONING

7.1 GENERAL

This chapter covers initial inspection and testing of compressor, condenser & indoor chilling unit at manufacturer's works, Initial inspection of other equipments/ materials on receipt at site, final inspection, testing & commissioning of all equipment at site & description of testing requirements & procedure.

All equipment shall be tested at manufacturer's work as per latest relevant BIS specifications or in the absence of BIS specification, approved testing methods shall be followed and test certificates/ reports submitted to the Engineer-in-charge. The contractor shall intimate in advance the probable date of such tests to the Engineer-in-charge to enable him / his representatives to witness the tests if he so desires. But under no circumstances shall this absolve the Contractor of his responsibility for Performance of the Equipment or System.

In addition to the above, all equipment and systems shall be tested after installation as required by various statutory authorities, certifying agencies and as required under various sections of these specifications / Special Conditions.

The Contractor shall leave necessary provisions required for fixing instruments, gauges, meters, etc. for testing the installation even if these are not shown on the drawings. All such instruments, services etc. needed for the tests shall be arranged by the Contractor at his own cost.

Notwithstanding approval of tests or equipment or materials by Engineer-in-charge / Statutory Authorities etc., up to the tests in static state as described here-in above, the Contractor shall be required to perform site tests to prove correctness of ratings and performance of equipment, machines and materials supplied and installed by him, in dynamic state also.

All equipment shall be capable of performing the duties specified in these specifications without damage, distortion or failure of any component.

The performance of various equipment individually shall not be less than quoted ratings and consumption of power, fuel or other consumable shall not exceed the ratings quoted by the tenderer, when tested in dynamic state. The special conditions regarding penalty clause may also be noted in this regard.

All test instruments shall be calibrated for accuracy prior to taking the performance tests.

All safety and control instruments shall be checked for proper operation, sequencing etc. and set points furnished to Engineer-in-charge.

In the event of short fall in rating of individual equipment/ materials or excessive consumption of power/ fuel etc. or non-fulfillment of performance of equipment/ materials or overall installation, in any way whatsoever, the Contractor shall at his own cost make good the defects by altering, repairing, replacing, augmenting etc. as required at his own cost and to the entire satisfaction of Engineer-in-charge and within reasonable time as may be decided by Engineer-in-charge.

7.2 INITIAL INSPECTION AT MANUFACTURER'S WORKS

- a. Physical verification for thickness and make shall be carried out as per contract before application of insulation.
- b. Manufacturer's test certificate for density shall be furnished.

Note: Accuracy of testing instruments shall be as mentioned in the final inspection procedure given below.

7.3 FINAL INSPECTION AND TESTING

The Contractor shall intimate in writing to Engineer-in-charge as and when individual components of the installation are ready for hydraulic / pneumatic / electrical, etc. tests required for further progress of erection. All such tests shall be carried out as per these specification and/ or as directed by Engineer-in-charge and recorded in the presence of Engineer-in-charge / his representatives

The Contractor shall intimate in writing to Engineer-in-charge, the proposed date of initial startup and request for ancillary requirements such as permanent power etc. to be made available to him for initial operation of his installation.

The Contractor shall, on approval of Engineer-in-charge, proceed with necessary pre-commissioning activities and tests and put the installation on initial operation and start-up during which preliminary adjustments and balancing shall be carried out. Testing shall be carried out for all three seasons.

Routine testing for summer, winter & Monsoon season, pressure testing for fabricated components shall be required.

Performance testing at site of complete Air conditioning plant as per various technical requirements, as stipulated in the Performance Testing Clause.

Based on preliminary observations during the initial operation described above, necessary modifications/ repairs/ replacements/ etc. if any shall be carried out by the Contractor to the entire satisfaction of Engineer-in-charge. On successful completion of initial operation, the Contractor shall proceed with trial runs.

Unless otherwise indicated, the trial runs shall be carried out for minimum period of 10 days, each of 24 hours duration. In case of interruptions of a duration of more than 4 hours at a time, the period of trial runs shall be extended by 1 (One) day.

After successful trial operations, the Contractor shall proceed with preliminary testing performed during static phase, i.e. rooms or facilities are complete and ready for operation, with all services connected and functional, but without full / any occupancy or equipment in the rooms/ facilities. The preliminary test readings shall be recorded at intervals of not more than 1 hr for a period of minimum 10 days of 24 hours duration each day. Such readings shall be recorded in format approved by Engineer-in-charge.

Test readings taken in the static state of operation shall not be considered as performance tests, unless such tests are not deemed to be affected by factors which shall be present in the dynamic state. All such test readings shall be witnessed by the Engineer-in-charge or his authorised representatives.

Final performance tests shall then be carried out in dynamic state i.e. when rooms/ facilities are in normal operation with all services and equipment functional and with normal occupancy of staff present and performing their normal functions.

Final performance test shall be carried out for a minimum period of 10 consecutive days of 24 hours duration each day, unless otherwise directed by Engineer-in-charge and for each equipment and overall system with test reading and observations being witnessed by Engineer-in-charge or his representatives.

The performance tests for Precision Air Conditioning System shall be carried out during peak summer and monsoon seasons. However, if these systems are required to be put into operation for beneficial use of Client at a time other than peak summer or monsoon seasons, then, the equipment and overall installation shall be taken over by the Department and put into operation. The final performance tests, in any case, shall have to be carried out during peak summer and monsoon and witnessed by Engineer-in-charge or his representative.

Pressure drops across chiller and condenser at specified flow rates shall be checked.

All instruments for testing shall be arranged by the Contractor and suitable provision made in the piping and / or equipment for installing the same.

7.4 TESTING REQUIREMENTS AND PROCEDURES

Balancing of all air systems and all tests as called for in the Specifications shall be carried out by the Contractor in accordance with the Specification, the Relevant Indian Standard Specification & Recommendation of the American Society of Heating, Refrigerating and Air-conditioning Engineers (USA). Test results for summer and monsoon cooling and winter heating shall be tabulated in approved manner and four copies shall be submitted to the Owner / Consultant for his scrutiny. Four copies of the certified manufacturers performance curves for each piece of equipment shall be submitted alongwith the test results. The contractor shall also provide to the Owner / Consultant four copies of record of all safety and automatic control settings for the entire installation.

The contractor shall arrange for all necessary balancing and testing equipment, instruments. Any defect in testing shall be rectified by the contractor entirely at his own cost, to the satisfaction of the Owner / Consultant. The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Owner / Consultant. All tests shall be carried out in the presence of the Owner / Consultant.

Performance tests of individual equipment and control shall be carried out as per manufacturer's recommendation. All tests and balancing shall be carried out in the presence Engineer-in-charge or his authorised representative.

The whole system balancing shall be tested with microprocessor based hi-tech instruments with an accuracy +/- 0.5%.

The instrument shall be capable of storing data and then down loading into a P.C.

The Contractor shall arrange, if required, a minimum but not limited to the following instruments:

- a. Microprocessor based calculation meter to measure DB and WB temperature, RH and Dewpoint.
- b. Velocicalc meter to measure air volume and air velocity
- c. Pitot tube
- d. Electronic rotary vane Anemometer
- e. Accubalance flow measuring hood

7.5 RUNNING-IN-PERIOD

After satisfactory final inspection as stated the contractor shall demonstrate the trouble free running of the installation for a period of not less than 10 days before CDRI takes over. The duty cycle of the plant during this Running-In-Period shall be same as specified in Technical Specifications. In case of multiple compressor installation, all the compressors should run by rotation. After the installation has operated for 10 days period without any breakdown or abnormal / unsatisfactory operation of any machinery during this period, the Precision Air Conditioning System shall be deemed to have run trouble-free. The contractor should include one year of free running maintenance after completion of 10 days of trouble free running including replacement of defective parts etc. at his own cost.

Power supply of 3 phase, 415 Volts, 50 Hz, AC shall be provided at one point by EPI / CDRI for group testing & commissioning of complete Precision Air Conditioning System after erection is completed. However, the contractor shall make his own arrangements for power required during construction, fabrication, erection & trial run etc.

The contractor shall arrange at his own cost for all staff, fuel, POL, refrigerant gas and other consumables during Trial run, Commissioning and Running-in-Period upto the date of acceptance. Nothing extra shall be paid on this account.

7.6 DATE OF ACCEPTANCE

Subject to the guarantee Clause date of taking over the installation after 10 days of trouble free operation shall be the date of acceptance. Any undue wear and tear of components during the "Running in Period" shall be made good by the contractor free of charge.

7.7 SEASONAL TESTS

The contractor shall carryout three Seasonal Tests for Summer, Monsoon & Winter as soon as the ambient / outside conditions are suitable for that. All the three seasonal tests (Summer, Monsoon & Winter) must be completed successfully during the Defects Liability Period of 12 months, otherwise Defects Liability Period will get extended till all the three Seasonal Tests are successfully completed. Nothing extra shall be paid on this account.

7.8 GUARANTEES

- a) The guarantee shall cover each & every material whether manufactured by the contractor or not. The contractor shall replace the defective parts with new ones. Replaced parts shall also be covered by a similar guarantee.
- b) The replaced parts shall be of genuine make and subject to approval by the EPI / CDRI.
- c) The contractor shall guarantee the performance of the entire process, equipment and pipeline for a period of one year from the date of handing over to CDRI.

The three Seasonal Tests are successfully completed. Nothing extra shall be paid on this account.

7.9 REPORTS

Provide 3 copies of the complete balancing and testing reports to EPI / CDRI. Report shall be neatly typed and bound suitable for a permanent record. Report forms shall contain complete test data and equipment data as specified.

7.10 FINAL DOCUMENTATION

The contractor shall leave the system operating in complete balance with water and air quantities as shown on drawings. Set stops on all balancing valves and lock all damper quadrants in proper position. Notify the department of any areas marginal or unacceptable system performance.

The above tests and procedures mentioned herein are for general guidance and information only, but not limited to the provisions of conditions of contract and design/ performance criteria.

Upon commissioning and final handing over of the installation, the Contractor shall submit (within 4 weeks) to the Engineer-in-charge 8 (Eight), portfolios of the following documents, indexed and bound together in hard cover ring binder (300 x 450 mm).

- a. Comprehensive operation and maintenance manual and spare parts catalogue for all equipments.
- b. As built drawings in hard copy and soft copy.
- c. Test certificates, consolidated control diagram and technical literature on all controls.
- d. Equipment warranties from manufacturer's.
- e. Rating charts for all equipment.
- f. Log books as per equipment manufacturer's standard format.
- g. List of recommended spares and consumables.

- h. Detailed circuit diagram, local diagram of various electrical components for control of all equipment provided.
- i. Sequence operation notes explaining the sequence of operations when operation button is pressed.

Any special tools required for the operation or the maintenance of the plant shall be supplied free with the plant.

At the close of the work and before issue of final certificate of completion by the Engineer-in-charge, the contractor shall furnish a written guarantee indemnifying CDRI/EPI against defective materials and workmanship for the Defects liability period.

Section 8 SCHEDULE OF TECHNICAL DATA

8.1 GENERAL

Technical data for all pieces of equipment and materials shall be submitted in the formats given in this section.

If the technical data is not filled in completely then the tender is liable for rejection.

Separate forms are to be filled in for different models of equipment and each alternative offered.

Performance charts and catalogues of all equipment are to be submitted along with the tender. The technical literature so enclosed will not be a substitute for the Data sheet, the data sheet has to be necessarily filled in.

Additional information if any, may be added at the end of each format.

Data given by the tenderer in this section is for general information of the Engineer-in-charge and shall not relieve the Contractor of his performance liability under any circumstances.

Tenderers shall carefully study the spaces allotted for installation of equipment and allied works and offer their equipment and systems to fit into the spaces allotted. The tenderers shall take into account the spaces required for maintenance etc. All requirements for safe and efficient installation and operation of the plants shall be deemed to be included in the offer.

All deviations from technical specification must be listed under section "Schedule of Departure from Specifications". Any deviation implied or mentioned in this schedule may be ignored at the discretion of the Engineer-in-Charge.

Non-compliance to above instruction may result in rejection of the tenders.

8.2 SCHEDULE OF TECHNICAL DATA

Indoor Unit		
<u>Description</u>	<u>Unit</u>	
Number of bay	--	
Number of circuit's	--	
Casing material	--	
Skin	--	
TYPE OF UNIT:		
Floor Unit	FA/RA/DA	
COMPRESSOR:		
Make	--	

Type	--	
Model No.	--	
No of Compressor / unit	nos.	
Power supply	V / Ph / Hz	
Capacity Control Arrangement	%	
Method of Lubrication	--	
Grade of Lubrication Oil	--	
Starting & unloading arrangement	--	
Motor rpm	rpm	
Motor class of insulation	--	
Motor protection	--	
EVAPORATOR COIL:		
Make	--	
Type	--	
No of Coil / unit	--	
Rows deep	nos.	
Face area	m ²	
Fins per Inch	nos.	
Tube Material / Size / Thick	-- / mm / mm	
Fin Material / Thick	-- / mm	
REFRIGERANT CONNECTIONS		
Gas Connection (OD)	mm	
Liquid Connection (OD)	mm	
EVAPORATOR FAN:		
Make	--	
Type of Fan	--	
Material Fan / Frame	--	
Type of Drive	--	
Fan diameter	mm	
No of Fan / unit	nos.	
Power supply	V / Ph / Hz	
Motor rpm	rpm	
Motor class of insulation	--	
Motor protection	--	
Type of Bearing	--	
Bearing Lubrication	--	
EXPANSION VALVE:		
Make	--	

Type	--	
FILTERS:		
Make	--	
Type	--	
Size	mm	
Qty.	nos.	
Filtration efficiency	% / micron size	
Pressure drop (clean condition)	mm wc	
Pressure drop (dirty condition)	mm wc	
HUMIDIFIER:		
Make	--	
Type	--	
Capacity	kg /hr	
Input power	kW	
Setting - Amps	Amp's	
Power supply	V / Ph / Hz	
ELECTRICAL HEATER:		
Make	--	
Capacity	kW	
Power supply	V / Ph / Hz	
DIMENSION AND WEIGHT:		
Width	mm	
Depth	mm	
Height	mm	
Footprint	mm ²	
Weight (Air Cooled)	kg	
Weight (Water Cooled)	kg	
Air cooled condenser		
Number of circuit's	--	
CONDENSER COIL:		
Make	--	
Type	--	
Face area	m ²	
Air Volume	m ³ / hr	
Rows deep	nos.	
Fins per Inch	nos.	

Tube Material / Size / Thick	-- / mm / mm	
Fin Material / Size / Thick	-- / mm / mm	
CONDENSER FAN:		
Make	--	
Type of Fan	--	
Fan Material	--	
Type of Drive	--	
No of Fan / Condenser	nos.	
Impeller Diameter	mm	
Power supply	V / Ph / Hz	
Motor Rated KW	kW	
Full Load Amps (FLA)	amps.	
Motor rpm	rpm	
Motor class of insulation	--	
Motor protection	--	
DIMENSION AND WEIGHT:		
Casing Material	--	
Vertical Discharge		
Width	mm	
Depth	mm	
Height	mm	
Horizontal Discharge		
Width	mm	
Depth	mm	
Height	mm	
Weight	kg	

Section 9 LIST OF APPROVED MAKES

SI No.	Item	Manufacturer/ Brand Name
1	Precision Units	Emerson-Liebert /Batliboi /APC /Hiross/Uniflair/Stulz/Blue Star
2	Grille/diffuser	Servex /Ravistar/ Core /Dynacraft/Mapro
3	Floor/ Underdeck Insulation (Closed Cell Elastomeric Nitrile Rubber along with adhesive)	Armacell – Armaflex (UK / German)/ Eurobatex – Union Foam (Italy)/ K- Flex/ Superlon
4	Fans : Axial / Centrifugal / Propeller Fans	Kruger/GEC (Alstom)/ NADI / Nicotra / Crompton
5	Pipes : MS / ERW / GI	Zenith / Jindal / Tata / SAIL / ITC
6	Fittings : G.I	Leader (ISI marked) / Zoloto (ISI marked) / Unique (ISI marked)
7	False Flooring Tiles	M-Floor/ KEBCO/ DONN / UNIFLAIR/ DMC

Section 10 APPENDIX-I

LIST OF BUREAU OF INDIAN STANDARDS CODES

IS: 277 – 1992	Galvanized steel sheet (Plane & Corrugated)
IS: 554 – 1985 (Reaffirmed 1991)	Dimensions for pipe threads where pressure tight joints are required on the thread.
IS : 655 – 1963 (Reaffirmed 1991)	Metal air duct
IS : 659 – 1964 (Reaffirmed 1991)	Air conditioning (Safety Code)
IS : 660 – 1963 (Reaffirmed 1991)	Mechanical Refrigeration (Safety code)
IS : 694 – 1990 (Reaffirmed 1994)	PVC insulated electric cables for working voltage up to and including 1100 volts.
IS : 732 – 1989	Code of practice for electrical wiring.
IS : 780 - 1984	Sluice valves for water work purposes.
IS : 822 – 1970 (Reaffirmed 1991)	Code of procedures for inspection for welds.
IS : 1239 (Part – 1) – 1990	Mild steel tube.
IS : 1239 (Part – II) –1992	Mild steel Tubular and other wrought steel pipefitting.
IS : 1255 – 1983	Code of practice for installation and maintenance of power Cables up to and including 33 KV rating (Second revision).
IS : 1554 1988 (Part –I)	PVC insulated (Heavy Duty) electric cables for working voltage upto and including 1100 volts.
IS : 1897 – 1983 (Reffirmed 1991)	Copper bus bar /strip for electrical purposes.
IS : 2379 – 1990	Colour code for the identification of pipelines.

IS : 2551 – 1982	Danger notice plate.
IS : 3034 - 1987	Code for practice for earthing.
IS : 3103 – 1975 (Reaffirmed 1999)	Code for practice for industrial ventilation.
IS : 3837 – 1976 (Reaffirmed 1990)	Accessories for rigid steel conduit for electrical wiring.
IS : 4736 – 1976 (Reaffirmed 1998)	Hot-dip zinc coating on steel tubes.
IS : 4894 – 1987	Centrifugal fan.
IS : 5133 – 1969 (Part-I) (Reaffirmed 1990)	Boxes for the enclosure of electrical accessories.
IS : 5216 – 1982 (Part-I) (Reaffirmed 1990)	Guide for safety procedure and practices for electrical work.
IS : 5312 (Part-I) – 1984 (Reaffirmed 1990)	Swing – check type reflux non-return valve for water works.
IS : 5424 1989 (Reaffirmed 1994)	Rubber mats for electrical purposes.
Is : 5578 & 11353-1985	Marking and identification of conductors.
IS : 6392 – 1971 (Reaffirmed 1988)	Steel pipe flanges.
IS : 8623 – 1993	Low voltage switch gear and control gear Assemblies (Required for type /partly type tested assemblies).
IS : 8623 – 1993 (Part-II)	Bus bar trunking system.
IS : 8828 – 1996	Circuit Breakers for over current protection for house hold and similar installation.
IS : 9537 – 1981 (Part-II)	Rigid Steel Conduits for electrical wiring.
IS : 10810 – 1988	Methods of test for cables.
IS : 13947 – 1993 (Part-I)	General rules for low voltage switch gears and control gears.
IS : 13947 – 1993 (Part-II) IEC 947 – 2	Circuit Breakers.

IS : 13947 1993 (Part-III)	Switches disconnectors and fuse for low voltage switch gear and control gears.
IS : 13947 – 1993 (Part-IV)	Low voltage switch gear and control for contractors and motor starters.
IS : 13947 – 1993 (Part-V)	Control circuit devices.
IS : 325	Three phase induction motor.
IS : 996	Single phase A.C. motor.
BS : EN : 779 – 1993	Filters.
CPWD Handbook on HVAC	CPWD's General Specifications for Heating, Ventilation & Air-Conditioning (HVAC) Works
ASHRAE Hand Books	American Society of Heating Refrigeration and Air Conditioning Engineers.
	Application 1999
	System & Equipments 2000
	Fundamentals 2001
	ASHRAE Indoor air quality Standard 62-2001
IEC	Relevant section.

SECTION 11**PRECISION AIR CONDITIONING TONNAGE LOAD**

Sl. No.	Description	Area (Sq. M.)	Supply CFM	Tonnage (in TR)	Precision AC Units installed
A	SPECIAL EQUIPMENT Plant (02 & 04)				
	GROUND FLOOR				
(i)	Left Side (NMR- Area)	1892.00	7825	8.5	02
(ii)	Right Side (NMR - Area)	1892.00	9375	8.5	02
B	SPECIAL EQUIPMENT Plant (02 & 04)				
	FIRST FLOOR				
(i)	Left side (Mass Lab.)	498.74	5299.55	8.5	01
		TOTAL			05

SECTION 12**LIST OF TENDER DRAWINGS**

Sl. NO.	DESCRIPTION	DRG. No.
1	Special Equipment & plant (02 & 04)- Ground floor	CDRI/ LKW/499/A 11A/ -02 Sheet EQP.1 / R 0
2	Special Equipment & plant (02 & 04)- First Floor	CDRI/ LKW/499/A 11A/ -02 Sheet EQP.1 / R 0
3	Special Equipment & plant (03)- (Equipment Allocation)- Ground Floor	CDRI/ LKW/499/A 11A/ -03 Sheet EQP.1 / R 0
4	Special Equipment & plant (03)- (Equipment Allocation)- First Floor	CDRI/ LKW/499/A 11A/ -03 Sheet EQP.1 / R 0