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Name of Work: Annual zonal contract for petty domestic air conditioning & refrigeration works in and outside of academic area.

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NIT amounting to Rs. 13,41,628/- is approved.

**Executive Engineer
I.W.D. Elect. & AC Divn.
I.I.T., Kanpur**

**Superintending Engineer
Central Office, I.W.D.
I.I.T., Kanpur**

PART-A

INDIAN INSTITUTE OF TECHNOLOGY KANPUR
INSTITUTE WORKS DEPARTMENT
Electrical & Air-conditioning Division
E-TENDER NOTICE

NIT No. 09/AC/2020/135

Dated : 19.08.2020

The Executive Engineer, IWD, I.I.T., Kanpur on behalf of Board of Governors of IIT Kanpur invites online item rate tender from air-conditioning contractors for the following work:-

Sl. No	Name of work and location	Estimated cost put to tender (In Rs.)	Earnest Money (In Rs.)	Period of Completion (in Month)	Last date & time of submission of tender	Period during which EMD, Cost of Tender Document, e-Tender Processing Fee and other Documents shall be submitted	Time & date of opening of tender
1	Annual zonal contract for petty domestic air conditioning & refrigeration works in and outside of academic area.	13,41,628/-	26833/-	12 months	Upto 3.30 PM on 04.09.2020	After last date and time of sub-mission of tender and upto 3:30 PM on 07.09.2020	At 3:30 PM on 09.09.2020

The E-tender documents is available on www.tenderwizard.com/IIT

Executive Engineer

Copy to:

1. Institute website: www.iitk.ac.in/iwd/tenderhall.htm
2. Notice Board

Information for e-tendering for Contractors

1. The intending tenderer must read the terms and conditions of FORM-6 for e-Tendering carefully. He should only submit his tender if he considers himself eligible and he is in possession of all the documents required.
2. Information and Instructions for tenderer posted on website shall form part of tender document.
3. The tender document consisting of plans, specifications, the schedule of quantities of various types of items to be executed and the set of terms and conditions of the contract to be complied with and other necessary documents can be seen and downloaded from website www.tenderwizard.com/IIT or www.iitk.ac.in free of cost.
4. But the tender can only be submitted after uploading the mandatory scanned documents as per list given below.
5. The intending tenderer has to fill all the details such as Banker's name, Demand Draft/Fixed Deposit Receipt /Pay Order/ Banker's Cheque/Bank Guarantee number, amount and date.

The amount of EMD can be paid by multiple Demand Draft / Pay Order / Banker's Cheque / Deposit at call receipt / Fixed Deposit Receipts along with multiple Bank Guarantee of any Scheduled Bank if EMD is also acceptable in the form of Bank Guarantee.

6. Those contractors not registered on the website mentioned above, are required to get registered beforehand. If needed they can be imparted training on online bidding process as per details available on the website.
7. The intending tenderer must have valid class-III digital signature to submit the tender.
8. On opening date, the contractor can login and see the tender opening process. After opening of tenders he will receive the competitor tender sheets.
9. Contractor can upload documents in the form of JPG format and PDF format.
10. Contractor must ensure to quote rate of each item. The column meant for quoting rate in figures appears in pink colour and the moment rate is entered, it turns sky blue.

In addition to this, while selecting any of the cells a warning appears that if any cell is left blank the same shall be treated as “0”.

Therefore, if any cell is left blank and no rate is quoted by the tenderer, rate of such item shall be treated as “0” (ZERO).

List of Documents to be scanned and uploaded within the period of tender submission:

- *Copy of registration if any.*
- *Required experience / completion certificates of similar nature of works.
The works certificates submitted by the bidder clearly indicate that:*
 1. *The completion certificate cost of the air-conditioning & refrigeration works.*
 2. *Actual date of completion of the air-conditioning work.*
- *Copy of EPF & ESI No.*
- *Details of turn over during the last three years.*
- *Copy of GST Registration No.*
- *EMD & details of processing fee.*

FORM -6 FOR e-Tendering

The Executive Engineer, IWD, I.I.T., Kanpur on behalf of Board of Governors of IIT Kanpur invites online item rate tenders from eligible air-conditioning contractors for the following work(s):
Annual zonal contract for petty domestic air conditioning & refrigeration works in and outside of academic area.

- 1.1 The work is estimated to cost Rs. **13,41,628/-** This estimate, however, is given merely as a rough guide.
- 1.2 The authority competent to approve NIT for the combined cost and belonging to the major discipline will consolidate NITs for calling the tenders. He will also nominate Division which will deal with all matters relating to the invitation of tenders.

2 Criteria of eligibility

- **The Tenderer should have completed satisfactorily at least *3 similar works each of value 40% of the estimated cost or *2 similar works of 60% of the estimated cost or *1 similar work of 80% of estimated cost during the last 7(seven) years. (at least one work of them should be in Central Govt. /Central Autonomous bodies/ Central PSU/State PSU /State Govt.),.**
 - **Details of average annual financial turnover on air-conditioning works should be at least 100% of the estimated cost during the last 3 consecutive financial years, list of works completed of the requisite magnitude along with the attested copies of certificates of satisfactory completion”.**
 - **Having ESI & EPF registration No. of government authorities.**
 - **Copy of GST Registration**
 - **Having a bank solvency certificate not less of 40% of estimated cost.**
3. Agreement shall be drawn with the successful tenderers on prescribed Form No. CPWD 7 (or other Standard Form as mentioned) which is available as a Govt. of India Publication and also available on website www.iitk.ac.in Tenderers shall quote his rates as per various terms and conditions of the said form which will form part of the agreement.
 4. The time allowed for carrying out the work will be **12 Months** from the date of start as defined in schedule ‘F’ or from the first date of handing over of the site, whichever is later, in accordance with the phasing, if any, indicated in the tender documents.
 5. The site for the work is available.*
 6. The tender document consisting of plans, specifications, the schedule of quantities of various types of items to be executed and the set of terms and conditions of the contract to be complied with and other necessary documents except Standard General Conditions of Contract Form can be seen on website www.tenderwizard.com/IIT, <https://eprocure.gov.in/cppp/latestactivetenders> or www.iitk.ac.in other necessary documents also can be seen in the office of the EE , IWD Electrical and Air conditioning Division, IIT, Kanpur between hours of 3:00 PM to 3:00 PM from **24.08.2020 to 04.09.2020** free of cost.
 7. After submission of the tender the contractor can re-submit revised tender any number of times but before last time and date of submission of tender as notified.

8. While submitting the revised tender, contractor can revise the rate of one or more item(s) any number of times (he need not re-enter rate of all the items) but before last time and date of submission of tender as notified.
9. When tenders are invited in three stage system and if it is desired to submit revised financial tender then it shall be mandatory to submit revised financial tender. If not submitted then the tender submitted earlier shall become invalid.
10. Earnest Money can be paid in the form of Treasury Challan or Demand Draft or Pay order or Banker`s Cheque or Deposit at Call Receipt or Fixed Deposit Receipt (drawn in favour of **Director, IIT, Kanpur** along with Bank Guarantee of any Scheduled Bank wherever applicable.
A part of earnest money is acceptable in the form of bank guarantee also. In such case, 50% of earnest money or Rs. 20 lac, whichever is less, will have to be deposited in shape prescribed above, and balance in shape of Bank Guarantee of any scheduled bank.
(i) **e-Tender Processing Fee – Rs. 1583/-** (including GST) drawn in favour of "**ITI Limited**" payable at Delhi through e-payment
Treasury Challan or Demand Draft or Pay Order or Banker`s Cheque or Deposit at Call Receipt or FDR or Bank Guarantee against EMD, Cost of Tender Document and Cost of Tender Processing Fee shall be placed in single sealed envelope superscripted as “Earnest Money, Cost of Tender Document and Cost of Tender Processing Fee” with name of work and due date of opening of the tender also mentioned thereon.
Copy of Enlistment Order and certificate of work experience wherever applicable and other documents if required and specified in this bid document shall be scanned and uploaded to the e-Tendering website within the period of tender submission and certified copy of each shall be deposited in a separate envelop marked as “Other Documents”.
Both the envelopes shall be placed in another envelope with due mention of Name of work, date & time of opening of tenders and to be submitted in the office of Superintending Engineer after last date & time of submission of tender and up to 03:30 PM **on 07.09.2020**.
The documents submitted shall be opened at 4.00 PM on **07.09.2020**.
Online tender documents submitted by intending tenderers shall be opened only of those tenderers, whose Earnest Money Deposit, Cost of Tender Document and e-Tender Processing Fee and other documents placed in the envelope are found in order.

The tender submitted shall be opened at 03:30 PM on **09.09.2020**.
11. The tender submitted shall become invalid and cost of tender & e-Tender processing fee shall not be refunded if:
(i) The tenderers is found ineligible.
(ii) The tenderers does not upload all the documents as stipulated in the tender document.
(iii) If any discrepancy is noticed between the documents as uploaded at the time of submission of tender and hard copies as submitted physically in the office of tender opening authority.
12. The contractor whose tender is accepted will be required to furnish performance guarantee of 5% (Five Percent) of the tendered amount within the period specified in Schedule F. This guarantee shall be in the form of cash (in case guarantee amount is less than ` 10000/-) or Deposit at Call receipt of any scheduled bank/Banker`s cheque of any scheduled bank/Demand Draft of any scheduled bank/Pay order of any Scheduled Bank of any scheduled bank (in case guarantee amount is less than ` 1,00,000/-) or Government Securities or Fixed Deposit Receipts or Guarantee Bonds of any Scheduled Bank or the State Bank of India in accordance with the prescribed form. **In case the contractor fails to**

deposit the said performance guarantee within the period as indicated in Schedule 'F', including the extended period if any, the Earnest Money deposited by the contractor shall be forfeited automatically without any notice to the contractor.

13. Intending Tenderers are advised to inspect and examine the site and its surroundings and satisfy themselves before submitting their tenders as to the nature of the ground and sub-soil (so far as is practicable), the form and nature of the site, the means of access to the site, the accommodation they may require and in general shall themselves obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect their tender. A tenderers shall be deemed to have full knowledge of the site whether he inspects it or not and no extra charge consequent on any misunderstanding or otherwise shall be allowed. The tenderers shall be responsible for arranging and maintaining at his own cost all materials, tools, & plants, water, electricity access, facilities for workers, and all other services required for executing the work unless otherwise specifically provided for in the contract documents. Submission of a tender by a tenderer implies that he has read this notice and all other contract documents and has made himself aware of the scope and specifications of the work and local conditions and other factors having a bearing on the execution of the work.
14. The competent authority on behalf of the Board of Governors, IIT, Kanpur does not bind itself to accept the lowest or any other tender and reserves to itself the authority to reject any or all the tenders received without the assignment of any reason. All tenders in which any of the prescribed condition is not fulfilled or any condition including that of conditional rebate is put forth by the tenderers shall be summarily rejected.
15. Canvassing whether directly or indirectly, in connection with tenderers is strictly prohibited and the tenders submitted by the contractors who resort to canvassing will be liable for rejection.
16. The competent authority on behalf of Board of Governors, IIT, Kanpur reserves to himself the right of accepting the whole or any part of the tender and the tenderers shall be bound to perform the same at the rate quoted.
17. The contractor shall not be permitted to tender for works in the IIT Kanpur responsible for award and execution of contracts, in which his near relative is posted a Divisional Accountant or as an officer in any capacity between the grades of Superintending Engineer and Junior Engineer (both inclusive). He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any gazetted officer in the IIT Kanpur. Any breach of this condition by the contractor would render him liable to be removed from the approved list of contractors of this Department.
18. No Engineer of Gazetted Rank or other Gazetted Officer employed in Engineering or Administrative duties in an Engineering Department of the Government of India is allowed to work as a contractor for a period of one year after his retirement from Government service, without the prior permission of the Government of India in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found any time to be such a person who had not obtained the permission of the Government of India as aforesaid before submission of the tender or engagement in the contractor's service.
19. The tender for the works shall remain open for acceptance for a period of **ninety (90) days** from the date of opening of tenders if any tenderer withdraws his tender before the said period or issue of letter of acceptance, whichever is earlier, or makes any modifications in

the terms and conditions of the tender which are not acceptable to the department, then the Government shall, without prejudice to any other right or remedy, be at liberty to forfeit 50% of the said earnest money as aforesaid. Further the tenderers shall not be allowed to participate in the retendering process of the work.

20. This Notice Inviting Tender shall form a part of the contract document. The successful tenderers/contractor, on acceptance of his tender by the Accepting Authority shall within 15 days from the stipulated date of start of the work, sign the contract consisting of:-

- a) The Notice Inviting Tender, all the documents including additional conditions, specifications and drawings, if any, forming part of the tender as uploaded at the time of invitation of tender and the rates quoted online at the time of submission of tender and acceptance thereof together with any correspondence leading thereto.
- b) Standard C.P.W.D. Form 7 or other Standard C.P.W.D. Form as applicable.

20.1.1 The tender document will include following three components:

Part A:-

CPWD-6, CPWD-7 including schedule A to F for the major component of the work, Standard General Conditions of Contract for CPWD 2014 as amended/modified up to **04.09.2020**.

Part B:-

General/specific conditions, specifications and schedule of quantities applicable to major component of the work.

Part C:-

Schedule A to F for minor component of the work. (SE/EE in charge of major component shall also be competent authority under clause 2 and clause 5 as mentioned in schedule A to F for major components), General/specific conditions, specifications and schedule of quantities applicable to minor component(s) of the work.

20.1.2 The tenderers must associate himself, with agencies of the appropriate class eligible to tender for each of the minor component individually.

20.1.3 The eligible tenderers shall quote rates for all items of major component as well as for all items of minor components of work.

20.1.4 Entire work under the scope of composite tender including major and all minor components shall be executed under one agreement.

20.1.5 Security Deposit will be worked out separately for each component corresponding to the estimated cost of the respective component of works. The Earnest Money will become part of the security deposit of the major components of work.

21. The EPF & ESI contribution paid to the contract workers shall be reimbursed on actual basis.

Executive Engineer

For & on behalf of the Board of Governors, IIT, Kanpur

ITEM RATE TENDER AND CONTRACT FOR WORK

- (A) **Tender for the work of:** | Annual zonal contract for petty domestic air conditioning & refrigeration works in and outside of academic area...

TENDER

I/We have read and examined the Notice Inviting tender, schedule, A,B,C,D,E&F. Specifications applicable, Drawings & Designs, General Rules and Directions, Conditions of Contract, clauses of contract, Special conditions, Schedule of Rate & other documents and rules referred to in the conditions of contract and all other contents in the tender document for the work.

I/We hereby tender for the execution of the work specified for the Board of Governors, IIT, Kanpur within the time specified in Schedule 'F', viz., schedule of quantities and in accordance in all respects with the specifications, designs, drawings and instructions in writing referred to in Rule-1 of General Rules and Directions and in Clause 11 of the Conditions of contract and with such materials as are provided for, by, and in respects in accordance with, such conditions so far as applicable.

We agree to keep the tender **open for (90) ninety days from the date of opening of tender** and not to make any modifications in its terms and conditions.

A sum of **Rs. 26,833/-** is hereby forwarded in Cash/Receipt Treasury Challan/Deposit at call Receipt of a Scheduled Bank/Fixed deposit receipt of scheduled bank/demand draft of a scheduled bank/bank guarantee issued by scheduled bank as earnest money. If I/we, fail to furnish the prescribed performance guarantee or fail to commence the work within prescribed period I/we agree that the said Board of Governors, IIT, Kanpur or his successors in office shall without prejudice to any other right or remedy be at liberty to forfeit the said earnest money absolutely. Further, if I/we fail of commence work as specified, I/we agree that Board of Governors, IIT, Kanpur or his successors in office shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the said earnest money and the performance guarantee absolutely, otherwise the said earnest money shall be retained by him towards security deposit to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to therein and to carry out such deviations as may be ordered, up to maximum of the percentage mentioned in Schedule 'F' and those in excess of that limit at the rates to be determined in accordance with the provision contained in Clause 12.2 and 12.3 of the tender form.

Further, I/We agree that in case of forfeiture of earnest money or both Earnest Money & Performance Guarantee as aforesaid, I/We shall be debarred for participation in the re-tendering process of the work.

I/We undertake and confirm that eligible similar work(s) has/ have not been got executed through another contractor on back to back basis. Further that, if such a violation comes to the notice of Department, then I/we shall be debarred for tendering in IIT, Kanpur in future forever. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee.

I/We hereby declare that I/we shall treat the tender documents drawings and other records connected with the work as secret/confidential documents and shall not communicate information derived there from to any person other than a person to whom I/we am/are authorized to communicate the same or use the information in any manner prejudicial to the safety of the State.

Dated _____ ** _____

Witness: **
Address: **
Occupation: **

**
Signature of contractor
Postal Address **

ACCEPTANCE

The above tender (as modified by you as provided in the letters mentioned hereunder) is accepted by me for and on behalf of the Board of Governors, IIT, Kanpur for a sum of Rs. _____ (Rupees _____)

The letters referred to below shall form part of this contract Agreement:-

- a) _____
- b) _____
- c) _____

For & on behalf of the Board of Governors, IIT,
Kanpur

Dated _____

Signature _____
Designation _____

Operative schedules shall be supplied separately to each intending tenderer)

SCHEDULE 'A'

Schedule of Quantities:

SCHEDULE 'B'

Schedule of materials to be issued to the contractor:

S. No.	Description of item	Quantity	Rates in figures & words at which the material will be charged to the contractor	Place of issue
1	2	3	4	5
-----NIL -----				

SCHEDULE 'C'

Schedule of Tools and Plants to be hired to the contractor

S. No.	Description	Hire charges per day	Place of issue
1	2	3	4
-----NIL -----			

SCHEDULE 'D'

Extra schedule for specific requirements/document for the work, if any: **As attached in tender form.**

SCHEDULE 'E'

Schedule of component of other Materials, Labour, POL etc. for price escalation : **N.A.**

SCHEDULE 'F'

Reference to General Conditions of contract.

Name of Work:	Annual zonal contract for petty domestic air conditioning & refrigeration works in and outside of academic area.	
Estimated cost of the work:	Air-conditioning Items of Work	13,41,628/-
Earnest money		26,833/-
Performance Guarantee	5% of the tendered value of the work	
Security Deposit	2.5% of the tendered value of the work	
General rules and direction :		

Definitions:

2(v)	Engineer-in-Charge		
	For Air-conditioning & Refrigeration/Electrical items of work	Executive Engineer, Institute Works Department IIT, Kanpur	
2(vi)	Accepting Authority	Superintending Engineer, Institute Works Department IIT, Kanpur	
2(vii)	Percentage on cost of materials and labour to cover all overheads and profits	15%	
2(viii)	Standard Schedule of Rates:		
	Electrical Items of Work:	D.S.R. 2018 with up to date correction slips	
2(ix)	Department:	Central Public Works Department	
2(x)	Standard CPWD contract Form:	GCC 2020, CPWD form-7 as modified & corrected up to 04.09.2020 (Whether correction vide latest circulars are incorporated or not in this document).	
Clause 1	i) Time allowed for submission of Performance Guarantee from the date of issue of letter of acceptance	15 Days	
	ii) Maximum allowable extension beyond the period as provided in i) above	7 Days	
Clause 2	Authority for fixing Compensation under Clause 2	Superintending Engineer, Institute Works Department IIT, Kanpur. Or successor thereof	
Clause 2 A	Whether Clause 2A shall be applicable	No	
Clause 5	i) Number of days from the date of issue of letter of acceptance for reckoning date of start	22 Days	
	ii) Time allowed for execution of work	12 Months	
Authority to decide	Extension of time	Superintending Engineer, Institute Works Department IIT, Kanpur	
Clause 6/ 6A		Only clause 6 applicable.	
Clause 7	Gross work to be done together with net payment/Adjustment of advances for material collected, if any, since the last such payment for being eligible to interim payment	Not applicable	
Clause 10A	Material to be provided by the contractor.	Applicable	
Clause 10B (ii), (iii)	Whether clause 10-B (ii) and 10-B (iii) shall be applicable.	Not Applicable	

Clause 10 C	Component of labour expressed as percentage of value of work		---
Clause 10 CA	Materials covered under this clause.	Nearest material(other than cement, reinforcement bars and structural steel) for which All India Whole sale price Index is to be followed.	Base price of all the materials covered under clause 10 CA
	1. Cement (PPC)	Nil	NIL
	2. Steel	Nil	Nil
Clause 10 CC	Increase/Decrease in Price of materials/wages		Not Applicable

Clause 11 Specification to be followed for execution of work:

For electrical works CPWD specifications 2005 internal and 2014 external electrical works

For Air conditioning & Refrigeration item of works CPWD Specifications 2017 HVAC for Air-conditioning & refrigeration works with up to date correction slips.(Hereinafter called CPWD specifications also)

Clause 12

12.2 & 12.3 Deviation limit beyond which clause 12.2 & 12.3 shall apply for building work ---

Clause 16 Competent Authority for Deciding reduced rates:

For electrical/civil/Air-conditioning& refrigeration items of work **Superintending Engineer, Institute Works Department IIT, Kanpur**

Clause 18 List of mandatory machinery, tools & plants to be deployed by the contractor at site. **Ladders, Multimeter, drill machine, crimping tools, spanner set, blower, Gas Charging line with equipment, welding torch etc**

Clause 36 (i) Requirement of technical Representative(s)

For supervision of air-conditioning/refrigeration & civil as well as electrical items of work, technical representatives of the respective disciplines will be required to be deployed.

SALIENT/MANDATORY REQUIREMENTS FOR THE TENDER

Name of Work: Annual zonal contract for petty domestic air conditioning & refrigeration works in and outside of academic area.

- 1 The tenderer is advised to read and examine the tender documents for the work and the set of drawings available with Engineer-in-charge. He should inspect and examine the site and its surroundings by himself before submitting his tender.
- 2 Separate schedule of quantity is included in this tender for air conditioning & refrigeration items of work. If the tenderer wants to offer any unconditional rebates on their rates, the same should also be offered in the respective components of schedule separately. The contractor shall quote the item rates in figures and words accurately so that there is no discrepancy in rates written in figures and words.
- 3 Time allowed for the execution of work is **12 Months**.
- 4 The contractor(s) shall submit a detailed program of execution in accordance with the master programme/milestone within ten days from the date of issue of award letter.
- 5 Contractor has to arrange and install field laboratory during the currency of work and nothing extra will be paid on this account.
- 6 Quality of the project is of utmost importance. This shall be adhered to in accordance with the provisions of CPWD specifications and guidelines given in the relevant paras.
- 7 Contractor has to deploy required Plant and machinery on the project. In case the contractor fails to deploy the plant and machinery whenever required and as per the direction of the Engineer-in-charge, he (Engineer-in-charge) shall be at a liberty to get the same deployed at the risk and cost of the contractor.
- 8 The contractor shall comply with the provisions of the Apprentices Act 1961, and the rules and orders issued there under from time to time. If he fails to do so, his failure will be a breach of the contract and the Superintending Engineer/Executive Engineer may in his discretion, without prejudice to any other right or remedy available in law, cancel the contract. The contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions of the said Act.
- 9 Temporary Electric connection shall be issued as per request and the water charges shall be recovered as per rule.

PART-B

QUALITY ASSURANCE OF THE WORK

Sampling of Materials:

1. The contractor shall procure all the materials at least in advance so that there is sufficient time to testing and approving of the materials and clearance of the same before use in work.
2. All materials brought by the contractor for use in the work shall be got checked from the Engineer-in-Charge or his authorized representative of the work on receipt of the same at site before use.
3. The contractor shall be fully responsible for the safe custody of the materials issued to him even if the materials are in double lock and key system.

SPECIAL CONDITION FOR SAFETY AT THE WORK SITE

The contractor will identify one of the supervisors for taking care of implementation of Safety systems.

The Contractor should follow the following General Guidelines governing the safety rules as laid down under:

1. Smoking is strictly prohibited at workplace.
2. Nobody is allowed to work without wearing safety helmet. Chinstrap of safety helmet shall be always on. Drivers, helpers and operators are no exception.
3. No one is allowed to work at or more than three meters height without wearing safety belt and anchoring the lanyard of safety belt to firm support preferably at shoulder level.
4. No one is allowed to work without adequate foot protection.
5. Usage of eye protection equipment shall be ensured when workmen are engaged for grinding, chipping, welding and gas-cutting. For other jobs as and when site safety co-coordinator insists eye protection has to be provided.
6. All safety appliances like Safety shoes, Safety gloves, Safety helmet, Safety belt, Safety goggles etc. shall be arranged before starting the job.
7. All excavated pits shall be barricaded & barricading to be maintained till the backfilling is done. Safe approach to be ensured into every excavation.
8. Adequate illumination at workplace shall be ensured before starting the job at night.
9. All the dangerous moving parts of the portable / fixed machinery being used shall be adequately guarded.
10. Ladders being used at site shall be adequately secured at bottom and top. Ladders shall not be used as work platforms.
11. Material shall not be thrown from the height. If required, the area shall be barricaded and one person shall be posted outside the barricading for preventing the tre-passers from entering the area.
12. Other than electricians no one is allowed to carry out electrical connections, repairs on electrical equipment or other jobs related thereto.
13. All electrical connections shall be made using 3 or 5 core cables, having a earth wire.
14. Inserting of bare wires for tapping the power from electrical sockets is completely prohibited.

15. A tools and tackles inspection register must be maintained and updated regularly.
16. Debris, scrap and other materials to be cleared from time to time from the workplace and at the time of closing of work everyday.
17. All the unsafe conditions, unsafe acts identified by contractors, reported by site supervisors and / or safety personnel to be corrected on priority basis.
18. No children shall be allowed to enter the workplace.
19. All the lifting tools and tackles shall be stored properly when not in use.
20. Clamps shall be used on Return cables to ensure proper earthing for welding works.
21. Return cables shall be used for earthing.
22. All the pressure gauges used in gas cutting apparatus shall be in good working condition.
23. Proper eye washing facilities shall be made in areas where chemicals are handled.
24. Connectors and hose clamps are used for making welding hose connections.
25. All underground cables for supplying construction power shall be routed using conduit pipes.
26. Spill trays shall be used to contain the oil spills while transferring / storing them.
27. Tapping of power by cutting electric cables in between must be avoided. Proper junction boxes must be used.

Superintending Engineer

INDIAN INSTITUTE OF TECHNOLOGY KANPUR

INSTITUTE WORKS DEPARTMENT

CENTRAL OFFICE

SPECIAL TERMS & CONDITIONS (ZONAL CONTRACTS)

1) The zonal contracts shall be drawn for execution of works of minor nature costing upto Rs. 1,30,000 each. Works beyond this amount shall not be within the scope of this contract and shall be executed thro' the empanelled contractors of the Institute.

2) Minor civil works of such nature as repairs, petty original, external development, plumbing, painting, interior furnishing etc. are executed in IIT in large number thro' out the year.

Minor electrical works comprise of internal and external repairs as well as petty works of original nature. Repairs to sub-stations is also covered under this category.

Similarly minor air-conditioning works means petty works of original nature.

3) For the purpose of zonal contracts the buildings and services in IIT campus are divided in 6 (six) zones as follows :

Zone No. I) Hall of Residence, Visitor's Hostel, RA Hostel & Health Centre.

Zone No. II) All Residences i/c Community Centre & Schools.

Zone No. III) Academic Area.

Zone No. IV) Over head lines, Sub-stations and street lights.

Zone No.V) Central Air-conditioning System

Zone No.VI) Domestic Air-conditioning System

4) The quantities specified in the Bill of Quantity are only approximate and may actually vary substantially in respect of individual items. However the cumulative value of work shall remain within a deviation limit of 50 (fifty)% of the accepted tender.

5) The Work Order shall be issued by the Superintending Engineer for each individual work as an when the works are administratively sanctioned by the Institute.

Each Work Order shall be deemed to be a part of the zonal contract. Accordingly all term & conditions contained in zonal contract shall apply on each individual work.

6) The work shall be carried out on the basis of the following :

i) General conditions of contracts for central CPWD works 2014 (amended upto date).

ii) CPWD specifications Vol. I & II for civil works.

iii) General specifications for Electrical works 2009/1995

iv) Delhi Schedule of Rates 2016 for civil works.

v) Delhi Schedule of Rates 2018 for electrical works.

vi) General specifications for HVAC work- 2014.

7) A large number of minor works shall be executed in each zone thro' out the year. It is quite possible that more than one work is awarded at a time. However they may be certain periods with out any work. Therefore the contractor shall have to organize his establishment accordingly. No claims on account of idle establishment shall be entertained.

8) Labour employed by the contractor shall not be allowed to stay within the premises of the Institute. However, a purely temporary structure shall be allowed to be erected for storing materials.

9) Only one running account bill shall be prepared and paid in respect of each individual work order. The payment against work orders shall be deemed to be advance payments subject to final settlement after the contract is concluded.

More than one payment shall not be allowed against a work order.

10) *The following time schedule shall be generally allowed for the execution of civil/electrical / air-conditioning works, or as decided by the Assistant Executive Engineer in consultation with the contractor :*

i)	<i>Works costing upto Rs. 45,000</i>	<i>14 days</i>
ii)	<i>Works costing from Rs. 45,000 to 90,000</i>	<i>21 days</i>
iii)	<i>Works costing from Rs. 90,000 to 1,30,000</i>	<i>28 days</i>

11) *The contractor shall always keep his establishment ready so as to commence the work immediately after the issue of work order and no mobilization period shall be allowed.*

12) *Generally the delays in completion of work shall not be allowed in a normal course. However in the event of genuine delays, beyond the control of the contractor, extension of time shall be allowed only on the certification of the Assistant Executive Engineer/Assistant Engineer concerned.*

13) *If the work is not commenced within a reasonable time, after the award of work but before the deemed date of completion, the Institute reserves the right to cancel the work order and get the work done through another agency.*

In the event of 3 (three) consecutive defaults as aforesaid the Institute reserves the right to determine the contract premature or rescind the contract altogether without assigning any further reasons.

14) *The Electrical works as well as air-conditioning works are often of urgent nature & in such cases the contractor shall be required to mobilise his establishment even at odd hours. For this purpose the contractor shall have to maintain a minimum establishment of workers, tools & plants in ready condition at all times.*

15) *Cost escalation under clause 10(c)(c) shall not be payable for works executed under the zonal contracts.*

16) *Rates for finished works shall be given for each item separately, both in words & figures. In the event of non compliance the tender shall be deemed incomplete and liable for rejection.*

17) *All entries by the tenderer should be made in one ink and one hand writing only. Tenders should be filled in legible hand writing and should not contain erasures, corrections and overwriting as far as possible. However if it becomes necessary, each correction etc. should be properly attested under dated signature.*

18) *The work shall be executed on the basis of the following CPWD specifications:*

i) Electrical Works :

- General specifications for Electrical Works Part-1 (Internal) 2017 with up to date corrections.*
- General specifications for electrical works (external) 2013 with upto date corrections.*
- General specifications of HVAC works 2014 with upto date corrections.*

19) *For the purpose of clause 12 of the General conditions of contract the following schedule of rates shall be applicable.*

i) Electrical Works: Based upon prevailing market rates.

20) *The special conditions listed above shall take precedence over all above provisions of the contract. The General Condition of contract for CPWD works shall be generally followed including the clause 21 i.e. work shall not be sublet.*

21) *The contractor shall have to execute the work in such place and condition where other agencies will also be engaged for other works such as site grading, filling and leveling, interiors, landscape, and electrical and mechanical engineering works, etc. No claim shall be entertained due to work being executed in the above circumstances.*

- 22) Each work orders issued against zonal contracts shall be guaranteed for a period of 6 (six) months from the actual date of completion of the works.
- 23) The execution staff shall maintain discipline and works ethics. However the institute shall have the right to ask any of the working staffs to leave the premises if in the opinion of the institute, the conduct of such an employee is not in the interest of the institute.
- 24) It shall be responsibility of the contractor to supply adequately trained manpower necessary for the execution of the work. In addition to this one Engineer and one electrician shall be available in day shift. The contractor shall be responsible for all the requirement of labour laws governing such deployment. If any violation is noticed any time the contractor shall be solely responsible. Subletting of work in any manner shall not be allowed and if found at any later stage, the contract shall be terminated.
- 25) It shall be the responsibility of the contractor to submit shop drawings before start of work and wherever suitable as directed by the Engineer-in-charge of the work.
- 26) **Taxes & Duties:**
Rates: The work shall be treated as on works contract basis and the rates tendered shall be for complete item of work and all charges for items contingent to the work, such as packing, forwarding, insurance, freight and delivery at site for the materials to be supplied by the contractor, watch and ward of all materials at the site, labour related expenses as per relevant labour laws, testing of materials/ samples etc. excluding Goods & Service tax (GST)
- 20.1 *Being an indivisible works contract, no other tax is payable other than GST. The GST shall be as applicable to IIT Kanpur as per Government rules.*
- 27) No contractor, to whom the provisions of the BOCW Act apply, shall be allowed to commence work on the campus unless he has produced the "Registration Certificate" issued by the office of DY. CLC (Central).
- 28) The contractor shall engage only such workers who are registered as beneficiaries with U.P BOCW welfare Board and in case of engagement of new workers, he shall ensure the submission of applications for registration of such workman with in appropriate time.
- 29) A certificate for administrative convenience shall be obtained from the contractor covered under BOCW act whether he has engaged 10 or more workman while working in the Institute and only there after, CESS @ 1% from the bills raised by him shall be deducted at source for all running works Cess, so deducted shall be deposited with the BOCW welfare board.
- 30) The contractor shall be also ensure that there is no shortage of technical staff for maintenance & repairing work for air-conditioning. A penalty of Rs.500/- shall be liable in case there is a shortage of man power and materials for completion of the work as per stipulated time period at Sl No.10.
- 31) Only the qualified experienced technical staff shall be engaged for the above work. The proof of qualification and experience of technical staff along with their identity proof has to be submitted to the institute and which shall be verified by Engineer-in-charge.
- 32) The company repaired/new compressors of the approved make shall be used in the work. However the contractor shall have to produce test certificate of the compressor which will be verified by the Engineer-in-charge.

CONTRACTOR

EXECUTIVE ENGINEER

Special Terms & conditions for air-conditioning works

Section 1 Additional Specification for Air-conditioning & Refrigeration Works

1. General

1.1 The motor and switchgears required for various items shall generally be as per specifications given below. All electric motors/compressor shall be suitable for 3 phase/1-phase, 50 Hz, 415 $\pm 10\%$ /215 $\pm 10\%$ Volts A.C. supply.

1.2 Painting

All sheet steel work shall undergo a multi tank process of degreasing, pickling in acid, cold rinsing, phosphate, passivating and then sprayed with a high corrosion resistant primer. The primer shall be baked in oven. The finishing treatment shall be by application of powder coated paint of approved shade and stoved.

Air Handling Units
(Floor Mounted Double Skin)

1. **General**

The air handling units shall be complete in all respects and shall generally comply with the specifications as given in the following paragraphs.

2. **Air Handling Units**

2.1 *The horizontal floor mounted type double skin air handling unit shall be compact, self contained and shall consist of blower assembly, cooling coil, air filters, drive set and motor all enclosed in an attractive galvanized sheet steel housing.*

2.2 *The blower assembly shall consist of single forward curve, double inlet, double width G.I. sheet impeller, blower housing of G.I. sheet and with smooth air inlet volutes, self aligning bearing blocks and supports for mounting the bearing on both side of blower housing. Fan housing and motor shall be mounted on a common extruded aluminum base mounted inside the fan section, anti vibration spring mounts or enemy foot mount. fan out let shall be connected to casing with the help of fire retardant fabrics*

2.3.1 *The cooling coil shall be of seamless copper tubes not less than 0.50 mm thick and have a minimum 12 mm O.D. The coil shall have continuous aluminium fins. The fins shall be 0.15mm nominal spaced by collars forming a integral part of the fins. The tube shall be staggered in the direction of air flow. The fins shall be uniformly bonded to the tubes by mechanical expansion of the tubes. The complete tube and fins shall be assembled in a rigid aluminium frame. The tube shall be interconnected with readymade copper 'U' Bends with soldering and copper headers. The circuiting shall be suitable to maintain the required water velocity. The headers shall be complete with water in/out connections, vent plug on top and drain at the bottom and designed to maintain water velocity between 0.6 to 1.8 m/s (2 to 6 FPS). The No. of fins shall not be less than 4.7 per cm length of coil.*

2.3.2 *The coils shall be tested against leaks at twice the working pressure but not less than 10 Kg/cm².*

2.4 *The air filter shall be of cleanable pleated fabric type with a minimum depth of 50 mm and efficiency of 90 % down to 10 micron particle size. Face velocity across these filters shall not exceed 550 FPM.*

2.5 *The fan motor shall be squirrel cage totally enclosed fan cooled type with suitable starter conforming to specifications under "control panel, motors and switch gears". The motor shall be VFP compatible. noise level at a distance of 2 M from AHU shall not be exceed 75 dBA.*

2.6 *The fan drive shall consist of grooved motor pulley, blower pulley, V belt, along with adjustable mounting for the motor and belt guard.*

3. **AHU Enclosure (Double Skin)**

3.1 *The AHU housing shall be made of Double skin design with suitable main structure frame work in different sections. The panels shall be double skin sandwich type with 0.6 MM pre coated galvanised sheet on the outside and 0.6 MM galvanised sheet on inside with 50 MM thick PUF injection insulation material in between. All sections shall be bolted to each other with neoprene rubber gasket and fixed with stainless steel screw in between them for perfect airtight joints. The gaskets shall be held in place by inserting them in the integral channels in the frame work.*

3.2 *The panels of AHUs shall be sandwiched with 50 MM thick polyurethane foam insulation of 40 KG/CUBM density having a 'K' value of 0.014 Kcal/Mhr ° C.*

3.3 **Drain pan**

The drain pan shall be construction of 18 Gauge stainless steel sheets, externally insulated with 12 MM thick closed cell polyethylene foam insulation with necessary slope to facilitate fast removal of condensate. Necessary supports will be provided to slide the coil in the drain pan.

4. **Controls**

4.1 *Each unitary AHU shall be provided with 2 way motorized control valve and thermostat.*

5. **Fresh Air Control**

An adjustable manual damper of G.I. Sheet along with a bird screen on the outside and a cleanable filter on the inside shall be fixed in the opening provided for this purpose in the air handling unit room wall.

6. **Accessories**

6.1 *The following accessories shall be provided as **part of the AHU price.***

6.1.1 *Flexible fire proof double canvass connection between fan outlet and duct.*

6.1.2 *Vibration isolators of 90% efficiency.*

6.2 *Each air handling unit shall be provided with the following accessories which shall be **paid separately.***

6.2.1 *One stem type thermometer for coil inlet and outlet, with tubing and gauge cocks.*

6.2.2 *One pressure gauge with cock for inlet and outlet of the coil, with tubing and gauge cocks.*

6.2.3 *Butterfly/Gate valve at coil inlet and balancing valves at coil outlet.*

6.2.4 *Drain line from unit to drain trap.*

7. **Testing**

The air handling unit shall be tested to measure air quantity and coil performance by measuring temperature difference, water pressure drop across coil and then calculating capacity by using the above measurements.

8. **Limitations**

8.1 *The air velocity across the cooling coil shall be as specified in the Schedule of Equipment. But in no case it shall exceed 550 FPM (2.55m per sec.).*

8.2 *The fan outlet velocity shall not exceed 1800 FPS (8. m per sec.).*

8.3 *The air velocity across the filters shall not exceed 400 FPM (2.00 m per sec.).*

Section 2

DUCT WORK AND OUTLETS

1. General

- 1.1 The work under this part shall consist of furnishing labour materials, equipment and appliances as specified necessary and required to install all sheet metal and other allied work to make the air conditioning supply, ventilating, and exhaust system ready for operation as per drawings.
- 1.2 Except as otherwise specified all duct work and related items shall be in accordance with these specifications.
- 1.3 Duct work shall mean all ducts, casings, dampers, access doors, joints, stiffeners and hangers.

2. Duct Materials

- 2.1 The ducts shall be fabricated from galvanized steel sheets class VIII conforming to ISS:277-1962 (revised) or aluminium sheets conforming to ISS:737-1955 (wherever aluminium ducts are specified).
- 2.2 All duct work, sheet metal thickness and fabrication unless otherwise directed, shall strictly meet requirements, as described in IS:655-1963 with amendment-I (1971 edition)

The thickness of the sheet shall be as follows :-

	Size of Duct	Sheet Thickness	Type of Joints	Bracing if any
2.2.1	Upto 750 mm	0.63 mm 24 Ga	G.I. Flange	
2.2.2	751 mm to 1000 mm	0.80 mm 22 Ga	25x25x3 mm Angle iron frame with 8 mm dia nuts & bolts	25x25x3 mm at the rate of 1.2 M from joints
2.2.3	1001 mm to 1500 mm	0.80 mm 22 Ga	40x40x5 mm Angle iron frame with 8 mm dia nuts & bolts	40x40x5 mm at the rate of 1.2 M from joints
2.2.4	1501 mm to 2250 mm	1.00 mm 20 Ga.	50x50x5 mm Angle iron frame with 10 mm dia nuts & bolts at 125 mm centre.	40x40x3 mm at the rate of 1.2 M to be Braced Diagonally
2.2.5	2251 mm and above	1.25 mm 18 Ga.	50x50x6 mm Angle iron frame with 10 mm dia nuts & bolts at 125 mm centre.	40x40x3 mm at the rate of 1.6 M from joints

- 2.3 The gauges, joints and bracings for sheet metal duct work shall further conform to the provisions as shown on the drawings.

- 2.4 Ducts larger than 600 MM shall be cross broken, duct sections upto 1200 MM length may be used with bracing angles omitted.
- 2.5 Changes in section of duct work shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 DEG. Angle from the axis of the main duct unless otherwise approved by the Engineer-In-Charge.
- 2.6 All ducts shall be supported from the ceiling/slab by means of M.S. Rods of 9 MM (3/8")DIA with M.S. Angle at the bottom. The rods shall be anchored to R.C. Slab using metallic expansion fasteners.

3. **Installations**

- 3.1 During the construction, the contractor shall temporarily close duct openings with sheet metal covers to prevent debris entering ducts and to maintain opening straight and square, as per direction of Engineer-In-Charge.
- 3.2 Great care should be taken to ensure that the duct work does not extend outside and beyond height limits as noted on the drawings.
- 3.3 All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be air tight and shall be made in the direction of air flow.

The ducts shall be re-inforced with structured members where necessary, and must be secured in place so as to avoid vibration of the duct on its support.

- 3.4 All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration.
- 3.5 The duct work shall be varied in shape and position to fit actual conditions at building site. All changes shall be subjected to the approval of the Engineer-In-Charge. The contractor shall verify all measurements at site and shall notify the Engineer-In-Charge of any difficulty in carrying out his work before fabrication.
- 3.6 Sponge rubber or approved equal gaskets of 6 MM maximum thickness shall be self adhesive installed between duct flanges as well as between all connections of sheet metal ducts to walls, floor columns, heater casings and filter casings. Sheet metal connections shall be made to walls and floors by means of wooden member anchored to the building structure with anchor bolts and with the sheet screwed to them.
- 3.7 Flanges bracings and supports are to be black, mild steel and are to be painted with rust proof primer on all surfaces before erection. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.
- 3.8 Joints, seams, sleeves, splitters, branches, takeoffs and supports are to be as per duct details as specified, or as decided by Engineer-In-Charge.
- 3.9 Joints requiring bolting or rivetting may be fixed by Hexagon nuts and bolts, stove bolts or buck bolts, rivets or closed centre top rivets or spot welding. Self tapping screws must not be used. All jointing material must have a finish such as cadmium plating or Galvanized as appropriate.

- 3.10 Fire retarding flexible joints are to be fitted to the suction and delivery of all fans. The material is to be normally double heavy canvass or as directed by Engineer-In-Charge. On all circular spigots the flexible materials are to be screwed or clip band with adjustable screws or toggle fitting. For rectangular ducts the material is to be flanged and bolted with a backing flat or bolted to mating flange with backing flat.
- 3.11 The flexible joints are to be not less than 75 MM and not more than 250 MM between faces.
- 3.12 The duct work should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.
- 3.13 Duct passing through brick or masonry, wooden frame work shall be provided within the opening. Crossing duct shall have heavy flanges, collars on each side of wooden frame to make the duct leak proof.

4. **Dampers**

- 4.1 At the junction of each branch duct with main duct and split of main duct, volume dampers must be provided. Dampers shall be two gauges heavier than the gauge of the large duct and shall be rigid in construction.
- 4.2 The volume dampers shall be of an approved type, lever operated and completed with locking devices which will permit the dampers to be adjusted and locked in any positions and clearly indicating the damper position.
- 4.3 The dampers shall be of splitter, butterfly or louver type. The damper blade shall not be less than 1.25 MM (18) Gauge, reinforced with 25 MM angles 3 MM thick along any unsupported side longer than 250 MM. Angles shall not interfere with the operation of dampers, nor cause any turbulence.
- 4.4 Automatic and manual volume opposed blade dampers shall be completed with frames and bronze bearings as per drawings. Dampers and frames shall be constructed of 1.6 MM steel sheets and blades shall not be over 225 MM wide. The dampers for fresh air inlet shall additionally be provided with fly mesh screen, on the outside, of 0.8 MM thickness with fine mesh.
- 4.5 Wherever require for system balancing, a volume balancing opposed blade damper with quadrant and thumb screw lock shall be provided.
- 4.6 After completion of the duct work, dampers are to be adjusted and set to deliver air flow as specified on the drawings.

5. **Fire Dampers**

- 5.1 Automatic fire dampers shall be provided wherever shown on the drawings. The damper shall be multi blade louvre type. The blades should remain in the air stream in open position and shall be constructed with minimum 1.8 MM thick galvanised sheets. The frame shall be of 1.6 MM thickness. Other materials shall include locking device, motorised actuator, control panel to trip AHU motor etc.
- 5.2 The fire dampers shall be capable of operating automatically on receiving signal from a fire alarm panel. All control wiring shall be provided between fire damper and electric panel.

6. **Access panel**

6.1 A hinged and gasketed access panel measuring at least 450 MM x 450 MM shall be provided on duct work before each reheat coil and at each control device that may be located inside the duct work.

7. **Miscellaneous**

7.1 All duct work joints are to be true right angle and with all sharp edges removed.

7.2 Sponge rubber gaskets also to be provided behind the flange of all grilles.

7.3 Each chute from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot.

7.4 Diverting vanes must be provided at the bends exceeding 600 MM and at branches connected into the main duct without a neck.

7.5 Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations. Additional supports are to be provided where required for rigidity or as directed by Engineer-In-Charge.

7.6 The ducts should be routed directly with a minimum of directional change.

7.7 The duct work shall be provided with additional supports/hangers, wherever required or as directed by the Engineer-In-Charge, at no extra cost.

7.8 All angle iron flanges to be welded electrically and holes to be drilled.

7.9 All the angle iron flanges to be connected to the GSS ducts by rivets at 100 MM centres.

7.10 All the flanged joints, to have a sponge rubber packing stuck to the flanges with suitable adhesive.

7.11 The G.S.S. ducts should be lapped 6 MM across the flanges.

7.12 The ducts should be supported by approved type supports at a distance not exceeding 2.0 Metres.

8. **Standard Grilles**

8.1 The supply and return air grilles shall be fabricated from extruded aluminium sections. The supply air grilles shall have single/double louvers. The front horizontal louvers shall be of extruded section, fixed/adjustable type. The rear vertical louvers where required shall of aluminium extruded sections and adjustable type. The return air grille shall have single horizontal extruded section fixed louvers. The grilles may or may not be with an outer frame.

8.2 The damper blades shall also be of extruded aluminium sections. The grill flange shall be fabricated out of aluminium extruded section. Grilles longer than 450 MM shall have intermediate supports for the horizontal louvers.

9. **Diffusers**

9.1 The ceiling type square diffusers shall be of aluminium extruded sections with flush or step down face, as specified with fixed pattern and neck.

9.2 All supply diffusers shall be provided with extruded aluminium dampers, with arrangement for adjustment from the bottom.

9.3 The slot diffusers shall be of aluminium extruded sections with diffusion plate and sliding damper.

10. **Linear Diffusers/Grilles**

10.1 The linear diffusers/grilles shall be fabricated from Aluminium extruded sections.

10.2 The diffusion blades shall be extruded, flush mounted type with single or double direction air flow.

10.3 The frame shall be of aluminium extruded section and shall hold the louvers tightly in fixed position.

10.4 The dampers as described under grilles shall be provided wherever specified.

11. **Exhaust Grilles**

11.1 The exhaust grilles shall be fabricated from aluminium extruded sections.

11.2 The exhaust grilles shall be horizontal fixed bar grilles with 15° blade inclination.

12. **Sensor Terminal**

12.1 Sensor mounting terminal with cap shall be provided for taking temperature, pressure or other measurement in ducts or AHUs.

12.2 The terminal shall be fabricated from gun metal stock, duly threaded with check nut, nut and washers.

13. **Painting and Vision Barrier**

13.1 All grilles, and diffusers shall be powder coated, before installation, in approved colour.

13.2 All ducts immediately behind the grilles/diffusers etc. are to be given two coats of black paint in matt finish.

13.3 The return air and dummy portion of all linear grilles shall be provided with a vision barrier made of 24 gauge galvanised sheets. The vision barrier shall be fixed to the false ceiling frame with self tapping screws and shall be given two coats of black paint in matt finish. Care shall be taken to ensure that the return air path is not obstructed.

14. **Testing**

14.1 After completion, all duct system shall be tested for air leakage.

14.2 The entire air distribution system shall be balanced to supply the air quantity as required in various areas and the final tabulation of air quantity through each outlet shall be submitted to the Engineer-In-Charge for approval.

Section 3

PIPE WORK

1. General

All piping work shall conform to quality standards and shall be carried out as per specifications and details given hereunder & shall follow the applicable on relevant Indian standards.

2. Pipes

2.1 All pipes upto 150 MM shall be M.S. E.R.W tube (black steel) heavy class as per I.S. 1239-79, Part-I with amendment-I of January '81.

3. Fittings

3.1 The dimensions of the fittings shall conform to I.S.1239/69 Part-II unless otherwise indicated, in the specifications.

3.2 All bends in sizes upto and including 150 MM dia. shall be readymade of heavy duty, wrought steel of appropriate class.

3.3 All bends in sizes 200 MM and larger dia. shall be fabricated from pipes of the same dia. and thickness, with a minimum of 4 sections, and having a minimum centre line radius of 1.5 diameter of pipes.

3.4 All fittings such as branches reducers etc. in all sizes shall be fabricated from pipes of the same Dia. and thickness, and its length should be at least twice the dia. of the pipe.

3.5 The branches may be Butt welded straight to the main line, without making a separate fitting, where specified on drawings or required by Engineer-In-Charge.

3.6 Blank ends are to be formed with flanged joints and 6 MM thick blank insertion of rubber gasket between flange pair for 150 mm and over, in case where, a future extension is to be made otherwise blank end discs of 6 mm thickness are to be welded on, with additional cross stiffeners from 50 mm x 50 mm M.S. Heavy angles, for sizes upto 350 MM dia. All ends larger than 400 MM dia. shall have dished ends.

4. Flanges

4.1 All flanges shall be of mild steel as per I.S. 6392/71 and shall be steel slip-on-type, welded to the pipes, flange thickness shall be as per BS10.

4.2 Flanges may be tack welded into position, but all final welding shall be done with joints dismounted. 3 mm thick gaskets shall be used with all flanged joints. The gaskets shall be fibre re-inforced rubber as approved by the Engineer-In-Charge. Special adhesive compound shall be used between flanges of steam, air and gas lines.

4.3 Flanges shall be used as follows :-

4.3.1 Counter flanges for equipment having flanged connections.

4.3.2 Flanged pairs shall be used on all such equipment, which may require to be isolated or removed for service e.g. Pumps, refrigeration machines, air handling units etc.

4.3.3 All threaded valves shall be provided with nipples and flanged pairs on both sides to permit flange connections, for removal of valves from main lines for repair/replacement.

5. Valves

5.1 Butterfly Valves

5.1.1 The butterfly valve shall consist of cast iron body preferably in two piece construction.

5.1.2 The disc shall consist of disc pivot and driving stem shall be in one piece centrally located.

5.1.3 The valve seat shall be synthetic material suitable for water duty. It shall line the whole body.

5.1.4 The disc should move in slide bearings on both ends with 'o' ring to prevent leakage.

5.1.5 The handle should have arrangement for locking in any set position.

5.1.6 All valves 200mm Dia. and above shall be gear operated.

5.1.7 The valve should be suitable for 12 Kg/cm² working pressure.

6. **Ball Valves**

6.1 All Valves 40 mm Dia. and below shall be of Gun Metal Ball type Valves with (FPT) female threads conforming to class 2 of IS 778 and mating flanges fitting.

6.2 All Ball valves shall be ISI Marked.

7. **Balancing Valves**

7.1 The balancing valves upto 80 mm Dia. shall be of gunmetal screwed type conforming to BS 5154 or equivalent specifications.

7.2 The valve shall be cast gunmetal ASTM B-62 and complete with non rising spindle. PTFE disc seal cast metal hand wheel.

7.3 The port opening shall permit precise regulation of flow rate, by accurately measuring the pressure drop across the port.

7.4 The valve shall be completed with two ports for connections to a mercury manometer, to measure the pressure drop, as well as a drain port.

7.5 The spindle shall have a shielded screw to set the flow at the desired level.

7.6 This valve shall be used wherever specified.

8. **Dual Plate Check Valves**

8.1 The body of the check valve shall be made from a single piece casting in cylindrical shape.

8.2 There shall be two plate, which shall be hinged in the centre of the circle. Both plates shall be have springs attached to them for assisting in closing action of the valve.

8.3 There shall be properly/designed metal to metal seal between the plates and the outer body, to ensure non leaking sealing.

8.4 The valve design shall confirm to API 594 or equivalent specifications.

9. **Automatic/Dynamic Balancing Valve.**

9.1 Automatic Dynamic Balancing Valve shall be of forged brass (upto 40mm dia.) grey iron (above 40mm dia.) construction of 1350K Pa pressure and 120°C temperature rating. The valves shall have precision calibrated, stainless steel carriage to achieve the desired/pre-fixed flow rates irrespective of the pressure fluctuations in the water lines within a range of 10-210 K. Pa. The flow rate within a tolerance of $\pm 5\%$ will be achieved by automatic adjustment of the open orifice area in response to the pressure differential changes. The end connection upto 80mm dia. should be threaded and for above 80mm dia. it should be flanged.

10. **Strainers**

10.1 The strainers shall either be pot type or 'Y' type with cast iron or fabricated steel body, tested upto pressure applicable for the valves as shown on the drawings.

10.2 The strainers shall have a perforated bronze sheet screen with 3 mm perforation and with a permanent magnet, to catch iron fillings.

10.3 Pot strainers shall be provided with flanged connections and 'Y' strainers shall be provided with flanged ends.

10.4 The strainers shall be designed to facilitate easy removal of filter screen for cleaning, without disconnection of pipe line.

11. **Other Valves**

11.1 All gauge cocks shall be of gunmetal plug type, complete with siphon (brass chrome plated).

11.2 All drain valves shall be of gunmetal with a hose union connection on one hand.

12. **'V' Form Thermometers (Industrial Type)**

12.1 The body shall be of aluminium alloy with anodized gold colored surface. The casing shall be adjustable side ways for reading from the front. The glass capillary shall be triangular in shape with the blue mercury filled in glass. Scale of reading shall be of the range 0°C to 50°C/32°F to 120°F.

12.2 Thermometer shall be suitable for 12 mm connections with long stem, so that thermometer is removable without damaging the insulation. M.S. socket to be welded on pipes shall be provided with thermometer.

13. **Jointing**

13.1 All pipe lines shall be welded type.

13.2 Square cut plain ends will be welded for pipes upto and including 100 MM Dia.

13.3 All pipes 125 MM Dia. or larger will be bevelled by 35 DEG. before welding.

14. **Pipe Supports/Hangers**

14.1 Pipe supports shall be provided and installed for all piping wherever indicated, required or otherwise specified. Wherever necessary, additional hangers and supports shall be provided to prevent vibration or excessive deflection of piping and tubing.

14.2 All vertical pipe support shall be made of 10mm M.S. Rods and the horizontal support shall be of M.S. angles of 50x50x4 mm thick.

14.3 Pipe supports shall be adjustable for height and prime coated with rust preventive paint & finish coated with black paint using approved grade of paint.

The spacing of pipe supports shall not be more than that specified below :-

<u>Nominal pipe size MM</u>	<u>Spacing (Metres)</u>		
15	1.25
20 & 25	2.00
32,30,50 & 65	2.50
80,100 & 125	2.50
150 & Above	3.00

14.4 Extra supports shall be provided at the bends and at heavy fittings like valves to avoid undue stresses on the pipes. Pipe hangers shall be fixed on wall and ceiling by means of approved metallic dash fasteners.

14.5 Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation, cause condensation. The pipe supports or Saddles shall be of PUF, factory fabricated to suit pipe sizes.

14.6 Hangers shall be supported from structural steel, concrete inserts & pipe racks, as specifically approved.

14.7 No hangers shall be secured to underside of light weight roof decking and light weight floor glass.

14.8 Mechanical equipment shall be suspended midway between steel joints and panel points.

14.9 Drilling or punching of holes in steel joint members will not be permitted.

14.10 Contractor shall make shop drawing for fixing of support for approval.

15. **Miscellaneous**

15.1 Provide all pipe work as required to make the apparatus connected complete and ready for regular and safe operation. Unless otherwise noted, connect all apparatus and equipment in accordance with manufacturer's standard details, as approved by Engineer-In-Charge.

15.2 Provide valves and capped connections for all low points in piping system, where necessary or required for draining systems. Provide Isolating valves & Drain valves in all risers to permit repairs without interfering with the rest of the system.

15.3 During construction, temporarily close, open ends of pipes with sheet metal caps, where necessary, or required to prevent debris from entering the piping system.

15.4 Support piping independently of all equipment so that the equipment is not stressed by the piping weight or expansion.

15.5 To facilitate the maintenance, repair and replacement:

15.5.1 Provide shut-off valves where indicated and for individual equipment, units at inlet and outlet, to permit unit removal for repairs, without interfering with the remainder of the system. Additional shut-off valves shall be provided as required to enable all systems to be

fully sectionalized. By-pass and stop valves shall be provided for all automatic control valves as specified.

- 15.5.2 Arrange piping for maximum accessibility for maintenance and repair, locate valves for easy access and operation. No valves shall be installed with handles pointing down, unless unavoidable.
- 15.5.3 Cut the pipes accurately according to measurements, established at building site & work into place without springing or forging.
- 15.5.4 Where pipes are to be buried under ground, they should be coated with one coat of bituminous paint. The top of the pipes shall not be less than 75 CM. from the ground level. Where this is not practical permission of Engineer-In-Charge shall be obtained for burying the pipes at lesser depth. The pipes shall be surrounded on all sides by sand cushions of not less than 15 CM. After the pipes have been laid and top sand cushions provided, the trench shall be refilled with the excavated soil, excess soil shall be removed from the site of work by the contractor.

16. **Sleeves**

- 16.1 Where pipes pass through floors, walls, etc provide Galvanized steel pipe sleeves 50 MM larger than outside diameter of pipe. Where pipes are insulated, sleeves shall be large enough to ample clearance for insulation.
- 16.2 Where pipes pass through outside walls or foundations, the space between pipe and sleeve shall be filled with rock wool covered with GI sheet.
- 16.3 The centre of pipes shall be in the centre of sleeves, and sleeves shall be flushed with the finished surface.

17. **Arrangement and alignment of piping**

- 17.1 All piping shall be arranged and aligned in accordance with the drawings as specified. Where special conditions are encountered in the field, the arrangement and alignment of piping shall be as directed by the Engineer-In-Charge.
- 17.2 The piping shall be installed in a uniform manner, parallel or perpendicular to walls or ceilings, and all changes in directions shall be made with fittings. The horizontal piping shall be run at right angles and shall not run diagonally across rooms or other piping. wherever possible all piping shall be arranged to provide maximum head room.
- 17.3 All piping shall be installed as directly as possible between connecting points in so far as the work of other trades permits. Where interference occurs with another trade whose work is more difficult to route, this contractor shall reroute his pipes as required to avoid interference, at the discretion of the Engineer-In-Charge.
- 17.4 All piping shall be carefully installed to provide for proper alignment, slope and expansion.
- 17.5 The stresses in pipe lines shall be guided and pipes shall be supported in such a manner that pipe lines shall not creep, sag or buckle.
- 17.6 Anchors and supports shall be provided wherever necessary to prevent any misalignment of piping.
- 17.7 Small tubing gauges, controls or other equipment installed on any apparatus, shall not be coiled nor excessive in length, but shall be installed neatly, carefully bent at all changes in direction, secured in place and properly fastened to equipment at intervals to prevent sagging.
- 17.8 The piping shall be grouped wherever practical and shall be installed uniformly in straight parallel lines in either vertical or horizontal positions.

18. **Testing**

- 18.1 In general, tests shall be applied to piping before connection of equipment and appliances. In no case shall the piping, equipment or appliances be subjected to pressures exceeding their test ratings.
- 18.2 The tests shall be completed and approved before any insulation is applied. Testing of segments of pipe work will be permitted, provided all open ends are first closed, by blank offs or flanges.

- 18.3 After tests have been completed the system shall be drained and flushed 3 to 4 times and cleaned of all dust and foreign matter. All strainers, valves and fittings shall be cleaned of all dirt, fillings and debris.
- 18.4 All piping shall be tested to hydraulic test pressure of at least one and half times the maximum operating pressure but not less than 10 kg/cm² for a period of not less than 12 hours. All leaks and defects in the joints revealed during the testing shall be rectified to the satisfaction of the Engineer-In-Charge, without any extra cost.
- 18.5 All the piping systems shall be tested in the presence of the Engineer-In-Charge or their authorized representative. Advance notice of test dates shall be given and all equipments, labour, materials required for inspection, and repairs during the test shall be provided by the contractor. A test shall be repeated till the entire systems are found to be satisfactory to the above authority. The tests shall be carried out for a part of work if required by Engineer-In-Charge in order to avoid hindrance in the work of the insulation contractor.
- 18.6 Miscellaneous piping, tests with air at 10.5 kg/cm² for a minimum of 24 hours without drop in pressure.
- 18.7 The contractor shall make sure that proper noiseless circulation is achieved through all piping systems. If due to poor bond, proper circulation is not achieved, the contractor shall bear all expenses for carrying out the rectification work including finishing of floors, walls and ceiling damaged in the process of rectifications.
- 18.8 The contractor shall provide all labours and materials to make provision for removing water and throwing it at the proper place, during the testing or/and after the testing to avoid damages to employer or other contractors' properties. Any damages caused by the contractor to the employer or other contractors' properties, shall be borne by the contractor.

19. **Drain Piping**

- 19.1 The drain piping shall be medium class galvanized steel as per IS 1239/1979.
- 19.2 The fittings shall be of 'R' brand or "Unik" or equal forged with screwed connections.
- 19.3 The gate valves shall be of gun metal duly ISI marked on each valve.
- 19.4 Pipe crosses shall be provided at bends, to permit easy cleaning of drain line.
- 19.5 The drain line shall be provided upto the nearest drain trap and pitched towards the trap.
- 19.6 Drain lines shall be provided at all the lowest points in the system, as well as at equipments, where leakage of water is likely to occur, or to remove condensate and water from pump glands.

20. **Painting**

- 20.1 All pipes supports, hangers, etc., shall be given two coats of red oxide primer.
- 20.2 All pipes, which are not to be insulated, shall then be given two coat of finish paint, of a type and colour, as approved by the Engineer-In-Charge.

Section 4

INSULATION

1. General

The Insulation of water piping, air handling units, ducting, chillers & refrigerant piping 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. The detailed specifications of the materials are listed under respective sub heads.

2.1	Pipe Insulation	:	Rigid Polyurethane Foam (PUF)
2.2	Drain Pipe Insulation	:	Polyethylene Foam (Kinney Foam)
2.3	Duct Insulation	:	Resin Bonded glass wool
2.4	Acoustic Treatment	:	Resin Bonded glass wool
2.5	Equipment Insulation	:	Expanded Polystyrene (SE) (EP).
2.6	Refrigerant Pipe	:	Nitrile rubber insulation

3. Pipe Insulation

3.1 The insulation for chilled water and drain piping, chillers, pump etc. shall be carried out from rigid polyurethane foam having a 'K' value of 0.018 W/mK. at mean temperature of 10°C and a density of 27.2 to 39.9 kgs/cubm. The material shall be factory faced on one side with aluminium foil on the outside, reinforced with kraft paper and fused to the insulation material. The aluminium foil shall be extended by a minimum of 50 mm on one side of the pipe section along the length to seal all longitudinal joints.

The aluminium foil facing shall be replaced with Kraft Paper facing wherever the pipe is to be covered with Tar felt.

3.1.2 The thickness of the insulation for chilled water pipes shall be 30 MM.

3.1.3 Preformed pipe sections shall be used for pipes upto and including 350 mm dia.

3.1.4 Pipes above 350 mm dia. shall be insulated with insulation slabs cut in mitred sections.

3.2 Drain Pipe Insulation

3.2.1 The material for insulation of drain pipes shall be sheets of Polyethelene foam having a 'K' valve of 0.027 W/mK at a mean temperature of 10°C and a minimum density of 26 Kg./cubm.

3.2.2 The thickness of insulation shall be 2 layer of 6 mm thickness..

3.3 Duct Insulation

3.3.1 The materials for duct insulation shall be resin bonded fibre glass, as described earlier but conforming to I.S. 8183 of 1976. The density of insulation shall not be less than 24 kg/cubm and material shall be in the form of blankets/rolls of uniform thickness. The 'K' value at 10° C. Shall not be less than 0.031 W/mK. It shall be factory faced with aluminium foil on one side reinforced with kraft paper and fused to the insulation material.

3.3.2 The thickness of duct insulation shall be as follows :

- a. Duct in conditioned space - 25 mm thick
- b. Duct in unconditioned space - 50 mm thick

3.4 Acoustic Treatment

3.4.1 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 boards of uniform density. The 'k' value at 10°C shall not be less than 0.03 W/mK. Facing shall be provided with 0.5 mm perforated aluminium sheet held with G.I. Nuts bolts or nailed to the batten work as required.

3.4.2 The thickness of insulation shall be as follow unless otherwise specified elsewhere :

- a. Duct Acoustic : 25 MM
- b. Room Acoustic : 50 MM

3.5 **Equipment Insulation**

3.5.1 The materials for equipment insulation shall be slabs of expanded Polystyrenes (Self extinguishing grade) having a 'K' Value of 0.035 W/mK at 10°C and a density not less than 20 Kg./Cum.

3.5.2 The complete shell of the chiller as well as its two heads, shall be factory insulated.

3.5.3 The insulation on chilled water pumps and expansion tank shall be of expanded polystyrene having a 'K' value of 0.035 W/mK at a mean temperature of 10°C and a density not less than 20 Kg/Cubm. The thickness of the insulation will be as given below :

- i) Expansion tank - 50 mm
- ii) Chilled water pumps - 50 mm

3.6 **CPRX Compound**

3.6.1 The cold compound adhesive being supplied shall be CPRX Type.

3.7 **Tar Felt**

3.7.1 The Tar felt used for water proofing shall conform to IS: 1322 Type 3 Grade-I.

4. **Installation**

4.1 **Chilled Water Piping (PUF)**

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

4.1.2 The pipes shall be given a coat of red oxide primer.

4.1.3 Two coats of CPRX Compound shall be applied on the cleaned pipe surface.

4.1.4 The preformed sections of insulation shall be fixed tightly to the surface taking care to seal all joints.

4.1.5 All joints along the circumference of the pipe sections shall be sealed with 50 mm wide aluminium faced adhesive tape.

4.1.6 All longitudinal joints shall be further sealed with 50 mm wide aluminium faced adhesive tape.

4.1.7 Insulation on pipes and valves in the AHU room shall be covered with 0.5 mm aluminium sheet cladding.

4.2 **Drain Piping**

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

4.2.2 Coat the pipe with one layer of red oxide primer.

4.2.3 Then two layer of 6mm thick insulation shall be wrapped on the pipe.

4.2.4 Then it shall be tied with 1 mm thick G.I. wires.

4.3 **Ducting**

4.3.1 Clean the surface with a wire brush and make it free from rust and oil.

4.3.2 Apply two coats of CPRX compound on the cleaned surface.

- 4.3.3 Wrap the duct with insulation blankets of the thickness mentioned in item 3.3.2 above and covered with 0.63 mm/19 mm wire mesh netting on the outside.
- 4.3.4 The joints shall be sealed with aluminium tape before covering with wire netting.
- 4.3.5 The Ducts in areas exposed to the weather shall be additionally covered with one layer of tar felt B.H. The tar felt shall be stuck with Hot Bitumen.

4.4 **Duct Acoustic Lining**

- 4.4.1 The duct surface shall first be cleaned from inside.
- 4.4.2 Then 25 mm square section made of 18 Ga (1.2 mm) thick G.I. sheet should be fixed on both ends of the duct piece.
- 4.4.3 The insulation slabs should be fixed between these sections of ducts using adhesive compound and **stick pins**.
- 4.4.4 The insulation shall then be covered with RP tissue, sealing all joint so that no fibre is visible.
- 4.4.5 The insulation shall then be covered with 0.5 mm perforated aluminium sheets.
- 4.4.6 The sheet of insulation shall be secured to the duct by means of stick pins as mentioned above.

4.5 **Equipment**

- 4.5.1 The surface shall first be cleaned with wire brush.
- 4.5.2 Then two layers of hot bitumen shall be applied.
- 4.5.3 The insulation shall then be fixed in one layer and sealing them with hot bitumen.
- 4.5.4 The insulation shall then be covered with 0.63 mm/ 19 mm mesh wire netting which shall be fixed to the insulation with brass 'U' nails.
- 4.5.5 The final finish shall be 0.50 mm aluminium cladding.

4.6 **Room Acoustic**

- 4.6.1 Fix 40 mm x 50 mm G.I. channels at 0.5 metre interval longitudinally then fix cross battens at 1.0 metre centre using suitable gutties, and brass screws.
- 4.6.2 Fill each rectangle with 50 mm glass wool and covered with RP tissue.
- 4.6.3 Tie with 24 gauge G.I. Wires at 300 mm intervals.
- 4.6.4 Then cover with 22 gauge (0.80 mm) perforated Aluminium sheet having 3 mm perforations at 6 mm centres. Overlap all joints and provide beading of 25 mm by 2 mm flats.
- 4.6.5 All corners joints shall be covered with 25 x 25 x 2 mm thick aluminium angles.

Section 5

ELECTRIC CABLING

1. General

The electric cable connections of motors and earthing of all equipments shall be carried out, as per specifications, given hereunder.

2. Cabling

2.1 The cabling of various equipment shall be carried using PVC Insulated and armoured cables.

2.2 The PVC armoured power cable for use on 415 volts system shall be 3 or 3.5 Core with aluminium conductors and be of 660/1100 volts grade, as per IS 1554 (Part I) 1964. The cross section of the cable shall be to suit the load and rating of the equipment. The cables shall be of aluminium conductor, PVC insulated, strip armoured with overall PVC sheathing.

2.2.1 The cables shall be laid as per IS-1255/1967, Indian standard code of practice.

2.2.2 The cables shall be laid, as per drawings in the ducts/pipes/trays etc. along a short and convenient route between switch board and the equipment, (either in trenches, on wall or on hangers, supported from the slab). Cable routing shall be checked at the site of work to avoid interference with structure, equipment etc. Where more than one cables are running close to each other, proper spacing should be provided between them.

2.2.3 The radius of bends of the cable should not be less than 12 times the overall dia. of cable in order to prevent undue stress and damage at the bends, the cables should be supported with wooden cleats on M.S. Supports, when laid in trenches, or wall/ceiling suspended hangers. When laid underground the cables should be covered with fine soft earth and protected with 2nd Class bricks. Suitable G.I. Pipe shall be used wherever cables are laid under the roads etc.

2.2.4 Wooden bushes shall be provided at the ends of pipes through which cables are connected through.

3. Surface Wiring

3.1 The surface wiring shall be cased in conduits which shall be of 1100 volts grade and conform to IS 9587-1987 (revised to date)

3.1.1 The conduits used shall be of high quality & all joints shall be made with sockets. The bends and elbows shall have inspection covers fixed with grease free screws. The joints shall be water tight. Approved metal saddles shall be used to secure the exposed conduits at a space of 1 meter or less. The connection of the conduits to switches etc., shall be secured by check nuts and ebonite bushes provided at the ends of conduits.

3.1.2 The M.S. conduits shall be heavy duty and rigid type-ISI marked/conforming to IS specifications. The wall thickness shall not be less than 2 mm. For conduits above 32 mm dia. Metallic conduits of 19 mm dia. and below shall not be used. Conduit accessories (Boxes etc.) shall conform to IS-5133-1968 and IS-2667-64 (amended-revised to date). Conduit pipes shall be jointed, wherever necessary by means of screwed couples and screwed accessories only. In Long distance straight, run of conduits inspection type couplers at suitable intervals shall be provided.

3.1.3 Threads on conduit pipes shall be between 13 mm to 19 mm long.

3.1.4 The wiring shall be carried-out as per IS 732-1989 (Amended and revised to date).

3.2 Flush inspection covers shall be provided in case of Concealed, recessed conduits. The staples for the conduits shall not be spaced more than 0.60 meters apart. Before filling up the chase with concrete the conduits should be given a coat of rust proof paint.

3.3 The wires shall be drawn only after all the conduits have been properly fixed in position. Fish wires (steel wire : 16 SWG) shall be laid in conduits for drawing of wires subsequently.

4. **Control Cabling/wiring**

- 4.1 Control cables shall be 1100 volts grade, as per IS 1554, made from copper conductor of 1.5 Sq mm PVC insulated single Core, strip armoured with an overall PVC sheathing.
- 4.2 The cables and conduits wiring shall be carried out as per details given under 2.2 and 2.3 above.

5. **Earthing**

- 5.1 All equipment connected with electric supply shall also be provided with double earthing continuity conductors. The size of G.I. earthing conductors shall be :-

Size of phase wire sq.mm Aluminium	Size of G.I. conductor Tape/Wire (Swg)
185	25 mm x 6 mm (strip)
150	25 mm x 6 mm (strip)
120	25 mm x 6 mm (strip)
95	4 Swg
70	4 Swg
50	6 Swg
35	6 Swg
25-6	6 Swg
4	6 Swg

Note :- Aluminium earthing conductors of equivalent Size may be used in lieu of GSS conductors mentioned above.

6. **Miscellaneous**

- 6.1 The final connections to the equipment shall be through Flexible connections in case of conduit wiring and also where the equipment is likely to be moved back and forth, such as on slide rails.
- 6.2 An isolator switch shall be provided at any motor which is separated from the main switch panel by a wall or partition or other barrier or is more than 15 metres away from the main panel.
- 6.3 Two separate and distinct earthing conductors shall be Connected from the equipment upto the main switch board panel.
- 6.4 The branch lines from the main panel to each equipment shall be separated and should not criss cross other lines.
- 6.5 The entire installation shall be tested as per Electricity rules and I.S.S. 732-1973 with amendments 1,2&3 prior to the commissioning of the plant and a suitable test report furnished by a competent and authorised person. The test report will be obtain by contractor himself at his own expenses.
- 6.6 All exposed switch board panels, conduits, hangers etc. shall be given 2 coats of suitable paint of approved colour, when all work has been completed.

Section 6 **TESTING AND COMMISSIONING**

1. General

- 1.1 The contractor must perform all inspection and tests of the system as a whole and of components individually as required, under the supervision of the architect, in accordance with the provisions of the applicable ASHRAE standards or approved equal in addition to furnish necessary test certificates from manufacturers.
- 1.2 The system shall then be commissioned, tested and balanced to fulfil the intent and purpose for which it is designed.
- 1.3 In addition continuous Run Tests shall be carried out during peak weather condition.

2. Compressors Condensers/Chillers/Evaporators/Pumps etc.

- 2.1 Hydraulic test for various components and assembled equipments at 1.5 times design pressure or double the operating pressure, whichever is higher.
- 2.2 Pneumatic leak test after assemblies at design pressure
- 2.3 Static and dynamic balancing on electronic precision machine for rotating parts, links, impellor/ crank shaft assemblies etc.
- 2.4 Testing of oil passages in compressor at 1.5 times pump discharge pressure.
- 2.5 Pressure drop test for condenser, chiller and evaporator.
- 2.6 For compressor assembly, electronic leak, air running test, pneumatic test with dry nitrogen and leak test in water.

3. Air Handling Units

3.1 Blowers

- 3.1.1 Dynamic/static balancing of impellers.
- 3.1.2 Performance test as per applicable codes.

3.2 Coils

- 3.2.1 Pneumatic test.

3.3 Filters

- 3.3.1 Test of filter elements as per B.S. 2831 B.S. 1701 as applicable. This is to ascertain filtration efficiency by weight at inlet and outlet.
- 3.3.2 Manufacturer's test certificates also to be produced for the assembled A.H.U. Final dimensional check will be done. Inspection may be done during assembly of components for quality of workmanship, painting etc.

3.3 Piping

Materials check for specifications and size.

3.4 Valves

Hydraulic./pneumatic test certificates.

3.5 Motors

Manufacturer's test certificate as per motor data sheet.

3.6 **Instruments and Controls**

Visual examination.

3.7 **Special Note**

Vendor to note that above procedure is to be followed in addition to the specifications attached with the tender.

4. **Associated Works at Site.**

- 4.1 All electrical items will be subjected to inspection at any stage during manufacturing activity. Routine electrical test as per relevant codes. Inspection of manufacturer's test certificates.
- 4.2 Inspection of raw materials to be used for fabrication and assembly and inspection of manufacturer's certificates.
- 4.3 Inspection of welding including welders qualification as desired by inspection engineers. Inspection of fabricated items.
- 4.4 Pressure testing of pipe fittings used for the refrigerant and water and other services.
- 4.5 Pressure testing, leak testing of complete piping network for chilled water. (Condenser water and refrigerant/services).
- 4.6 Checking of electrical circuits (power & controls) and checking functioning of controls of refrigerant systems and other circuits of air conditioning plant.
- 4.7 Checking of calibration of controls and instrumentation
- 4.8. Checking of assemblies or electrical control panel, instruments panels, local panels (dimensional and functional) annunciator panels etc.
- 4.9 Inspection of complete electrical installation at site.
- 4.10 Performance testing of complete A.C. Plant as per specifications.

5. **Vendor Responsibility**

- 5.1 The above inspection procedure is given for general guidance and information of vendors. The inspection of purchaser/consultant is strictly not limited to these.
- 5.2 The inspection engineer of purchaser/consultant will have full right, to have detailed inspection at any stage right from placement of order to completion of project, as and when desired by inspection engineer.
- 5.3 Co-ordination of inspection agency of purchaser/consultant with his factory/subvendor's factory/erection site will be the sole responsibility of successful vendor, subsequent to placement of order for complete air conditioning plant, covered under these technical specifications.

6. **Piping System**

- 6.1 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 pressure exceeding their test ratings.

- 6.2 Tests shall be completed and approved before any insulation is applied.
- 6.3 After tests have been completed, the system shall be drained and cleaned of all dust and foreign matter. All strainers, valves and fittings shall be cleaned of all dirt, fittings, and debris.

6.4 **Water Piping**

All water piping shall be tested and proven tight under Hydrostatic pressure of 11 Kg/Cm² (150 PSI) or 1.5 times the design pressure whichever is more unless stated otherwise in the specifications. The prescribed pressure shall be maintained for eight hours. In case leaks are detected, the pressure test will be repeated, after the repair of the leaks.

7. **Duct Work**

- 7.1 All branches and outlets shall be tested for air quantity, and the total of the air quantities shall be within plus five percent (5%) of fan capacity.
- 7.2 Fire dampers, volume dampers and splitter dampers shall be tested for proper operation.

8. **Electrical Equipment**

- 8.1 All electrical equipment shall be cleaned and adjusted on site before application of power.
- 8.2 The following tests shall be carried out:
 - 8.2.1 Cables and Wires continuity tests.
 - 8.2.2 Insulation resistance tests, phase to phase and phase to earth, on all circuits and equipment, using a 500 Volts meggar. The meggar reading shall be not less than one megaohm.
 - 8.2.3 Earth resistance between conduit system and earth must not exceed half (1/2) CMH.
 - 8.2.4 Phasing out and phase rotation tests.
 - 8.2.5 Operating tests on all protective relays to prove their correct operation before energising the main equipment.
 - 8.2.6 Operating tests on all starters, circuit breakers etc.

9. **Plant Audit & Certification work**

- 9.1 The work of plant audit & certification shall be done by an approved outside agency.
- 9.2 The whole system balancing shall be tested with microprocessor based Hi-tech instruments with an accuracy of $\pm 0.5\%$.
- 9.3 The instrument shall be capable of storing data and then downloading into a PC. The agency shall provide a minimum but not limited to the following instruments.
 - 9.3.1 Microprocessor based velocity calculation meter to measure DB and WB temperature, RH and dew point.
 - 9.3.2 Velocicalc meter to measure air volume and air velocity.

- 9.3.3 Pitot tube.
- 9.3.4 Electronic Rotary Vane Anemometer.
- 9.3.5 Accubalance Flow Measuring Hood.
- 9.4 The outside agency shall analyse all the data and shall be responsible for the capacity and performance audit and certification of the plant.
- 9.5 The successful Bidder shall be responsible to provide necessary sockets and connections for fixing of the Testing Instruments, probes etc.

10. **Commissioning of the System**

The system shall be commissioned by adopting the following procedure.

- 10.1 The installation as a whole shall be balanced and tested upon completion, and all relevant information, including the following shall be submitted to the architects.
 - 10.1.1 Air volume passing through each unit, duct, grilles, aperatures.
 - 10.1.2 Static pressure in each air duct.
 - 10.1.3 Water flow passing through each condenser, chiller, AHU etc.
 - 10.1.4 Differential pressure readings across each filter, fan and coil, and through each pump.
 - 10.1.5 Electrical current readings, in amperes of full and average load running and starting, together with name plate current of each electrical motor.
 - 10.1.6 Continuous recording over a specified period, of ambient wet and dry bulb temperatures under varying degrees of internal heat loads and use and occupation, in each zone of each part of the building.
- 10.2 Daily records should 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. The current and voltage drawn by each machine.
- 10.3 Any other readings shall be taken which may subsequently be specified by the architect.

11. **Air Balancing**

- 11.1 All air handling/ ventilation equipments, duct work and outlets shall be adjusted and balanced to deliver the specified air quantities, at each inlet and outlet as indicated on the drawings.
- 11.2 If these air quantities cannot be delivered without exceeding the speed range of the pulley or the available horse power, the architect shall be notify, before proceeding with the balancing of air distribution system.
- 11.3 A proper record shall be maintained as per Test Proforma given else where.

12. **Water Balancing**

- 12.1 The output of water pumps shall be checked using the balancing valves, provided on the pumps, for this purpose, to ensure the output and pressures match the specified requirement.

12.2 Then flow to Condensers/Chillers, Air handling units etc. shall be individually adjusted and balanced to match the flow rate as given in specifications/ drawings to meet the requirement.

12.3 The balancing valves, provided on the equipments, shall be used for adjustment.

13. **Miscellaneous**

13.1 The above tests and procedures are mentioned herein, for general guidance and information only, but not by way of limitation to the provisions of conditions of contract and specification.

13.2 The date of commencement of all tests listed above, shall be subject to the approval of the architect and In accordance with the requirements of this specification.

13.3 The contractor shall supply 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 architect requests such a test for determining specified or guaranteed data, as given in the specification or on the drawings.

13.4 Any damage resulting from the tests shall be repaired and/or damaged material replaced, to the the satisfacion of the architect without any extra cost.

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

13.6 The contractor must inform the architect when such tests are to be made, giving sufficient notice, in order that the architect or his nominated representative may be present.

13.7 Complete records of all tests must be kept and 3 copies of these and location drawings must be furnished to the architect.

13.8 The contractor may be required to repeat the test as required, should the Ambient conditions at the time, do not give, in the opinion of the architect, sufficient and suitable indication of the effect and performance of the installation as a whole or of any part, as required.

Section 7

FAN COIL UNITS

1. General

The fan coil units shall be complete in all respects and shall generally comply with the specifications as given hereunder.

2. Fan Coil Units

2.1 *The coil units shall be of seamless copper tube not less than 0.5 mm thick walls and min. 9 MM OD tube dia. The coil shall have continuous aluminium sheet fins with die formed collars for mounting. The finned coil, fan section with motor, drain pans, air filters, filter box, fan speed regulator and other controls.*

2.2 Cooling Coil

The coil shall be of seamless copper tubes not less than 9 mm O.D. 0.40 mm thick. The coil have continuous aluminium plate fins. The fins shall be spaced by collars forming integral part of the fins. The tubes shall be staggered in the direction of air flow. The coil circuit should be sized for adequate water velocity but not exceeding 1.8 M/s (6 F.P.S) the fins shall be uniformly bonded to the tubes by hydraulic expansion of the tubes.

The coils shall be tested against leaks at a hydraulic pressure of 10 kg/sq.cm. This pressure shall be maintained for a period of 2 hours. No drop should be observed indicating any leaks.

2.3 Fan Section

2.3.1 *This shall consist of (2) two light weight aluminium impellers of forward curved type, both statically and dynamically balanced, along with properly designed G.I. sheet casings of 18 gauge.*

2.3.2 *The two impellers shall be directly mounted on to a double shaft, single phase multiple winding motor capable of running at (3) three speeds.*

2.3.3 *A. G.I. Plenum of 18 gauge shall connect the fan outlets to the coil.*

2.4 Drain pans

2.4.1 *The drain pan shall be of double skin construction made of 1.6 mm (16 GA.) G.I. Sheet, covering the whole of coil section and extended on one side for accommodating coil connection, valve etc and complete with a 25 mm drain connection. The drain pan shall be insulated with 25 mm expanded polystyrene and covered with second G.I. tray.*

2.5 Air Filter

The filter shall be cleanable type 12 mm thick, of wire mesh to be mounted, behind the pan in a filter box made of G.I. Sheet of 18 gauge.

3. Speed Control

A sturdy switch shall be provided with the unit complete with wiring, for off and with minimum (3) three speed control, of the fan.

4. Painting

The fan coil units shall be powder coated in suitable colour.

5. **Automatic Controls (Wherever Required)**

5.1 *Each unit shall have a room type thermostat and a 2 way motorised water valve. The valve shall be fixed at a convenient location. The thermostat shall be mounted along with the speed control switch on a common plate. The plate shall clearly indicate the fan positions. The controls should be as per specifications under 'controls'.(price separately)*

5.2 *The water valves on inlet line shall be of gun metal ball type with integral water strainers, having BSP(FPT) inlet and flare type mpt outlet connection. The valve on return line shall be as above, but without the water strainer.*

6. **Water Connections**

The water lines shall be finally connected to the coil of the fan coil unit, by at least 300 mm long, type I seamless solid drawn copper tubing with flare fittings and connections.

Section 8

FILTERS

1. **General**

1.1 *The various types of Filters to be used in the Different Systems, to achieve the required degree of air purification shall confirm to the following specifications.*

2. **Standard Filters**

2.1 *The standard filters shall have an efficiency of 90 % down to 10 Microns.*

2.2 *The frames of the filter shall be of G.I. of suitable rigidity.*

2.3 *The filtering media shall be 5 ply pleated synthetic media, closely packed to give the required efficiency.*

3. **Miscellaneous**

Suitable packing shall be provided in the frames of all filters, to prevent any leakage of air through the gaps, between the filter joints. All such joints shall be properly sealed against any leakage of unfiltered air.

LIST OF APPROVED MAKES

1.	<i>Compressor (Recip.)</i>	<ul style="list-style-type: none"> • <i>Kirlosker (Emercon)</i> • <i>Tecumseh</i> • <i>Carrier</i> • <i>Hitachi</i>
2.	<i>Compressor (Rotary)</i>	<ul style="list-style-type: none"> • <i>Kirlosker (Emercon)</i> • <i>Tecumseh</i> • <i>Highly</i> • <i>Hitachi</i> • <i>Matsushita</i> • <i>Mitsubishi</i> • <i>Samsung</i>
3.	<i>Compressor for refrigerator</i>	<ul style="list-style-type: none"> • <i>Kirlosker (Emercon)</i> • <i>Tecumseh</i> • <i>Godrej</i> • <i>BPL</i> • <i>Whirlpool</i>
4.	<i>Fan motor</i>	<ul style="list-style-type: none"> • <i>Voltas</i> • <i>Suprit</i> • <i>Sundra</i> • <i>Crompton Greaves</i> • <i>GEC</i> • <i>Windsor</i>
5.	<i>Bushes for motor</i>	<ul style="list-style-type: none"> • <i>MSP</i>
6.	<i>Capacitor</i>	<ul style="list-style-type: none"> • <i>Epcos</i> • <i>Seatron</i> • <i>Siemens</i> • <i>Sharda</i> • <i>Asian</i> • <i>Keil</i>
7.	<i>Relays</i>	<ul style="list-style-type: none"> • <i>Indfos</i> • <i>Renutrol</i> • <i>Hitech</i> • <i>Shriram</i> • <i>Godrej</i> • <i>Whirlpool</i> • <i>BPL</i>
8.	<i>OLP</i>	<ul style="list-style-type: none"> • <i>Indfos</i> • <i>Renutrol</i> • <i>Hitech</i> • <i>Shriram</i> • <i>Godrej</i> • <i>Whirlpool</i> • <i>BPL</i>
9.	<i>PCB</i>	<ul style="list-style-type: none"> • <i>Hitachi</i> • <i>Voltas</i> • <i>Videocon</i> • <i>Carrier</i> • <i>LG</i> • <i>Samsung</i>
10.	<i>Thermostat</i>	<ul style="list-style-type: none"> • <i>Indfos</i> • <i>Annapurna</i> • <i>Ranutrol</i> • <i>Hitech</i>

11.	<i>Solenoid Valve</i>	<ul style="list-style-type: none"> • <i>Precession</i> • <i>Indfos</i>
12.	<i>Selector Switch</i>	<ul style="list-style-type: none"> • <i>AGI</i> • <i>Reswi</i>
13.	<i>Timer for Refrigerator</i>	<ul style="list-style-type: none"> • <i>Indfos</i> • <i>Hitachi</i> • <i>Voltas</i> • <i>Videocon</i> • <i>Carrier</i> • <i>LG</i> • <i>Samsung</i>
14.	<i>Heater for refrigerator</i>	<ul style="list-style-type: none"> • <i>Indfos</i> • <i>Hitachi</i> • <i>Voltas</i> • <i>Videocon</i> • <i>Carrier</i> • <i>LG</i> • <i>Samsung</i>
15.	<i>Bi-Metallic for Refrigerator</i>	<ul style="list-style-type: none"> • <i>Indfos</i> • <i>Hitachi</i> • <i>Voltas</i> • <i>Videocon</i> • <i>Carrier</i> • <i>LG</i> • <i>Samsung</i>
16.	<i>PCB for refrigerator</i>	<ul style="list-style-type: none"> • <i>Indfos</i> • <i>Hitachi</i> • <i>Voltas</i> • <i>Videocon</i> • <i>Carrier</i> • <i>LG</i> • <i>Samsung</i>
17.	<i>Freezer temp. sensor for refrigerator</i>	<ul style="list-style-type: none"> • <i>Indfos</i> • <i>Hitachi</i> • <i>Voltas</i> • <i>Videocon</i> • <i>Carrier</i> • <i>LG</i> • <i>Samsung</i>