



भारतीय प्रौद्योगिकी संस्थान इंदौर
Indian Institute of Technology Indore

**Infrastructure
Development
Office**

INDIAN INSTITUTE OF TECHNOLOGY INDORE

SIMROL, KHANDWA ROAD, INDORE 453552

www.iiti.ac.in



TENDER DOCUMENT FOR

**Balance work of HVAC system in PHY- 2 (1D) & CSE-2 (1A)
Buildings at IIT Indore**

NIT No: IITI/IDO/PR/E/NIT/HVAC/R&C/2020-21/14

Last date of Submission: February 09, 2021



Index

Name of Work: - Balance work of HVAC system in PHY- 2 (1D) & CSE-2 (1A) Buildings at IIT Indore .

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INDIAN INSTITUTE OF TECHNOLOGY INDORE

NOTICE INVITING TENDER

The Project In-Charge, IIT Indore invites item rate bids in two bid system for following work:

NIT No.: IITI/IDO/PR/E/NIT/HVAC/R&C/2020-21/14

Name of Work: Balance work of HVAC system in PHY- 2 (1D) & CSE-2 (1A) Buildings at IIT Indore ”.

Estimated Cost: ₹ 12, 00,981/-

Time of Completion: **45 days**

Date of availability of tender document for download from **February 03, 2021** to **February 09, 2021 (15:00 hrs)** can be seen on website https://www.iiti.ac.in/tender_estate, and downloaded free of cost and shall be submitted online on website central public procurement portal (CPPP) <https://eprocure.gov.in/eprocure/app> .

No Pre-bid meeting will be held, however queries can be sent on email ryadav@iiti.ac.in

For Site visit, kindly send the request on ryadav@iiti.ac.in and timing will be between 10 AM and 4 PM on **February 05, 2021**

Date of submission of bids Up to **3.00 PM** of **February 09, 2021**

Time and date of opening of eligibility bid: **February 10, 2021 at 3.30 PM**



INFORMATION AND INSTRUCTIONS FOR BIDDERS

The Project in Charge, IIT Indore on behalf of IIT Indore invites online item rate tenders from eligible firms / contractors of repute in two bid system for the following work:

Sl.		Name of work & Location	Estimated cost put to tender	Period of Completion	Site Visit	Last date & Time of submission /uploading of eligibility and financial bids and other documents as specified	Time & date of opening of Eligibility bid
1	IIT/IDO/PR/ENITHVAC/IR&C/20 20-21/14	<u>Balance work of HVAC system in PHY- 2 (1D) & CSE- 2 (1A) Buildings at IIT Indore ”.</u>	Rs. 12,00,981/-	45 days	Between 10 AM to 4PM on February 05, 2021.	Up to 3 PM of February 09, 2021	At 3:30 PM of February 10, 2021

1. Contractors who fulfill the following requirements shall be eligible to apply. Joint ventures are not accepted.
- (a) Should have satisfactorily completed the similar works in CPWD / MES / MPPWD / Central PSUs / IITs / IIMs / IISERs/ any private establishment as mentioned below during the last five years ending previous day of last date of submission of bids.

Three similar works each costing not less than Rs. 4.80 Lakhs

or

Two similar works each costing not less than Rs. 7.20 Lakhs

or

One similar work costing not less than Rs. 9.60 Lakhs

Eligible similar work shall mean works of **"Supply Installation Testing & commissioning of HVAC System.**

The value of executed works shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum; calculated from the date of completion to previous day of last date of submission of bids.

- (i) Should have an average annual financial turnover of Rs. 6.0 Lakhs during the last three years ending March 31, 2020.
- (ii) Should not have incurred any loss (profit after tax should be positive) in more than two years during the last five years ending March 31, 2020.
- (iii) Should have a solvency of Rs. 4.8 Lakhs
- (iv) Should have valid 'A' or 'B' class electrical contractor license from Govt. of M.P. or Govt. of India.
- (v) Should have GST registration certificate.
- (vi) Should have EPF registration certificate.
- (vii) Should have ESIC registration certificate.
- (viii) Should have PAN CARD registration certificate.



- (ix) Should have company/firm registration certificate.
 - (x) Should have Building & other construction works (BOCW) registration certificate.
 - (xi) Should have labor license registration certificate.
2. The intending bidder must read the terms and conditions of CPWD-6 carefully. He should only submit his bid if he considers himself eligible and he is in possession of all the documents required and should submitted with technical bid.
3. Information and Instructions for bidders posted on website shall form part of tender and bid document.
4. The bid document consisting of plans, specifications, the schedule of quantities of various types of items to be executed and the set of terms & conditions of the contract to be complied with and other necessary documents can be seen and downloaded from website stated above.
5. The tender can only be submitted after uploading the mandatory scanned documents as per list given.
6. **Documents to be submitted with technical bid:**
- (i) Copy of Certificate of Work experience, Certificate of Financial Turnover from Chartered Accountant, Bank Solvency Certificate and other documents mentioned above shall be submitted and all documents mentioned in **ELIGIBILITY BID DOCUMENTS** in the prescribed formats of Form 'A' to 'G' and Annexure 'A' to 'F' along with certified copies of supporting documents shall also be submitted. At the time of submission of bid contractor shall submit 'Affidavit / Certificate from CA mentioning Financial Turnover of last 5 years or for the period as specified in the bid document and further details, if required shall be asked from the Contractor after opening of Eligibility bid documents. There is no need to upload entire voluminous balance sheet.
7. The Eligibility bid shall be opened first on due date and time as mentioned above. The time and date of opening of financial bid of contractors qualifying the eligibility bid shall be communicated to them at a later date.
8. IIT Indore reserves the right to reject any prospective application without assigning any reason and to restrict the list of qualified contractors to any number deemed suitable by it, if too many bids are received satisfying the laid down criteria.
-



Bid Security Declaration
(To be signed by bidders in lieu of EMD on Company's Letter Head)

To,
Registrar
IIT Indore

This Bid Securing Declaration is made by
(Authorized signatory) on behalf of (Company
Name) as part of fulfillment of Bid Submission in lieu of Earnest Money Deposit (EMD).

This Bid Securing Declaration is made accepting that if we withdraw or modify our bids during the period of validity, or if we are awarded the contract and we fail to sign the contract, or to submit a performance security before the deadline defined in the request for bid documents, we will be liable for suspension for a period of two years from being eligible to submit Bids for contract with IIT Indore.

Date:
Place:

(Signature of Authorized Person)
With Company Seal



Indian Institute of Technology Indore

Notice Inviting Tender

1. Project in Charge IIT Indore on behalf of IIT Indore invites item rate bids from eligible firms/contractors of repute in two bid systems for the work of **“Balance work of HVAC system in PHY- 2 (1D) & CSE-2 (1A) Buildings at IIT Indore “**.

1.1 The work is estimated to a composite cost of: ₹ 12,00,981 /- this estimate, however, is given merely as a rough guide.

1.2 Criteria of eligibility for contractors: Same as Mentioned in earlier pages.

1.3 To become eligible for issue of bid, the bidder shall have to furnish an affidavit as under: -

I/We undertake and confirm that eligible similar works(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 Indore 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.

2. Agreement shall be drawn with the successful bidder on prescribed Form No. CPWD 8 modified / amended up to last date of receipt of tender, Bidder shall quote their rates as per various terms and conditions of the said form which will form part of the agreement.
3. The time allowed for carrying out the work will be 45 days 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 bid documents.
4. The site for the work is available at IIT Indore
5. The bid 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, 2014 can be seen on website mentioned on earlier pages.
6. **Copy of certificate of work experience, Certificate of financial turnover from Chartered Accountant, Bank Solvency Certificate and other documents mentioned shall be submitted within the period of bid submission and all documents mentioned in ELIGIBILITY BID DOCUMENTS in the prescribed formats of Form 'A' to 'G' and Annexure 'A' to 'F' along with certified copies of supporting documents shall also be submitted** At the time of submission of bid contractor must submit 'Affidavit / Certificate from CA mentioning Financial Turnover of last 5 years or for the period as specified in the bid document and further details, if required, shall be asked from the Contractor after opening of Eligibility bid documents.
7. The bid submitted shall become invalid and shall not be refunded if:
 - (i) The bidder is found ineligible.
 - (ii) The bidder does not submit all the documents (including service tax registration/VAT registration/Sales Tax registration) as stipulated in the bid document.



- (iii) If any discrepancy is noticed between the documents as uploaded at the time of submission of bid and hard copies as submitted physically by the lowest bidder in the office of bid opening authority.
- (iv) **If a tenderer quotes nil rates against each/ any item in item rate tender or does not quote any percentage above / below on the total amount of the tender or any section /sub head in percentage rate tender, the tender shall be treated as invalid and will not be considered as lowest tenderer.**
8. The contractor whose bid is accepted will be required to furnish performance bank guarantee of **3% (Five Percent)** of the bid amount within the period specified in Schedule F. This guarantee shall be in the form of 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 contractor whose bid is accepted will also be required to furnish either copy of applicable licenses / registrations or proof of applying for obtaining labor licenses, registration with EPFO, ESIC and BOCW Welfare Board including Provident Fund Code No. if applicable and also ensure the compliance of aforesaid provisions by the sub contractors, if any engaged by the contractor for the said work and program chart (Time and progress) within the period specified in Schedule 'F'.**
9. The description of the work is as follows:
The scope of works includes "Balance work of HVAC system in PHY- 2 (1D) & CSE-2 (1A) Buildings at IIT Indore (Risk & cost)."
- Intending bidders are advised to inspect and examine the site and its surroundings and satisfy themselves before submitting their bids 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 bids. A bidder 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 bidder 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 bid by a bidder implies that it has read this notice and all other contract documents and has made itself aware of the scope and specifications of the work to be done and of conditions and rates at which stores, tools and plant, etc. will be issued to it by the Government and local conditions and other factors having a bearing on the execution of the work.
10. The competent authority on behalf of the Board of Governance of IIT Indore does not bind itself to accept the lowest or any other bid and reserves to itself the authority to reject any or all the bids received without the assignment of any reason. All bids in which any of the prescribed condition is not fulfilled or any condition including that of conditional rebate is put forth by the bidder shall be summarily rejected.
11. Canvassing whether directly or indirectly, in connection with bidders is strictly prohibited and the bid submitted by the contractors who resort to canvassing will be liable to rejection.



12. The competent authority on behalf of Board of Governance of IIT Indore reserves to himself the right of accepting the whole or any part of the bid and the bidder shall be bound to perform the same at the rate quoted.
 13. The contractor shall not be permitted to bid for works in the IIT Indore in which its near relative is posted as an officer in any capacity between the grades of Superintending Engineer and Junior Engineer (both inclusive) responsible for award and execution of contracts. It shall also intimate the names of persons who are working with it in any capacity or are subsequently employed by it and who are near relatives to any Gazetted officer in the IIT Indore or in the Ministry of Education.
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 previous permission of the Government of India in writing. This contract is liable to be cancelled if either the contractor or any of its 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 bid or engagement in the contractor's service.
 14. The bid for the works shall remain open for acceptance for a period of **90 days (Ninety days)** from the date of opening of technical bid. If any bidder withdraws its bid before the said period or issue of letter of acceptance, whichever is earlier, or makes any modifications in the terms and conditions of the bid which are not acceptable to the department, **then IIT Indore shall, without prejudice to any other right or remedy, be at liberty to forfeit 100% of the said performance guaranty as aforesaid. Further the bidders shall not be allowed to participate in the re-bidding process of the work.**
 15. The Eligibility bid shall be opened first on due date and time. The time and date of opening of financial bid of contractors qualifying the eligibility bid shall be communicated to technically qualified bidders only at a later date.
 16. This Notice Inviting Bid shall form a part of the contract document. The successful bidder, on acceptance of its 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 Bid, all the documents including additional conditions, specifications and drawings, if any, forming part of the bid at the time of invitation of bid and the rates quoted online at the time of submission of bid and acceptance thereof together with any correspondence leading thereto.
 - b) Standard C.P.W.D. Form 8 amended / modified up to last date (or other Standard C.P.W.D. Form as applicable) of receipt of bid.
-



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 President of India 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.

I/We agree to keep the tender open for Ninety (90) days from the due date of opening of eligibility bid and not to make any modification in its terms and conditions.

A sum of Rs. (Rs.....) is hereby forwarded in online is scanned and uploaded. If I/We, fail to furnish the prescribed performance guarantee within prescribed period, I/we agree that the said President of India 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 to commence work as specified, I/We agree that President of India or his successors in office shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the said performance guarantee absolutely. The said Performance Guarantee shall be guarantee to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to 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 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 Indore 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 Deposited / 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 therefrom 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 #.....

Signature of Contractor

Postal Address#

Witness: #

Address: #

Occupation: #

To be filled in by the contractor/witness as applicable



ACCEPTANCE

The above tender (as modified vide letters mentioned hereunder) is accepted by me for and on behalf of the IIT Indore for a sum of ₹. _____

(Rupees _____)

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

- a)
- b)
- c)

For & on behalf of the IIT Indore.

Signature

Dated

Designation



FORM OF PERFORMANCE SECURITY BANK GUARANTEE BOND

1. In consideration of the President of India (hereinafter called "The Government") having offered to accept the terms and conditions of the proposed agreement between.....and.....
(hereinafter called "the said contractors") for the work(hereinafter called "the said agreement") having agreed to production of a irrevocable Bank Guarantee for Rs.....(Rupees.....only) as a security /guarantee from the contractor(s) for compliance of his obligations in accordance with the terms and conditions in the said agreement, we..... (indicate the name of the bank)
(hereinafter referred to as "the Bank") hereby undertake to pay to the Government an amount not exceeding Rs.....(Rupees.....only) on demand by the Government.
2. We(Indicate the name of the Bank) do hereby undertake to pay the amounts due and payable under this Guarantee without any demure, merely on a demand from the Government stating that the amount claimed is required to meet the recoveries due or likely to be due from the said contractors. Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the Bank under this Guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs.....(Rupees.....only).
3. We, the said Bank further undertake to pay to the Government any money so demanded notwithstanding any dispute or disputes raised by the contractors in any suit or proceeding pending before any Court or Tribunal relating thereto, our liability under this present being absolute and unequivocal. The payment so made by us under this bond shall be a valid discharge of our liability for payment there under and the contractors shall have no claim against us for making such payment.
4. We.....(indicate the name of the Bank) further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said agreement and that it shall continue to be enforceable till all the dues of the Government under or by virtue of the said agreement have been fully paid and its claims satisfied or discharged or till Engineer-in-Charge on behalf of the government certified that the terms and conditions of the said agreement have been fully and properly carried out by the said contractors and accordingly discharges this guarantee.
5. We(Indicate the name of the Bank) further agree with the Government that the Government shall have the fullest liberty without our consent and without effecting in any manner our obligations hereunder to vary any of the terms and conditions of the said agreement or to extend time of performance by the said contractors from time to time or to postpone for any time or from time to time any of the powers exercisable by the Government against the said contractors and to for-bear or enforce any of the terms and conditions relating to the said agreement and we shall not be relieved from our liability by reason of any such variation or extension being granted to the said contractors or for any for-bearance, act of omission on the part of the Government or any



indulgence by the Government to the said contractor(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision have effect of so relieving us.

6. This guarantee will not be discharged due to the change in the constitution of the Bank or the contractor(s).
7. We (Indicate the name of the Bank) lastly undertake not to revoke this guarantee except with the previous consent of the Government in writing.
8. This guarantee shall be valid upto_____ Unless extended on demand by Government. Notwithstanding anything mentioned above, our liability against this guarantee _____ is _____ restricted _____ to Rs. _____ (Rupees _____ only) and unless a claim in writing is lodged with within six months of the date of expiry or the extended date of expiry of this guarantee all our liabilities under this guarantee shall stand discharged.

Dated _____ the _____ day of _____ for
_____ (Indicate the name of Bank).



Instructions for Online Bid Submission

The bidders are required to submit soft copies of their bids electronically on the CPP Portal, using valid Digital Signature Certificates. The instructions given below are meant to assist the bidders in registering on the CPP Portal, prepare their bids in accordance with the requirements and submitting their bids online on the CPP Portal.

More information useful for submitting online bids on the CPP Portal may be obtained at:

<https://eprocure.gov.in/eprocure/app>.

REGISTRATION

- 1) Bidders are required to enroll on the E- Tender module of the Central Public Procurement Portal (URL: <https://eprocure.gov.in/eprocure/app>) by clicking on the link “Online bidder Enrollment” on the CPP Portal which is free of charge.
- 2) As part of the enrolment process, the bidders will be required to choose a unique username and assign a password for their accounts.
- 3) Bidders are advised to register their valid email address and mobile numbers as part of the registration process. These would be used for any communication from the CPP Portal.
- 4) Upon enrolment, the bidders will be required to register their valid Digital Signature Certificate (Class III Certificates with signing key usage) issued by any Certifying Authority recognized by CCA India (e.g. Sify / nCode / eMudhra etc.), with their profile.
- 5) Only one valid DSC should be registered by a bidder. Please note that the bidders are responsible to ensure that they do not lend their DSC’s to others which may lead to misuse.
- 6) Bidder then logs in to the site through the secured log-in by entering their user ID / password and the password of the DSC / e-Token.

SEARCHING FOR TENDER DOCUMENTS

- 1) There are various search options built in the CPP Portal, to facilitate bidders to search active tenders by several parameters. These parameters could include Tender ID, Organization Name, Location, Date, Value, etc. There is also an option of advanced search for tenders, wherein the bidders may combine a number of search parameters such as Organization Name, Form of Contract, Location, Date, Other keywords etc. to search for a tender published on the CPP Portal.
- 2) Once the bidders have selected the tenders they are interested in, they may download the required documents / tender schedules. These tenders can be moved to the respective ‘My Tenders’ folder. This would enable the CPP Portal to intimate the bidders through SMS / email in case there is any corrigendum issued to the tender document.
- 3) The bidder should make a note of the unique Tender ID assigned to each tender, in case they want to obtain any clarification / help from the Helpdesk.

PREPARATION OF BIDS



- 1) Bidder should take into account any corrigendum published on the tender document before submitting their bids.
- 2) Please go through the tender advertisement and the tender document carefully to understand the documents required to be submitted as part of the bid. Please note the number of covers in which the bid documents have to be submitted, the number of documents - including the names and content of each of the document that need to be submitted. Any deviations from these may lead to rejection of the bid.
- 3) Bidder, in advance, should get ready the bid documents to be submitted as indicated in the tender document / schedule and generally, they can be in PDF / XLS / RAR / DWF/JPG formats. Bid documents may be scanned with 100 dpi with black and white option which helps in reducing size of the scanned document.
- 4) To avoid the time and effort required in uploading the same set of standard documents which are required to be submitted as a part of every bid, a provision of uploading such standard documents (e.g. PAN card copy, annual reports, auditor certificates etc.) has been provided to the bidders. Bidders can use "My Space" or "Other Important Documents" area available to them to upload such documents. These documents may be directly submitted from the "My Space" area while submitting a bid, and need not be uploaded again and again. This will lead to a reduction in the time required for bid submission process.

Note: My Documents space is only a repository given to the Bidders to ease the uploading process. If Bidder has uploaded his Documents in My Documents space, this does not automatically ensure these Documents being part of Technical Bid.

SUBMISSION OF BIDS

- 1) Bidder should log into the site well in advance for bid submission so that they can upload the bid in time i.e. on or before the bid submission time. Bidder will be responsible for any delay due to other issues.
- 2) The bidder has to digitally sign and upload the required bid documents one by one as indicated in the tender document.
- 3) Bidders are requested to note that they should necessarily submit their financial bids in the format provided and no other format is acceptable. If the price bid has been given as a standard BoQ format with the tender document, then the same is to be downloaded and to be filled by all the bidders. Bidders are required to download the BoQ file, open it and complete the white coloured (unprotected) cells with their respective financial quotes and other details (such as name of the bidder). No other cells should be changed. Once the details have been completed, the bidder should save it and submit it online, without changing the filename. If the BoQ file is found to be modified by the bidder, the bid will be rejected. **The vendor/firm should fill the complete details as mentioned in BOQ and exclusion of any cell of BOQ (Financial bid), the cost will be treated as inclusive of GST and other charges as mentioned in the BOQ column.**
- 4) The server time (which is displayed on the bidders' dashboard) will be considered as the standard time for referencing the deadlines for submission of the bids by



the bidders, opening of bids etc. The bidders should follow this time during bid submission.

- 5) All the documents being submitted by the bidders would be encrypted using PKI encryption techniques to ensure the secrecy of the data. The data entered cannot be viewed by unauthorized persons until the time of bid opening. The confidentiality of the bids is maintained using the secured Socket Layer 128 bit encryption technology. Data storage encryption of sensitive fields is done. Any bid document that is uploaded to the server is subjected to symmetric encryption using a system generated symmetric key. Further this key is subjected to asymmetric encryption using buyers/bid opener's public keys. Overall, the uploaded tender documents become readable only after the tender opening by the authorized bid openers.
- 6) The uploaded tender documents become readable only after the tender opening by the authorized bid openers.
- 7) Upon the successful and timely submission of bids (i.e. after Clicking "Freeze Bid Submission" in the portal), the portal will give a successful bid submission message & a bid summary will be displayed with the bid no. and the date & time of submission of the bid with all other relevant details.
- 8) The bid summary has to be printed and kept as an acknowledgement of the submission of the bid. This acknowledgement may be used as an entry pass for any bid opening meetings.

ASSISTANCE TO BIDDERS

1. Any queries relating to the tender document and the terms and conditions contained therein should be addressed to the Tender Inviting Authority for a tender or the relevant contact person indicated in the tender.
2. Any queries relating to the process of online bid submission or queries relating to CPP Portal in general may be directed to the 24x7 CPP Portal Helpdesk.

GENERAL INSTRUCTIONS TO THE BIDDERS

- 1) The tenders will be received online through portal <http://eprocure.gov.in/eprocure/app>. In the Technical Bids, the bidders are required to upload all the documents in pdf format.
- 2) Possession of a Valid Class II/III Digital Signature Certificate (DSC) in the form of smart card/e-token in the company's name is a prerequisite for registration and participating in the bid submission activities through <https://eprocure.gov.in/eprocure/app>. Digital Signature Certificates can be obtained from the authorized certifying agencies, details of which are available in the web site <https://eprocure.gov.in/eprocure/app> under the link "Information about DSC".
- 3) Tenderer are advised to follow the instructions provided in the "Instructions to the Tenderer" for the e-submission of the bids online through the Central Public Procurement Portal for E- Tender at <http://eprocure.gov.in/eprocure/app>

Online Bid Form



The bidder shall complete the online bid form and the appropriate price schedule furnished in the online bidding documents, indicating, inter alia for the goods to be supplied, a brief description of the goods, their country of origin, quantity and prices.

Online Bid prices

The Bidder shall indicate on the Price Schedule the unit price and total bid prices of the goods it proposes to supply under the Contract. To this end, the Bidders are allowed the option to submit the online bids for any one or more schedule specified in the "Schedule of Requirement" and to offer discounts for combined schedules. However, Bidders shall quote for the complete requirement of goods and services specified under each schedule on a single responsibility basis, failing which such bids (for the schedule in question) will not be taken into account for evaluation and will not be considered for award.

For taking assistance for
bid submission, if any

CPP Portal website: www.eprocure.gov.in
CPP Portal Help Desk Toll Free No.:1800233731
180030702232



GENERAL CONDITIONS OF CONTRACT

The names of concerned authorities as per GCC 2016 of CPWD should be read as below:

Sr. No.	Name of Concerned authority as per GCC of CPWD	To be read as
1	2	3
1	President of India	IIT Indore
2	Engineer-In-Charge	Project In charge
3	Director General	Director, IIT Indore
4	Department	Infrastructure Development Office, IIT Indore
5	Chief Engineer CPWD	Project In charge,
6	Director General (works)CPWD	Director, IIT Indore
7	Additional Director General	Dean of Infrastructure Development, IIT Indore
8	The Divisional Engineer	Dy. Ex. Engineer, IIT Indore

- The word “CPWD” will remain intact, wherever the rules, forms, formats, annexures, appendices, clauses, rate analysis formats, specifications etc. published by CPWD are referred.

DEFINITIONS

In the contract, the following expressions shall, unless the context otherwise requires, have the meanings hereby respectively assigned to them:

The CONTRACT shall mean the documents forming the tender and acceptance thereof together with the documents referred to therein including conditions, specifications, designs, drawings and instructions issued from time to time by the Engineer-in-Charge and all these documents taken together shall be deemed to form one contract and shall be complementary to one another.

The WORKS OR WORK shall, unless there be something either in the subject or context repugnant to such construction, be construed and taken to mean the works, by virtue of the contract contracted, to be executed whether temporary or permanent, and whether original, altered, substituted or additional.

The SITE shall mean the land/or other places on, into or through which work is to be executed under the contract or any adjacent land, path or street through which work is to be executed under the contract or any adjacent land, path or street which may be allotted or used for the purpose of carrying out the contract.

The CONTRACTOR shall mean the individual, firm or company, whether incorporated or not, undertaking the works and shall include the legal personal representative of such individual or the persons composing such firm or company, or the successors of such firm or company and the permitted assignees of such individual, firm or company.



General Condition of Contract for CPWD works 2019 as amended up to CON/295 shall become parts & parcel of the tender documents

The Board of Governors of IIT Indore shall mean its successors also. The Engineer In-charge shall mean the Project in charge IIT Indore or his authorized representative.

The Institute shall mean the Indian Institute of Technology Indore or his nominee as notified. The Accepting Authority shall mean the Director, IIT Indore on the behalf of Board of Governors IIT Indore.

The Expected Risks shall mean risks due to riots (other than those on account of contractor's employees), war (whether declared or not) invasion, act of foreign enemies, hostilities, civil war, rebellion revolution, insurrection, military or usurped power, damages from aircraft, acts of God, such as earthquake, lightening and unprecedented floods, and other causes over which the contractor has no control and accepted as such by the Accepting Authority.

The Market Rate shall mean the rate as decided by the Engineer-in-Charge on the basis of the cost of material and labor at the site where the work is to be executed plus 15% cover all the overheads and profits.

The Schedule(s) referred to in these conditions shall mean the relevant schedule(s) annexed to the tender document and the Standard Schedule of Rates of the Institute with the amendments there to issued up to the date of issue of notice inviting tenders.

The Tendered Amount shall mean the amount of the work as stipulated in the letter of award.

Where the context so requires, words imparting the singular only also include the plural and vice versa. Any reference to masculine gender shall, whenever required, include feminine gender and vice versa.

Headings to the General Conditions of Contract shall not be deemed to form part thereof or be taken into consideration in the interpretation or construction thereof or of the contract.

The contractor shall be furnished, free of cost one certified copy of the contract except standard specifications, Schedule of Rates and such other printed and published documents, together with all the drawings as may be forming part of the contract. None of these documents shall be used for any purpose other than that of this contract.

WORKS TO BE CARRIED OUT

The work to be carried out under the Contract shall, except as otherwise provided in these conditions, include all labor, materials, tools, plants, equipment and transport which may be required in preparation of and in the full and entire execution and completion of the works. The descriptions given in the Schedule of Quantities shall, unless otherwise stated, be held to include wastage on materials, carriage and cartage, carrying and return of empties, hoisting, setting, fitting and fixing in position and all other labor necessary in and for the execution and completion of the work as aforesaid in accordance with good practice and recognized principles.



SUFFICIENCY OF TENDER

The contractor shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his tender for the works and of the rates and prices quoted in the Schedule of Quantities, which rates and prices shall, except as otherwise provided, cover all his obligations under the Contract and all the matters and things necessary for the proper completion and maintenance of the works.

DISCREPANCIES AND ADJUSTMENT OF ERRORS

The several documents forming the Contract are to be taken as mutually explanatory of one another, detailed drawings being followed in preference to small-scale drawings and figured dimensions in preference to scale and special conditions in preference to General Conditions.

In the case of discrepancy between the Schedule of Quantities, the Specifications and/ or the Drawings, the following order of preference shall be observed: -

- Description of Schedule of Quantities. Particular
- Specification and Special Condition, if any.
- Drawings
- CPWD Specifications
- Indian Standard Specifications of BIS.
- ISHRAE - Society of Heating, Refrigerating and Air Conditioning Engineers

If there are varying or conflicting provisions made in any one document forming part of the contract, the Accepting Authority shall be the deciding authority with regard to the intention of the document and his decision shall be final and binding on the contractor.

Any error in description, quantity or rate in the Schedule of Quantities or any omission there from shall not vitiate the contract or release the contractor from the execution of the whole or any part of the work comprised therein according to drawings and specifications or from any of his obligations under the contract.



Special conditions of the contract

The following special instructions/ conditions are applicable to tenderer.

1. The tenderer shall supply the following information along with the tender:

- Names and addresses of the clients whose similar works have been executed by the tenderer. IIT Indore reserves right to verify such credentials.
- Copy of contractor's 'A' or 'B' class electrical license (wherever applicable) issued by the electrical licensing authorities of Government of M.P. /Govt. of India.
- Any other information the tenderer feels necessary to make his offer complete, without changing or without having intent to modify / change any of the tender condition to be submitted in a separate sheet.
- Deviation/Any exclusion, deviation from specification shall be clearly spelt out and listed at one place in the offer only and tenderer shall substantiate the same with appropriate reasons. In absence of the same, it will be considered that tenderer has followed the specification fully in words and spirit.

2. Since the given work is the balance work in which some of the material is supplied and already installed at site. Hence integration with existing system shall be taken into consideration by the contractor.

3. Tools, tackles, and consumables:

- Testing equipments required for the work shall be in good condition (calibrated annually) and arranged by the contractor. The testing instruments shall be of sufficient capacity and quantity as per the site requirements. The instruments like insulation tester, earth tester, earthing rods, multi-meters, testing kits, thermometer etc. shall be required at site during installation, commissioning, testing activities.
- The contractor shall be fully responsible for arranging the supply of required tools & tackles, cable crimping tools, ladders etc. In addition to above, the personal protective equipments of proper rating (PPE) like helmets, safety belts, hand gloves, safety shoes, torch, ladder etc. for all working persons shall also be arranged.

The consumable items like jelly, cotton waste, dungry cloth, emery paper, CRC & CTC and material required for housekeeping including detergents, phenyl, soap etc. shall be provided by the contractor.

4. The contractor shall employ the required number of technical and non-technical manpower. During contract period, the contractor shall depute qualified, experienced and competent manpower as per the site set-up/staff requirement for executing the work. During execution of installation, commissioning, testing activities, in case some additional manpower is required, contractor shall provide the same free of cost. For entry in institute, contractor shall submit the details of the employees i.e. Address proof, I.D. proof, photo etc. for gate pass of all deputies.



5. The contractor shall not be entitled for any additional payment during the tenure of the contract due to increase in cost of manpower or any.
6. The price offered by the contractor shall include the charges for any minor maintenance, the details of which may not be explicitly available in the tender specification, but it is essential for this work.
7. **Housekeeping:** The contractor shall maintain the installations, commissioning, testing activities clean and tidy inside as well as around the installations and substation buildings. This shall also include sweeping, mopping, cleaning of cobwebs, removal of scrap generated during contract period, etc. in the substations building. All required materials for housekeeping like broom, cobweb broom, mop, bucket, soap, detergents, phenyl, etc. shall be arranged by the contractor. No rags and waste etc. shall be thrown near the building. This shall be deposited in the scrap yard and dustbins provided nearby, as per the department instructions. Also, furniture and fixture therein shall be maintained.

It is the responsibility of the contractor to hand over the entire system to IITI on completion of the contract period in working condition.

8. The final handing over / taking over will be done after joint inspection by IITI and contractor on the completion of contract period. The liability towards damage/ replacement shall be limited to 05% (Five percent) of the order value.
9. **Inspection:** Inspection will be carried out by IITI as and when required. Inspection by statutory bodies/ authorities will be under the scope of contractor. Contractor shall intimate IITI authority the schedule of such statutory bodies/ authorities' inspection.

10. Safety

- Specifications and standards: The installations, commissioning, testing activities shall be in conformity with relevant Indian Standard specification, National Electric codes, Indian Electricity Rules.
- The contractor, his agents, representatives, workmen etc. shall strictly observe the orders pertaining to fire/LV/HV/EHV (Electrical) precautions prevailing within the restricted areas/electrical substations etc.
- The contractor, his agents, representatives, workmen etc. shall strictly adhere to the fire/electric shock precautionary measures while working near the explosive areas/HV/LV/Electrical substation areas. During such times, the workmen should be headed by their site supervisor as a precautionary measure. The regular team of the contractor shall be very well aware of firefighting, Cardio-Pulmonary Resuscitation, first aid etc.
- While working at height, Personal Protective Equipments (PPE) like safety belts, helmet, ladder and scaffoldings etc. shall be used as per the recommended safety guidelines.

11. Accident or injury to workmen:



- IITI shall not be responsible for any injury or loss of any workers of the contractor that may take place while on work. Any compensation or expenditure towards treatment for such injury or loss of life shall be the sole responsibility of the contractor. The contractor is solely responsible for any damage or injury or accident that may occur to any of his personnel working under this contract. He will not claim any compensation from IITI.
- In order to meet any type of emergency, a dedicated vehicle along with driver shall be made available by the contractor in IIT Indore.

12. Theft of Parts:

Contractor shall be fully responsible for theft, burglary, fire or any mischievous deeds by his workers/ staff and shall replace the items under such category. Any loss occurred due to negligence will be recovered from the contractor. Security/ Safety of all installations in substations will be the responsibility of contractor.

13. Materials, Consumables & Tools etc.:

For performance of contract, the Contractor will arrange all the materials/ consumables, tools & machines/ testing equipment's required for execution of said jobs, which will be included in quoted rates. No extra payment for the same will be made by the Institute.

14. During the period of installations, commissioning, testing activities, no extra payment what so ever towards replacement of parts or consumables etc. shall be entertained. It shall be included in rates quoted.
15. Rates quoted in the financial bid must be inclusive of all central, state and local taxes etc. including trade tax on works contract. Rate are also inclusive of payment to the Labor Department in accordance with the prevailing Labor law, including all statutory liability fixed by the Labor commissioner or any other law enforcement agency. Also, if new taxes are introduced, same also would be applicable.
16. All the statutory fees/ charges need to be paid for functional/ operational of the equipments shall be paid to government bodies by contractor. IITI will reimburse the same after the submission of original receipt to IITI.
17. Contractor shall be solely responsible for payment of wages/salaries and allowances to their personnel as per the rules or act applicable under government order. All central, state, local laws & bye laws applicable will be observed by the contractor and IIT Indore will be kept indemnified of such payable by the contractor.
18. Any unauthorized person (or visitor) shall not be allowed to come inside the campus without the approval of Engineer in charge and Security officer. Staff deployed at IIT Indore will get the temporary ID card and which shall be available with the concern at the time of duty. For the purpose of proper identification of the employees of the contractor deployed for the work, contractor shall issue identity cards bearing their photographs/ identification etc. and such employees shall display their identity cards at the time of duty.



19. Engineer-in-charge, IIT Indore shall be at liberty to carry out surprise check on the persons as deployed by the contractor in order to ensure that persons deployed by him are doing their duties.
20. For performing the assigned work, the contractor shall deploy medically and physically fit persons (Preferably below the age of 50). The contractor shall ensure that the persons are punctual and disciplined and remain vigilant in performance of their duty. Persons so engaged by the contractor shall be from amongst properly trained electrician of high integrity and good conduct and shall be conversant in the local language i.e. Hindi. In no circumstances, persons below 18 years of age should be employed.
21. The contractor shall further keep the IIT Indore indemnified against any loss to the IIT Indore property and assets. IIT Indore shall have further right to adjust and/or deduct any of the amounts as aforesaid from the payments due to the contractor under this contract.
22. The contractor shall ensure that the persons so deployed do not allow any property of the IIT Indore related to Equipment's to be taken out of the premises without a Gate Pass signed by the Engineer in-charge of the IIT Indore.
23. Saturdays / Sundays should be utilized primarily for the installations, commissioning, testing activities, where shutdown is required, in consultation with & approval of the engineer-in-charge of IIT Indore.
24. In case, any staff not found up to the mark and not able to work properly or behave improperly, he will have to be changed as per the instruction of the Engineer in charge, IIT Indore.
25. **SUSPENSION**: - IITI may by written notice of suspension to the contractor, suspend all payments to contractor hereunder if the later fails to perform any of its obligations under this contract, including the carrying out of the services provided that such notice of suspension (i) shall specify the nature of the failure and (ii) request the contractor to remedy such failure within the period not exceeding fifteen (15) days, after such notice of suspension.
26. **TERMINATION**: - Termination to the contractor may be given after the occurrence of any of the events specified below:
- If the contractor fails to remedy a failure in the performance of their obligations.
 - If the contractor fails to comply with any final decision reached as a result of arbitration proceedings.
 - If the IITI, in its sole discretion and for any reason whatsoever, decides to terminate this contract.
 - If the contractor, in the judgement of the IITI has engaged in corrupt or fraudulent practices in executing the contract.



- e) In case the contract is terminated, the balance amount of fee if any, paid earlier (advance) shall be paid back by the contractor to IIT Indore within thirty days of termination letter, failing which the same shall be recovered by encashing the existing performance bank guarantee/security deposit submitted by contractor.
- 27.** Approval of the statutory bodies like CEA/ local bodies and shall be deemed to be included in the contract. The contractor shall notify IIT Indore in writing about such approvals to be taken and inform the compliance of the same. The fees paid to the CEA/ local bodies as per the challan will be reimbursed to the contractor by IIT Indore. The original challan and approvals shall be handed over to IIT Indore.
- 28.** The persons deployed by the contractor for the services mentioned above shall be the employees of the contractor for all intents and purposes and that the persons so deployed shall remain under the control and supervision of the contractor.
- 29.** The contractor shall at his own cost, if required, take necessary insurance cover up to the handing over in respect of the aforesaid services rendered to IIT Indore and shall comply with the statutory provisions of Contract Labor (Regulation & Abolition) Act, 1970; Employees State Insurance Act; Workman's Compensation Act, 1923; Payment of Wages Act, 1936; The Employees Provident Fund (and Miscellaneous Provisions) Act, 1952; Payment of Bonus Act, 1965; The Minimum Wages Act, 1948; Employer's Liability Act, 1938; and/or any other rules/ regulations and/ or statutes that may be applicable to them. The contractor shall indemnify the Institute against all claims which may be made upon the Institute whether under the aforesaid statutes or any other statute in force during the currency of this contract.
- 30.** Contractor shall deploy his persons in such a way that they get weekly rest. The working hours / leave, for which the work is taken from them, do not violate relevant provisions of Shops and Establishment Act. The contractor shall arrange to provide reliever equally qualified in case of absence/leave/off etc. The contractor shall in all dealings with the persons in his employment have due regards to all recognized festivals, days of rest and religious or other customs. In the event of the contractor committing a default or breach of any of the provisions of the Labor Laws including the provisions of Contract Labor (Regulation and Abolition) Act, 1970 as amended from time to time or in furnishing any information, or submitting or filling any statement under the provisions of the said regulations and rules which is materially incorrect, he shall without prejudice to any other liability pay to the Director, IIT Indore, a sum as may be claimed by IIT Indore.
- 31.** Contractor shall be deposit 5% of the contract value along with the acceptance of contract as performance bank guarantee (format for performance bank guarantee will be provided to the successful bidder) to IIT Indore and this will be refunded after the successful completion of the contract. The validity of the performance bank guarantee should be beyond 180 days of warranty/defect liability period.
- 32.** Contractor shall keep the IIT Indore indemnified against all claims whatsoever in respect of



the employees deployed by the contractor, in case any employee of the contractor so deployed enters in dispute of any nature whatsoever, it will be the primary responsibility of the contractor to contest the same. In case IIT Indore is made party and is supposed to contest the case, the IIT Indore will be reimbursed for the actual expenses incurred towards Counsel fee and other expenses, which shall be paid in advance by the contractor to IIT Indore on demand. Further, the contractor shall ensure that no financial or any other liability comes on IIT Indore in this respect of any nature whatsoever and shall keep IIT Indore indemnified in this respect.

33. No accommodation & transportation facility will be provided by the IIT Indore.

34. PAYMENT: - Payment will be made as per **clause 1 of commercial conditions** after satisfactory completion of services and on presentation of bill. No advance payment will be made. Income tax and all other statutory tax deduction at source as per the rules in force will be deducted from the bill.

GST: - The rate quoted by the contractor shall be inclusive of all taxes (including GST) and other charges.

35. Institute reserves the right to curtail or enhance the scope of work either by deletion of certain items entirely or by reducing/ increasing the quantities of certain items as required and reviewed by the Institute from time to time and therefore, the final value of the work shall be worked out and paid to the extent of work actually carried out.

36. In the event of any question, dispute/ difference arising under the agreement or in connection herewith (except as to matters the decision of which is specially provided under the agreement) the same shall be referred to the sole arbitration by the Director, IIT Indore & his decision will be final and binding to the contractor.

37. The Arbitrator may give interim awards and/or directions, as may be required, Subject to the aforesaid provisions the Arbitrator & Conciliation Act, 1996 and the rules made hereunder and any modification thereof from time to time being in force shall be deemed to apply to the arbitration proceedings under this clause.

38. JURISDICTION: Disputes of any nature that may be arise in connection with the execution of this order shall be governed by the laws of India and subject to the jurisdiction of courts situated in Indore, India only.

Place:

Name:

Date:

Signature



BRIEF PARTICULARS OF THE WORK

COMMERCIAL AND ADDITIONAL CONDITIONS

GENERAL:

This specification covers “Balance work of HVAC system in PHY- 2 (1D) & CSE-2 (1A) Buildings at IIT Indore (Risk & Cost)”.

Location: The work is to be executed in the premises of IIT Indore.

These conditions are intended to amplify the General Conditions of Contract and shall be read in conjunction with the same. For any discrepancy between the General Conditions and these Special Conditions, the more stringent shall apply.

These additional specifications are to be read in conjunction with the specifications given in the tender. In case any item/ items or part thereof are not covered under these specifications, the same shall be carried out as per relevant part of the CPWD General Specification for Electrical Works Part-I Internal -2016, Part –II External -2005 amended up to dates, relevant electricity act BIS/IEC and as per direction of Engineer –in - Charge. These additional specifications are to be read in conjunction with above and in case of variations- specifications given in this additional condition shall apply. However, nothing extra shall be paid on account of these additional specifications and conditions, as the same are to be read along with schedule of quantities for the work. In case of discrepancy among the specifications/conditions as mentioned above the precedence given in general condition of contract shall be followed.

The tenderer should in his own interest visit the site and get familiarize with the site conditions before tendering.

No T&P shall be issued by the Department and nothing extra shall be paid on account of this.

COMMERCIAL CONDITIONS:

Type of Contract: The work to be awarded by this tender shall be treated as indivisible works contact.

Submission and opening of Tenders:

- (i) The tender shall be submitted through e-tendering online.
- (ii) The tenderers are advised not to deviate from the technical specifications / items, commercial terms and conditions of NIT like terms of payment, guarantee, arbitration clause, escalation.

The Eligibility documents will be uploaded electronically which shall be comprised of the following:

- i) Documents meeting eligibility criterion given in the “INFORMATION AND INSTRUCTIONS FOR CONTRACTORS FOR e-TENDERING”.

The price bid will be opened through e-tendering only, at the defined time and date of only those firms who are eligible.

Firms should clearly note that price bids with any condition including that of conditional rebates shall be rejected forthwith.

The department reserves the right to reject any or all the price bids and call for fresh prices /tenders as the case may be without assigning any reason.

1. Payment

Following payment terms shall be applicable.

- No advance payment shall be made.
- Following percentage of contract rates shall be payable against the stage of work shown herein:
- Payment related to Balance work of HVAC system in PHY- 2 (1D) & CSE-2 (1A) Buildings at IIT Indore (At Risk & Cost)”.

Sr. No.	<u>Stages</u>	Amount in %
1.	On Supply of material at site in good condition on pro-rata basis along with test certificates, guarantee of manufacturer against defect, performance and availability of spare parts for required number of years as per tender document, insurance till handover to the department.	60%
2.	On Installation, Testing, Commissioning, and completion of successful running in period.	30%
3.	Handing over of the complete installations, As build drawings, warranty certificates, manuals etc. to the Department.	10%

Deduction of security deposit from above shall be governed by standard/ relevant clause of the CPWD 7/8.

For other items, the terms of payment will be decided by the Engineer- In-Charge and shall be binding on the contractor.

2. Termination for Insolvency

The Department may at any time terminate the Contract by giving written notice to the Contractor, if the Contractor becomes bankrupt or otherwise insolvent. In this event, termination will be without compensation to the Contractor, provided that such termination will not prejudice or affect any right of action or remedy which has accrued or will accrue thereafter to the Department.

3. Termination on account of willful misrepresentation

The contract is liable to be terminated if at any stage it is found that the contract was obtained by willful miss-representation in terms of documents or undertakings by the contractor.

4. Settlement of Disputes

If any dispute or difference of any kind whatsoever shall arise between the Department and the Contractor in connection with or arising out of the contract, the parties shall make every effort to resolve amicably such dispute or difference by mutual consultation.

- a. If, after thirty (30) days the parties have failed to resolve their dispute or difference by such mutual consultation, then either the Department or the Contractor may give notice to the other party of its intention to commence arbitration, as hereinafter provided, as to the matter in dispute, and no arbitration in respect of this matter may be commenced unless such notice is given.
- b. Any dispute or difference in respect of which a notice of intention to commence arbitration has been given in accordance with this clause shall be finally settled by arbitration. Arbitration may be commenced prior to or after delivery of the Goods under the contract.
- c. Arbitration proceedings shall be conducted in accordance with the rules of procedure specified in the GCC.
- d. Notwithstanding any reference to arbitration herein,
 - i. the parties shall continue to perform their respective obligations under the contract unless they otherwise agree; and
 - ii. the Department shall pay the Contractor any monies due the Contractor for the part of work which is not under dispute.

5. Limitation of liability

Except in cases of criminal negligence or willful misconduct, and in the case of infringement pursuant to Clause 6,

- i. The Contractor shall not be liable to the Department, whether in contract, tort, or otherwise, for any indirect or consequential loss or damage, loss of use, loss of production, or loss of profits or interest costs, provided that this exclusion shall not apply to any obligation of the Contractor to pay liquidated damages to the Department and
- ii. The aggregate liability of the Contractor to the Department, whether under the contract, in tort or otherwise, shall not exceed the total contract price, provided that this limitation shall not apply to the cost of repairing or replacing defective equipment.

6. Governing language

The contract shall be written in English. All correspondence and other documents pertaining to the contract which are exchanged by the parties shall be written in the same language.

7. Applicable Law The applicable laws shall be that of Union of India

Notices

Any notices given by one party to the other pursuant to this Contract shall be sent to other party in writing or by E-mail, tele-fax, or facsimile and confirmed in writing to the other party's address as below:

Project in Charge (II)

**IIT Indore, Infrastructure Development Office,
Indore.**

A notice shall be effective when delivered or on the notice's effective date, whichever is later.

8. Rates

The rate quoted by bidder, shall be firm and inclusive of all taxes (including GST etc.), duties and levies and all charges for packing, forwarding insurance, freight and delivery, installation, testing, commissioning etc. at site including temporary constructional storage, risks, overhead charges, general liabilities/obligation etc. A certificate of TDS shall be issued by the department to the contractor. The tendered rates must be inclusive of all such taxes.

Taxes and Duties

- a. A local Contractor shall be entirely responsible for all taxes, duties, license fees, etc, incurred until delivery of the contracted Goods to the Department.
- b. Income Tax, GST, labor cess & other statutory deduction etc. shall be made at source as per the prevalent laws. The deductions of security deposit, income- Tax, etc. shall be done after calculation of the above due payments as per clauses and net payment shall be reduced accordingly.
- c. Contractor will be entirely responsible for all taxes, stamp duties, license fees, etc and other such levies imposed outside India, custom duties, as well as for taxes and levies to be charged in connection with supplies made from India and services performed in India, and the Department shall pay all the customs duties and import taxes in consequence of the importation of the goods.
- d. Contractors will be entirely responsible for all taxes, duties, license fees, octroi, road permits, etc in connection with delivery of goods at site including incidental services and commissioning. Price bid submitted by the Contractor shall include all taxes in the contract price. No 'C' / 'D' form shall be issued by the Department
- e. Income / Corporate Taxes in India:

- i. The Contractor shall be liable to pay all corporate taxes and income tax that shall be levied according to the laws and regulations applicable from time to time in India and the price bid by the Contractor shall include all such taxes in the contract price.
- ii. Wherever the laws and regulations require deduction of such taxes at the source of payment, the Department shall effect such deductions from the payment due to the Contractor. The remittance of amounts so deducted and issuance of certificate for such deductions shall be made by the Department as per the laws and regulations in force. Nothing in the Contract, shall relieve the Contractor from his responsibility to pay any tax that may be levied in India on income and profits made by the Contractor in respect of this contract.
- iii. The Contractor's staff, personnel and labor will be liable to pay personal income taxes in India in respect of such of their salaries and wages as are chargeable under the laws and regulations for the time being in force, and the Contractor shall perform such duties in regard to such deductions thereof as may be imposed on him by such laws and regulations.

iv. **CONTRACTOR INTEGRITY:**

The Contractor is responsible for and obliged to conduct all contracted activities in accordance with the contract using state-of-the-art methods and economic principles and exercising all means available to achieve the performance specified in the Contract.

9. SECURITY DEPOSIT:

Security Deposit shall be deducted from each running bill and the final bill to the extent of **2.5% of the gross amount payable** subject to a maximum amount of 2.5% of the tendered value as per clause 17 of GCC. This is against defect liability period of 36 months.

10. PERFORMANCE GUARANTEE:

The successful tenderer shall submit an irrevocable performance guarantee of 5% of the tendered amount in addition to other deposits mentioned elsewhere in the contract for his proper performance of the contract agreement within 10 days of issued of letter of acceptance of tender. This guarantee shall be in the form of Demand draft/Pay order or irrevocable bank guarantee bond of any scheduled bank or the State bank of India in the specified format or in the form of Government security, fixed deposit receipt pledged in favor of Registrar/Executive Engineer or as specified in the letter of acceptance of tender. The performance guarantee shall be initially valid up to stipulated date of defect liability period/warranty period plus 180 days beyond. This bank guarantee shall be kept valid till the recording of completion certificate for the work by the competent authority. This guarantee shall be submitting directly through the bank.

11. CONTRACTOR'S OBLIGATIONS:

Unless otherwise mentioned in the tender documents, the following works shall be done by the contractor and therefore, their cost shall be deemed to be included in their



tendered cost- whether specifically indicated in the schedule of work or not: -

- i) Complete wiring.
- ii) Making good all damages caused to the structure during installation and restoring the same to their original finish.
- iii) Minor building work necessary for installation of equipments, making opening in the wall/floors/slabs/tables or modifications in the existing openings wherever provided and restoring the same to their original condition/ finish and necessary grouting etc. as required. Opening in the slab/retaining walls/brick wall etc. shall be made by means of core cutting machines only.
- iv) Sealing of all floor slab/wall openings provided by the Department or made by the contractor for laying cables from fire safety points of view.
- v) Suspenders, brackets and floor/wall supports for suspending/supporting cable tray, cables etc.
- vi) Removal & disposal of the all the malba/ debris occurs during the execution of work from the site.
- vii) The Contractor is obliged to work closely with the Departments staff, act within its own authority and abide by directives issued by the Department and implementation activities.
- viii) The Contractor will abide by the job safety measures prevalent in India and will free the Department from all demands or responsibilities arising from accidents or loss of life the cause of which is the Contractor's negligence. The Contractor will pay all indemnities arising from such incidents and will not hold the Department responsible or obligated.
- ix) The Contractor is responsible for managing the activities of its personnel or sub-contracted personnel and will hold itself responsible for any misdemeanors. The Contractor will treat as confidential all data and information about the Department, obtained in the execution of his responsibilities, in strict confidence and will not reveal such information to any other party without the prior written approval of the Department.

12. PATENT RIGHTS (Clause 6):

In the event of any claim asserted by a third party of infringement of copyright, patent, trademark or industrial design rights arising from the use of the Goods or any part thereof in the Department's country, the Contractor shall act expeditiously to extinguish such claim. If the Contractor fails to comply and the Department is required to pay compensation to a third party resulting from such infringement, the Contractor shall be responsible for the compensation including all expenses, court costs and lawyer fees. The Department will give notice to the Contractor of such claim, if it is made, without delay.

13. Safety Codes and Labor Regulations

- i) In respect of all labor employed directly or indirectly on the work for the performance of contractor's part of work, the contractor at his own expense, will arrange for the safety provisions as per the statutory provision, B.I.S. recommendations, factory act, workman's compensation act, CPWD code and instructions issued from time to time. Failure to provide such safety requirements would make the tenderer liable for penalty for Rs. 2000/- for each violation. In addition, the Engineer-in- charge, shall be at liberty to make arrangements and provide facilities as aforesaid and recover the cost from the contractor.
- ii) The contractor shall provide necessary barriers, signals and other safety measures while executing the installation or wherever necessary so as to avoid accident. He shall also indemnify Department against claims for compensation arising out of negligence in this respect. Contractor shall be liable, in accordance with the Indian law and Regulations for any accident occurring due to any cause. The department shall not be responsible for any

accident occurred or damage incurred or claims arising their form during the execution of work. The contractor shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the contractor due to the above provisions thereof.

14.Power Supply

- i. Power supply shall be provided by the department if available to contractor at one point for installation at site suitable for 5 KW load. Termination switchgears with energy meter however, shall be provided by the contractor. Further extension if required shall be done by the contractor. For final system commissioning & handing over, power supply of 3 Phase, 415 volts, or 1Phase, 230 V, 50 Hz as applicable shall be made available in the control room(s) of the respective systems. The recovery of electricity so consumed shall be made from their bill as per tariff in force.
- ii. The contractor shall not use the power supply for any other purpose than that for which it is intended for. No major fabrication work shall be done at site. Power supply shall be used only for welding/ cutting works. Power supply shall be disconnected in case of such defaults and the contractor shall then have to arrange required power supply at his cost.

15.Water Supply

The water supply required for the execution of work shall be made available by the Department as per applicable tariff/rate to the contractor.

16.Machinery for Erection

All tools and tackles required for unloading/ handling of equipments and materials at site, their assembly, erection, testing and commissioning shall be the responsibility of the contractor.

17.Compliance with Regulations and Indian Standards:

- i. All works shall be carried out in accordance with relevant regulation, both statutory and those specified by the Indian Standards related to the works covered by this specification. In particular, the equipment and installation will comply with the following:
 - a. Factories Act.
 - b. Indian Electricity Rules.
 - c. NBC Part-4
 - d. B.I.S. & other standards as applicable.
 - e. Workmen's compensation Act.
 - f. Statutory norms prescribed by local bodies like CEA, Power Supply Co., etc.
- ii. Nothing in this specification shall be construed to relieve the successful tenderer of his responsibility for the design, manufacture, and installation of the equipment with all accessories in accordance with currently applicable statutory regulations and safety codes.
- iii. Successful tenderer shall arrange for compliance with statutory provisions of safety regulations and departmental requirements of safety codes in respect of labor employed on the work by the tenderer. Failure to provide such safety requirement would make the tenderer liable for penalty of Rs. 500/- for each default. In addition, the department will be at liberty to make arrangement for the safety requirements at the cost of tenderer and recover the cost thereof from him.



18. Co-ordination with other Agencies

The contractor during the execution of the works shall co-ordinate with other agencies associated work with the project and shall work in harmony with them without causing any hindrance or obstruction on the progress of work in any way.

19. Mobilization Advance:

No mobilization advance shall be paid for this work.

20. Insurance and Storage:

All consignments are to be duly insured up to the destination from manufacturer's place/warehouse at the cost of the contractor. The insurance covers shall be valid till the equipment is handed over duly installed, tested and commissioned.

21. VARIATION IN QUANTITY:

Quantities shown against each item of work or supply are tentative which may vary on either side (plus or minus). The contractor should ensure from the Engineer-in-charge the actual quantity required/ to be used/ to be supplied before bringing the materials at site. In case the actual quantity of material required at the site is less than the stipulated quantity, the contractor cannot claim to supply entire quantity stipulated in the schedule of quantities of work as well as cannot demand for payment thereof. The contractor shall therefore, be very careful about the quantity of materials to be supplied /brought at site. The decision of the Engineer-in-charge in this regard shall be final and binding on the part of the contractor.

22. Quality of Materials and Workmanship

- i) The components of the installation shall be such design so as to satisfactorily function under all conditions of operation.
- ii) The entire work of manufacture/fabrication, assembly and installation shall conform to sound engineering practice.
- iii) All equipments and material to be used in work shall be manufactured in factories of good repute having excellent track record of quality manufacturing, performance and proper after sales service.
- iv) All equipments and materials to be supplied in the work shall be brand new having its date of manufacturing not more than 6 months old from the date of delivery at site with manufacturer's certificates, warrantee cards, technical catalogues, instructions, manuals and wiring diagrams, drawings etc.
- v) In order to ensure genuineness of equipments/materials, copy of invoice of each equipments/materials, custom clearance paper in case of imported materials duly authenticated by bidder shall be invariably produce to engineer-in-charge.

23. Care of the Building

Care shall be taken by the contractor during execution of the work to avoid damage to the building. Care shall also be taken by the contractor to avoid the damage to any of these existing service/service lines, any part of the building etc. If any damage is caused to any of the existing services/service lines, or any part of the building the same shall be repaired/rectified and made functional or restored so its original finish by the contractor immediately at his own expenses failing which the same shall be repaired/ rectified and made functional by department at the risk and cost of the contractor. The decision of the Engineer-in-charge in this regard shall be final & binding. He shall also remove all

unwanted and waste materials arising out of the installation from the site of work from time to time.

24. After Sales Services

The contractor shall ensure adequate and prompt after sales service free of cost during guarantee period, and against payment after guarantee period is over, in the form of maintenance, spares and personal as and when required during normal life span of the equipments and shall minimize the breakdown period. In case of equipment supplied by other manufacturers, the firm shall submit the guarantee from manufacturer for the same before the entire installation is taken over.

25. Liaisoning and Co-operation with other agencies:

The successful tenderer shall co-ordinate with other contractors and agencies engaged in the operation and maintenance of the building so as to make the execution of this works contract smooth. If any unreasonable hindrance is caused to other agencies / damage is caused to the existing installation resulting in loss of work or disruption in services during the course of work, such expenditure incurred upon restoration and loss of work shall be recovered from the successful tenderer. Water proofing of pits shall not be damaged under any circumstances.

26. All the debris due to the works shall be cleared every now and then and site shall be kept clean by the contractor at all times.

27. The electrical work shall be carried out according to the drawing & schedule supplied subject to change if any made by the Engineer –in –charge.

28. Termination of wires/cables shall be crimped properly with copper/aluminum lugs connection. All the stranded wires must be terminated to the boards/ MCB's etc. through suitable lugs by crimping for which no extra payment will be made.

29. Proper sleeving should be provided to the bare earth conductor for which no extra payment will be made.

30. All chases, holes, recess etc. for conduits and other allied work shall be done to the original finish as per requirement without any additional cost.

31. Bad - workman ship is liable to be rejected in total.

32. The contractor or his authorized representative will have to sign the site order book and comply with the remarks therein every now and then.

33. Contractor has to follow the local security/safety rules and regulations and such instructions on restricted hours of work as may be imposed on him by the department / local authorities, while working in security/restricted zones, and no claim on account of the loss of labor/ idle labor will be entertained.

34. All repairs and patch works shall be neatly carried out to match with the original finish by the contractor to the entire satisfaction of the Engineer -in-Charge.

35. The agency has to obtained approval of the department/Engineer-in-Charge to the

drawings & more subsequent changes, additions, deviations etc. as required without extra charge.

36. No quantity deviation is permitted without written approval of the competent authority. Permissible deviation shall be sanctioned by the competent authority as per the agreement. Deviation beyond permissible limits shall be sanctioned by the competent authority as per the prevailing Local Market Rates only and the decision of the department is final and binding on the contractor.
37. The quantities given in schedule of work for all the items are tentative. The work shall be carried out as per actual requirement and as approved by the Engineer -in – Charge.
38. All statutory / Mandatory recoveries enforce and as notified by competent authority from time to time shall be recovered from the bills of the agency.
39. Contractor should submit completion plan and certificate along with final bill, failing which 2.5% of value of work, subject to a ceiling of Rs. 15,000/- will be deducted from the bills or the final bill shall not be paid. Decision of Engineer-in-charge shall be final and binding in this regard. However, the completion plan is not necessary for maintenance contractors and this recovery condition shall not be applicable.
40. The Contractor has to make his own arrangement for the safety of his workman. Department shall not be responsible in case of any accident taking place during the work.
41. All the staff engaged by the contractor shall be purely his liability and department in no way shall be responsible for any compensation for any of their acts/ accidents. In case any accident occurs during the execution of the work leading to injuries, damages to human being equipment and or loss of life, the contractor shall be fully responsible for setting all claims and indemnity the department against any claims arising out of such accident.
42. **2.5% of Bill Amount will be deducted as Security Deposit for defect liability period of 36 months and which will be released after successful completion of Defect Liability period.**

LOCATION / SITE DETAILS

- | | |
|--|---|
| <ol style="list-style-type: none"> 1 Address of site 2 Location 3 Ambient temperature 4. Latitude - 22.52°N,
Longitude - 75.92°E | <p>IIT Indore
Simrol, Indore (Madhya Pradesh.)
42 °C max., 10 °C min,</p> |
|--|---|

CONTRACTORS ARE ADVISED TO VISIT THE SITE BEFORE QUOTING THE RATES. OTHERWISE IT WILL BE ASSUMED THAT THE PARTY HAS ALREADY VISITED THE SITE BEFORE QUOTING THE TENDER. AN UNDERTAKING SHOULD BE FURNISHED IN ACCORDANCE WITH ANNEXURE ENCLOSED.



PART –II

PROFORMA OF SCHEDULES

SCHEDULE 'A'

Schedule of quantities (as per CPWD.3)

As per enclosed BOQ.

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'

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.	NIL
SCHEDULE 'E' Reference to General Conditions of contract.	GCC for Central PWD Works, 2014 incorporating amendment up to last date of submission of tender.
Name of Work	<u>Balance work of HVAC system in PHY- 2 (1D) & CSE-2 (1A) Buildings at IIT Indore .</u>
Estimated cost of work	Rs. 12,00,981/-
Earnest money	NIL
Performance guarantee	3% of tendered value
Security deposit	2.5% of billing value (from each running bill)
SCHEDULE 'F'	
GENERAL RULES & DIRECTIONS: Officer inviting tender	Project In-Charge (I), IIT Indore
Maximum percentage for quantity of items of work to be executed beyond which rates are to be determined in accordance with Clauses 12.2 & 12.3:	See under Clause 12
Definitions:	
2(v) Engineer-in-Charge	Project In-Charge, IIT Indore
2(viii) Accepting Authority	Director, IIT Indore



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2(x) Percentage on cost of materials and labour to cover all overheads and profits:	15%		
2(xi) Standard Schedule of Rates	DSR 2018 with up to date correction slip and market rates.		
2(xii) Department	Infrastructure Development Office		
9(ii) Standard CPWD Contract Form	General Conditions of Contract for Central PWD Works 2014 incorporating amendments upto last date of submission of tender.		
Clause 1			
(i) Time allowed for submission of performance guarantee, programme chart (time and progress) and applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare Board or proof of applying thereof from the date of issue of letter of acceptance.	As per Part-A		
(ii) Maximum allowable extension with late fee at 0.1% per day of performance guarantee amount beyond the period provided in (i) above	As per Part-A		
Clause 2			
Authority for fixing compensation under clause 2	Director IIT Indore		
Clause 5			
Number of days from the date of issue of letter of acceptance for reckoning date of start	As per Part-A		
Table of Milestone(s)			
Milest one No.	Description of Milestone	Time allowed from date of start (Month)	Amount to be withheld in case of non achievement of milestone
As per Part-A			
Note : The withhold milestone will only be released when subsequent milestone is achieved within the specified time.			
Time allowed for execution of work		45 days	
Authority to decide:			
(i) Extension of time		Dean, Infrastructure Development, IIT Indore	
(ii) Rescheduling of milestones		Project In-Charge (I)	
(iii) Shifting of date of start in case of delay in handing over of site		Project In-Charge (I)	
Schedule of handing over of site		Site is already available for handing over	
Schedule of issue of Designs			
		Already included in NIT	



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Clause 5.2 Nature of Hindrance Register (either Physical or Electronic)		Physical
Clause 5.4 Schedule of rate of recovery for delay in submission of the modified programme in terms of delay days		
SI No.	Contract Value	Recovery (Rupees)
I.	Less than or equal to Rs 1 Crore	500
II.	More than Rs 1 Crore but less than or equal to Rs 5 Crores	1000
III.	More than Rs 5 Crore but less than or equal to Rs 20 Crores	2500
IV.	More than Rs 20 Crores	5000
Clause 6, 6A Clause applicable - (6 or 6A)		As per Part-A
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		Nil
Clause 7A Whether Clause 7A shall be applicable		As per Part-A
Clause 8B		
(i) This shall not apply for maintenance or upgradation contracts not involving any services.		
(ii) For other works, the limit shall be as below:		
SI No.	Contract Value	Limit (Rupees)
I.	Less than or equal to Rs 1 Crore	2000
II.	More than Rs 1 Crore but less than or equal to Rs 5 Crores	5000
III.	More than Rs 5 Crore but less than or equal to Rs 20 Crores	25000
IV.	More than Rs 20 Crores	50000
Clause 10A List of testing equipment to be provided by the contractor at site lab. As per directions of Engineer-in-charge.		

CLAUSE- 2A Incentive for Early Completion:-Not Applicable

CLAUSE- 8A Contractor to Keep Site Clean : - Applicable

CLAUSE- 9A Payment of Contractor's Bills to Banks :- Deleted

CLAUSE- 10 B Secured Advance on Non-Perishable Materials: - DELETED

CLAUSE-10B Mobilization Advances:--DELETED
Plant Machinery & Shuttering Material Advance :- DELETED
Interest and Recovery:-- DELETED

CLAUSE10-C Payment on Account of Increase in Prices / Wages due to Statutory Order(s) :-
 - DELETED

CLAUSE– 10CA Payment due to Variation in Prices of Materials after receipt of tender:-
DELETED

CLAUSE– 10 CC Payment due to Increase / Decrease in Prices / Wages after Receipt of
Tender for Works - DELETED

Clause 12

12.2 & 12.3

Deviation Limit beyond which clauses 12.2 & 12.3 shall apply for work 30%

Clause 16

Competent Authority for deciding reduced rates Project In-charge (I)

Clause 25

Constitution of Dispute Redressal Committee (DRC)

Chairman – Asso. Dean, Infrastructure Development (II)

Member - Project In-charge (I)

Member - Dy. Ex. Engineer (Electrical)



SCOPE, TECHNICAL SPECIFICATIONS AND APPROVED MAKES

HEATING VENTILATION & AIR-CONDITIONING

PART I – GENERAL

1.1 INTRODUCTION

1.1.1 SCOPE

1.1.1.1 These specifications cover the following types of air-conditioning, and ventilation:

- i) Central air-conditioning system
- ii) Mechanical ventilation system

1.1.1.2 Central air-conditioning system included in these specifications is by means of centrifugal type compressors.

1.1.1.3 These Specifications cover the equipments and materials for the system, their testing and/or inspection as may be necessary before their dispatch from their respective works, their delivery at site, all preparatory works, assembling, installation and adjustments, commissioning, final testing, putting in to operation, equipment capacity computation and handing over of the complete system.

1.1.2 RELATED DOCUMENTS

These Specifications shall be read in conjunction with the General conditions of contract, schedule of work, drawings and other documents connected with the work.

1.1.3 TERMINOLOGY

The definition of terms used in these specifications shall be in accordance with IS: 3615- "Glossary of terms used in refrigeration and air-conditioning". Some of the commonly used terms are defined in Appendix' A'.

PART II - FACTORY BUILT AIR HANDLING UNIT (AHU)

2.1 SCOPE

This chapter covers the detailed requirements of factory built double skin air handling unit (AHU) for central air-conditioning system.

2.2 FACTORY BUILT AIR HANDLING UNIT (AHU)

2.2.1 TYPE

The air handling unit shall be of double skin construction, draw through type in sectionalized construction consisting of blower section, coil section, humidification section (where specified), filter section and drain pan. Unless otherwise specified, the unit shall be horizontal type.

2.2.2 RATING

- i) The capacity of the cooling coil, the air quantity from the blower fan and static pressure of blower fan shall be as laid down in the tender documents. Where these parameters as calculated by the tenderer exceed the specified values, the coils and the blower fan shall satisfy these calculated values.
- ii) The coil shall be designed for a face velocity of air not exceeding 155 m/min.
- iii) The requisite static pressure demanded by the air circuit shall be developed by the fan at the selected operating speed. The static pressure value shall not in any case be less than 40 mm water gauge in normal cases, not less than 65 mm water gauge where microvee filters are also used and not less than 100 mm water gauge where absolute filters-are also used. The fan motor HP shall be suitable to satisfy these requirements and the drive losses.



- iv) The air outlet velocity from the blower fan shall not exceed 610 m/min.
- v) Noise level at a distance of 2M from AHU shall not exceed 75dBA.

2.2.3 MATERIAL AND CONSTRUCTION

2.2.3.1 HOUSING / CASING

i) The housing/ casing of the air handling unit shall be of double skin construction. The housing shall be so made that it can be delivered at site in total semi knocked down conditions depending upon the requirements. The main framework shall be of suitable structural sections. The entire framework shall be assembled using mechanical joints to make a sturdy and strong framework for various sections. Framework of all air handling units shall be made of thermal break hollow extruded aluminum profile. **In case of AHU casing design with no contact between inner and outer surface, thermal break profiles can be avoided.**

ii) Double skin panels shall be minimum 25mm thick made of 0.8mm pre-plasticized and pre-painted with PVC guard, GSS sheet on outside and 0.8mm galvanized sheet inside with polyurethane foam insulation of density not less than 38 kg/cum injected in between by injection moulding machine. These panels shall be joined and connected to the framework/ supports with soft rubber gasket in between (if necessary) to make the joints airtight and low air leakage potential. The gaskets shall be inserted within groove in extruded aluminum profile of the framework. For units installed outdoor, the thickness of double skin panels shall be minimum 40 mm.

iii) Frame work for each section shall also be joined together to make the joints air tight. Suitable doors with nylon handles and all access panels should be openable with allen key/ suitable locking arrangement. Aluminium die-cast powder coated/ Nylon hinges & latches shall be provided for access to various panels for maintenance. However, AHU in the form of complete single unit shall also be acceptable with access door(s) for maintenance to various sections. The entire housing shall be mounted on galvanized steel channel frame work made out of G.I. sheet of thickness not less than 2mm. For higher capacity AHUs hot dip galvanized steel channel framework made of minimum 3 mm thick G.S. sheet shall be used.

2.2.3.2 DRAIN PAN

Drain pan shall be made out of minimum 1.25 mm stainless steel sheet externally insulated (If Drain pan is outside the unit), with 10mm thick closed cell Polyethylene foam/ equivalent suitable insulation with necessary dual slope to facilitate fast removal of condensate. Necessary supports will be provided to slide the coil in the drain pan.

2.2.3.3 COOLING COIL

i) The coil shall be made from seamless solid drawn copper tubes. The minimum thickness of tube shall be 0.35 mm for cooling coils. The coil shall be provided with auto purge valve wherever required.

ii) The depth of the coil shall be such as to suit the requirements, viz. re-circulated air applications, or 100 % fresh air applications and the bypass factor required shall be



specified in the tender specifications. The coil shall be 6 rows deep for normal re-circulated air application and 8 rows deep for all outdoor air application, unless otherwise specified in the tender specifications. In case of 8 rows deep coils, it shall be made of 2x4 rows deep coils with a spacing of 200mm between the two coils, access door and independent drain pan.

iii) U bends shall be of copper, jointed to the tubes by brazing, soft soldering shall not be used.

iv) Each section of the coil shall be fitted with flow and return headers to feed all the passes of the coil properly. The headers shall be of copper and shall be complete with water in/out connections, vent plug on top and drain at the bottom. The coil shall be designed to provide water velocity between 0.6 to 1.8 m/s in the tubes.

v) The fins shall be of aluminum. The minimum thickness of the fins shall be 0.15 mm nominal. The no. of fins shall not be less than 4-5 per cm length of coil. Fins may be of either spiral or plate type. The tubes shall be mechanically expanded to ensure proper thermal contact between fins and tubes. The fins shall be evenly spaced and upright. The fins bent during installation shall be carefully realigned. For coastal areas fins shall be phenolic coated and for 100% FA application fins shall be hydrophilic type.

vi) The coil shall be suitable for use with the refrigerant specified or with water as the case may be. Refrigerating coils shall be designed for the maximum working pressure under the operating conditions. Water coils shall be designed for a maximum working pressure of 10 kg./sq.cm.

vii) Shut off and regulating valves at the inlet and outlet of water shall be provided. In the case of DX coils, solenoid valve and expansion valves shall be provided at the inlet of coil.

2.2.3.4 SUPPLY AIR FAN AND DRIVE

i) The supply air fan shall be AMCA certified for air performance and sound rating and should be selected for maximum efficiency and shall be Centrifugal type with forward/backward curved blades double inlet double width type or Plug type direct driven aerofoil backward curved fans. For static pressure upto 65mm forward curved blades shall be used and for higher sizes backward curved blades shall be used in case of DIDW fans.

ii) The fan housing of Galvanized sheet steel and the impellers shall be fabricated from heavy gauge steel sheet as per approved manufacturer's standard. The side plates shall be die-formed for efficient, smooth airflow and minimum losses. Fan impeller shall be mounted on solid shaft supported to housing using heavy duty ball bearings. Fan housing and motor shall be mounted on a common extruded aluminum base mounted inside the fan section on anti-vibration spring mounts or cushy-foot mount. The fan outlet shall be connected to casing with the help of fire retardant fabric.

iii) The fan impeller assembly shall be statically and dynamically balanced.



iv) If belt drive is applicable, the fan shall be fitted with V belt drive arrangement consisting of not less than two evenly matched belts. Belts shall be of oil resistant type. Adequate adjustments shall be provided to facilitate belt installation and subsequent belt tensioning by movement of the motor on the slide rails. A readily removable door guard shall be provided.

v) The fan motor shall be totally enclosed fan cooled squirrel cage induction motor with IP-54 protection & selected for quiet running. The motor shall be suitable for operation on $415 \pm 10\%V$, 3phase, 50 Hz, A.C. supply. The motor shall conform to IS: 325. "Three phase induction motors" having class F insulation. The fan motor shall have the efficiency level of IE-3 or EFF1 whichever is more efficient and it shall be ECBC compliant.

vi) The fan motor starter shall be as per Electrical specifications.

2.2.3.5 AIR FILTERS

The air used in an air-conditioning system must be filtered to maintain a clean atmosphere in the conditioned space. The concentration of contaminants in the air and the degree of cleanliness required in the conditioned space will determine the type of filter or filters that must be used.

2.2.3.5.1 TYPE OF FILTERS

i) Pre-filters: Cleanable metallic viscous type filter made out of aluminum wire mesh or of dry cleanable synthetic type minimum 50mm thick, shall be provided on the suction side of AHU as standard equipment with the unit. These filters shall have the efficiency of 90% down to 10 micron particle size. When these filters become loaded or full of dirt, it is removed from service and replaced by another filter. The dirty filter can then be washed in a cleaning solution in a tank, dried and then given a bath of viscous oil. Face velocity across these filters shall not exceed 155 MPM.

2.2.3.5.2 GENERAL CONSTRUCTION OF FILTERS

i) Each AHU shall be provided with a factory assembled filter section containing pre-filters made of cleanable metal viscous filters made of corrugated aluminum wire mesh, or dry cleanable synthetic filters. These shall be minimum 50 mm thick with a frame work of aluminum/GI.

ii) The filter area shall be made up of panels of size convenient for handling. The filter panels shall be held snugly within suitable aluminum framework made out of minimum 1.6 mm GI/ aluminum sheet with sponge neoprene gaskets by sliding the panels between the sliding channels so as to avoid air leakage.

iii) In order to indicate the condition of these filters while in operation, a manometer shall be provided to indicate the pressure drop across the fine filters and absolute filters.

iv) Special filters, if any specified in the tender specifications shall be provided in addition to the above filters. In that event, the latter shall function as pre-filters.

v) Each filter shall carry test certificate from manufacturer.

2.2.4 INSTRUMENTS AND VALVES

The following instruments shall be provided at the specified locations in the AHUs for the chilled water/ hot water system:

- i) Pressure gauges at the inlet and outlet of the coil with tubing and gauge cock
- ii) Stem type thermometers at the inlet & outlet of coil with tubing & gauge cock
- iii) Butterfly valve at the inlet and outlet of coil
- iv) Pressure independent valve along with proportionate thermostat at the outlet of coil
- v) Y-strainer at the inlet of coil

2.2.6 INSULATION

The insulation of casing shall be as per Para 2.2.3.1 (ii) & that of drain pan shall be as per 2.2.3.2.

2.2.7 INSTALLATION

The air handling unit shall be so installed as to transmit minimum amount of vibration to the building structure. Adequate vibration isolation shall be provided by use of rubber/ neoprene pads and/or vibration isolation spring mountings.

2.3 HIGH WALL MOUNTED UNITS

The units shall be wall-mounted type. The units include pre-filter, fan section and DX coil section. The housing of units shall be light weight powder coated galvanized steel. Units shall have an attractive external casing for supply and return air.

2.3.1 INSTALLATION:

The units shall be mounted on ribbed rubber pads for vibration isolation. The contractor shall supply the required charge of refrigerant, lubricant and other consumables, for commissioning and testing of the equipment. All the equipment shall be thoroughly tested and checked for leaks. All safety controls shall be suitably set and a record of all setting shall be furnished to the project supervisor. Providing and fixing M.S. structural support for condensing unit with vibration isolator pad in-between support and structure and vibration isolation suspender and pads for evaporating units. Providing and fixing Suitable rain protection canopy above the condensing units.

2.3.2 DIMENSIONS:

Dimensions given in figures shall be taken in preference to scaled dimensions in all cases. Before commencing any work the contractor shall get clarifications wherever necessary.

2.3.3 PAINTING:

Shop coats of paint that have become marred during transportation or erection shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop-painted surfaces.

2.3.4 CONDENSATE DRAIN PIPING:

All pipes to be used for condensate drain shall be Insulated medium class GI pipe & all joints should be Gluing or solvent cementing as per manufacturer recommendation.



2.3.5 REFRIGERANT PIPING:

- i) All refrigerant pipes and fittings shall be type 'L' hard drawn copper tubes and wrought copper fitting suitable for connection with silver solder.
- ii) All joints in copper piping shall be swaged joints using low temperature brazing and/or silver solder. Before joining any copper pipe or fittings, its interior shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while construction of the joints. Subsequently, it shall be thoroughly blown out using nitrogen.
- iii) Refrigerant lines shall be sized to limit pressure drop between evaporator and condensing unit to less than 0.2 kg per Sq.cm.
- iv) After the refrigerant piping installation has been completed the refrigerant piping system shall be pressure tested using, Freon mixed with nitrogen at a pressure of 20 Kg per Sq. cm. (High side) and 10 Kg per Sq. cm (Low side) pressure shall be maintained on the system for a minimum of 12 hours. The system shall then be evacuated to a minimum vacuum of 70 cm. of mercury and held for 24 hours, during which time change in vacuum shall not exceed 12 cm of mercury. Vacuum shall be checked with vacuum gauge.
- v) All refrigerant piping shall be installed strictly as per the instructions and recommendations of air conditioning equipment manufacturers.
- vi) The copper thickness of wall shall be 20G/22G(0.7 to 1 mm)

2.3.6 POWER SUPPLY:

Power supply near the indoor unit will be provided by the electrical contractor. Power supply from MCB to indoor unit and outdoor unit to Indoor unit by the HVAC contractor along with earthing.

PART III - CIRCULATING WATER PUMPS

3.1 SCOPE

This chapter covers the general requirements of water circulating pumps for central air-conditioning.

3.2 TYPE

The pumps shall be centrifugal type direct driven with a 3 phase, $415 \pm 10\%$ volts, 50 Hz, A.C motor. The pumps shall be of End suction top discharge type vertical split casing type with operating speed not exceeding 1500 rpm. **The pump motor shall be energy efficient with efficiency level of IE-3 or EFF1 whichever is more efficient and it shall be ECBC compliant.**

3.3 RATING

The pumps shall be suitable for continuous operation in the system. The head and discharge requirements shall be as specified in the tender documents. The discharge rating shall not be less than the flow rate requirement of the respective equipments through which the water is pumped. The head shall be suitable for the system and shall take into

consideration the pressure drops across the various equipments and components in the water circuit as well as the frictional losses. The pumps offered shall be of high efficiency.

3.4 MATERIAL AND CONSTRUCTION

- i) The centrifugal pumps shall conform to IS 1620. The motor starter shall be in accordance with Electrical specifications. The motor shall be totally enclosed fan cooled type.
- ii) The pump casing shall be of heavy section close grained cast iron. The casing shall be provided with air release cock, drain plug and shaft seal arrangement as well as flanges for suction and delivery pipe connections as required.
- iii) The impeller shall be of bronze or gunmetal. This shall be shrouded type with machined collars. Wear rings, where fitted to the impeller, shall be of the same material as the impeller. The impeller surface shall be smooth finished for minimum frictional loss. Rile impeller shall be secured to the shaft by a key.
- iv) The shaft shall be of stainless steel and shall be accurately machined. The shaft shall be balanced to avoid vibrations at any speed within the operating range of the pump.
- v) The shaft sleeve shall be of bronze or gunmetal. This shall extend over the full length of the stuffing box or seal housing. The sleeve shall be machined all over and ground on the outside.
- vi) The bearings shall be ball or roller type suitable for the duty involved. These shall be grease lubricated and shall be provided with grease nipples/cups. The bearings shall be effectively sealed against leakage of lubricant.
- vii) The shaft seal shall be stuffing box type unless otherwise specified, so as to allow minimum leakage compatible with the operation of the seal. The stuffing box shall be of adequate length and shall be packed with graphite asbestos or any other suitable material for the operating temperature. A drip well shall be provided beneath the seal.
- viii) In the case of HSC pumps, the same shall be directly coupled to the motor shaft through a flexible coupling protected by a coupling guard. In case of mono block pumps with solid casing, the motor and pumps shall be on a common shaft.
- ix) The pump and motor shall be mounted on a common base plate either of cast iron or fabricated from rolled steel section. The base plate shall have rigid, flat and true surfaces to receive the pump and motor mounting feet.

3.5 ACCESSORIES

Each pump shall be provided with the following accessories:-

- i) Pressure gauges at suction and discharge sides,
- ii) Butterfly valves on suction and discharge, and
- iii) Reducers, as may be required to match the sizes of the connected pipe work.
- iv) Non-return valve at the discharge.

3.6 INSULATION



The thermal insulation of the pump casing for hot/chilled water circulating pumps shall be of the same type and thickness as provided for the connected pipe work.

3.7 INSTALLATION

i) The pump and motor assembly shall be mounted and arranged for ease of maintenance and to prevent transmission of vibration and noise to the building structure or excess vibration to the pipe work.

ii) More than one pump and motor assembly shall not be installed on a single base or cement concrete block. The mass of the inertia block shall not be less than the combined mass of the pump and motor assembly. The inertia block shall be vibration isolated from the plant room floor by 25 mm. neoprene or any other equivalent vibration isolation fittings. Where spring mountings are used for vibration isolation, these shall be complete with leveling screws and lock nuts and shall be placed over a concrete plinth for distribution of the mass of the assembly over the plant room floor. The pump motor sets shall be properly aligned to the satisfaction of the Engineer-in-charge.

PART IV - DUCTING

4.1 SCOPE

This chapter covers the general requirements for sheet metal ductwork for air distribution with associated items such as air outlets and inlets, fresh air intake and fire dampers.

4.2 MATERIAL

4.2.1 RECTANGULAR DUCTS

i) All ducts shall be fabricated either from Galvanized Sheet Steel (GSS) conforming to IS: 277 or aluminum sheets conforming to IS: 737. The steel sheets shall be hot dip galvanized with coating of minimum 120 grams per square meter (GSM) of Zinc.

ii) The thickness of sheets for fabrication of rectangular ductwork shall be as under. The thickness required corresponding to the longest side of the rectangular section shall be applicable for all the four sides of the ductwork.

Longest side (mm)	Minimum sheet thickness	
	For GSS	For Aluminum
750 mm and below	0.63	0.80
751 mm to 1500 mm	0.80	1.00
1501 mm to 2250 mm	1.00	1.50



2251 mm & above

1.25

1.80

i) All sheet metal connections, partitions and plenums required for flow of air through the filters, fans etc. shall be at least 1.25 mm thick galvanized steel sheets, in case of G.I. sheet ducting or 1.8 mm thick aluminum sheet, in case of aluminum sheet ducting and shall be stiffened with 25mm x25 mm x 3 mm angle iron braces.

ii) Circular ducts, where provided shall be of thickness as specified in IS: 655 as amended upto date.

iii) Aluminium ducting shall normally be used for clean room applications, hospitals works and wherever high cleanliness standards are functional requirements.

4.2.2 FLAT OVAL SPIRAL DUCTS

i) All Flat Oval/ Round Spiral Duct and Fittings shall be manufactured from 120 gsm galvanized steel of lock forming quality.

ii) All Flat Oval/ Round Spiral Ducts should have in Continuous external reinforcement with 4-ply Spiral lock seam at regular intervals of 125 mm of maximum length of 3 m each. The fabrication of flat Oval spiral ducts & duct fittings should be as per SMACNA High pressure duct standards, 1985.

iii) All Flat Oval/ Round Spiral Ducts and Duct fittings shall be joined with slip joint connects of 50mm insertion length and fastened with rivets.

Minimum duct wall thickness shall be as indicated in Table below:-

Flat Oval Duct Gauge

Major Dimension Duct Width (MM)	Longitudinal Seam (GAUGE)	Spiral Seam (GAUGE)	Fitting (GAUGE)
UPTO 600	20	24	20
601 TO 750	20	22	20
751 TO 900	20	22	20
901 TO 1050	18	22	18
1051 TO 1200	18	22	18
1201 TO 1350	18	20	18
1351 TO 1500	18	20	18
1501 TO 1750	16	20	16
1751 & ABOVE	16	18	16



ROUND Duct Gauge

Major Dimension Duct Width (MM)	Seam (GAUGE)	Fitting (GAUGE)
UPTO 600	24	24
601 TO 900	22	22
901 TO 1250	22	20
1251 & ABOVE	18	18

- 1) Reinforcement for oval/ Round duct shall be of the same and spacing interval as specified for rectangular duct or shall be provided to limit wall deflection to $\frac{3}{4}$ in. (19mm) and reinforcement deflection to $\frac{1}{4}$ in (6.4mm)
- 2) Unless otherwise specified, joints and seams shall be similar to those indicated for round duct.
- 3) Fittings shall conform to the thickness schedules in Table, shall conform to the seam, joint, and connection arrangements permitted for round duct, and shall be reinforced to conform to Point no. 1.
- 4) The duct construction shall be capable of withstanding a pressure 50 percent greater than that of the assigned pressure class without structural failure or permanent deformation.
- 5) Duct wall deflection at atmospheric pressure, with reinforcement and connections in place, shall not exceed $\frac{1}{4}$ in. (6.4 mm) on widths of 36 in. (914mm) or less of $\frac{1}{2}$ in (13 mm) on greater widths. Refer Criteria in Chapter 11 of SMACNA Standards – 2005 Third Edition.
- 6) Supports shall conform to those permitted for rectangular duct, with the overall dimensions taken as references.

TESTING

After duct installation, total duct work (Air-conditioning and Mechanical Ventilation Ducts) should be tested for leakage. The procedure for leak testing should be followed as per SMACNA – “HVAC Air Duct Leakage Test Manual” (First Edition – 1985)

DUCTWORK LEAKAGE TESTS:

- 1) This section of the specification describes the ductwork leakage testing procedure.
- 2) All ductwork shall be pressure tested for leakage, smoke test is not acceptable.
- 3) The sub contractor shall provide the necessary test equipment and skilled labour to carry out the tests satisfactorily.



- 4) Testes shall be witnessed and certified by the Client / PMC's representative. Prior to witness of final tests, the sub-contractor shall carry out preliminary tests to ensure the test results are within specified limits.
- 5) All duct work shall be tested for leakage without duct insulation or duct enclosure at the joints.
- 6) Accuracy of the test apparatus shall be within:
 - a) $\pm 5\%$ of the indicated flow rate or 0.5 l/s, whichever is greater, and
 - b) 5% of the indicated static pressure in duct under test.
- 7) The test apparatus shall have a calibration certificate, chart of graph dated not earlier than one year before the test for which it is used.

4.3 CONSTRUCTION

4.3.1 DUCTS

- i) Ducts shall be fabricated at site or factory fabricated and shall be generally as per IS: 655 "Specifications for metal air ducts", unless otherwise deviated in these General Specifications.
- ii) The interior surfaces of the ducting shall be smooth.
- iii) All the ducts upto 600mm longest side shall be cross broken between flanges by a single continuous breaking. Ducts of size 600mm and above shall be cross broken by single continuous breaking between flanges and bracings. Alternatively, beading at 300mm centers for ducts upto 600mm longest side, and 100mm centers for ducts above 600mm size shall be provided for stiffening.
- iv) As far as possible, long radius elbows and gradual changes in shape shall be used to maintain uniform velocity accompanied by decreased turbulence, lower resistance and minimum noise. The ratio of the size of the duct to the radius of the elbow shall be normally not less than 1:1.5.
- v) Flanged joints shall be used at intervals not exceeding 2500mm. Flanges shall be welded at corners first and then riveted to the duct.
- vi) Stiffening angles shall be fixed to the sides of the ducts by riveting at 1.2.5 meters from joints for ducts of size 600mm to 1500mm, and 0.6mm from joints for ducts of size larger than 1500mm. Bracings for ducts larger than 1500mm can alternatively be by/diagonal angles.
- vii) Plenums for filters shall be complete with suitable access door of size 450mm x450mm.

4.3.2 AIR OUTLET AND INLETS (SUPPLY AND RETURN)

- i) All air outlets and intakes shall be made of extruded aluminum sections & shall present a neat appearance and shall be rigid with mechanical joints.
- ii) Square and rectangular wall outlets shall have a flanged frame with the outside edges returned or curved 5 to 7 mm and fitted with a suitable flexible gasket between the



concealed face of the flanges and the finished wall face. The core of supply air register shall have adjustable front louvers parallel to the longer side to give upto 22.5 degrees vertical deflection and adjustable back louvers parallel to the shorter side to achieve a horizontal spread air pattern to at least 45 degrees. Return air grilles shall have only front louvers. The outer framework of the grilles shall be made of not less than 1.6 mm thick aluminum sheet. The louvers shall be of aero foil design of extruded aluminum section with minimum thickness of 0.8mm at front and shall be made of 0.8mm thick aluminum sheet. Louvers may be spaced 18 mm apart.

iii) Square and rectangular ceiling outlets/intakes shall have a flange flush with the ceiling into which it is fitted or shall be of anti-smudge type. The outlets shall comprise an outer shell with duct collar and removable diffusing assembly. These shall be suitable for discharge in one or more directions as required. The outer shell shall not be less than 1.6 mm thick extruded section aluminum sheet. The diffuser assembly shall not be less than 0.80 mm thick extruded aluminum section.

iv) Circular ceiling outlets/intakes shall have either flush or anti smudge outer cone as specified in the tender specifications. Flush outer cones shall have the lower edge of the cone not more than 5 mm below the underside of the finished ceiling into which it is fitted. Anti-smudge cones shall have the outer cone profile designed to reduce dirt deposit on the ceiling adjacent to the air outlet. The metal sheet used for construction of these shall be minimum 1.6 mm thick extruded aluminum sheet.

v) Linear diffusers shall have a flanged frame with the outside edges returned 3.5 mm and shall have one to four slots as required. The air quantity through each slot shall be adjustable. The metal sheet used for the construction of these shall be minimum 1.6 mm thick extruded aluminum sheet.

vi) Grilles and diffusers constructed of extruded aluminum sections shall have grille bars set straight, or deflected as required. These shall be assembled by mechanical interlocking of components to prevent distortion. These grilles and diffusers shall have a rear set of adjustable blades, perpendicular to the face blades for deflection purposes.

vii) All supply air outlets shall be fitted with a volume control device, made of extruded aluminum gate section. The blades of the device shall be mill finish/ block shade pivoted on nylon brushes to avoid rusting & rattling noise, which shall be located immediately behind the outlet and shall be fully adjustable from within the occupied space without removing any access panel. The volume control device for circular cutlets shall be opposed blade radial/shutter type dampers, or two or more butterfly dampers in conjunction with equalizing grid. Opposed blade dampers shall be used for square and rectangular ceiling/ wall outlets and intakes.

viii) All the products supplied by contractor should supplement 'in performance by selection curves of product ratings from the manufacturer.

ix) Laminar supply air diffusers shall be made of 2mm thick powder coated aluminum sheet duly insulated with 5mm thick dosed cell polyethylene foam insulation having factory laminated aluminum foil and joints covered with self adhesive aluminum tape and having holes 2/3 mm dia including frame work.

4.3.3 FRESH AIR INTAKES

i) Fresh air intake grills shall be made of extruded aluminum sections.



ii) A flanged frame using RS sections shall be provided on front face to conceal the gap between the louvers and the adjoining wall face. Corners of frame shall be welded. The frame shall be made structurally rigid.

iii) Louvers made from extruded aluminum section shall be in modular panel form for ease of handling. These shall be free from waves and buckles. Vertical blades shall be truly vertical and horizontal blades shall be truly horizontal. Butt joints in blades shall not be accepted.

iv) Additional intermediate equally spaced supports and stiffeners shall be provided to prevent sagging/vibrating of the louvers, at not more than 750mm centers where the louver's length is longer than 750mm.

v) A bird wire screen made of 12 mm mesh in 1.6 mm steel wire held in angle or channel frame shall be fixed to the rear face of the louver frame by screens.

4.4 FIRE DAMPERS

i) Fire dampers shall be provided in all the supply air ducts and return air ducts (where provided), return air passage in the air-handling unit room and at all floor crossings. Access door will be provided in the duct before each set of fire dampers.

ii) Fire dampers shall be multi blade louvers type. The blade should remain in the air stream in Open position & shall allow maximum free area to reduce pressure drop & noise in the air passage. The blades and frame shall be constructed with minimum 1.6mm thick galvanized sheet & shall be factory fitted in a sleeve made out of 1.6mm galvanized sheet of minimum 400mm long. It shall be complete with locking device, motorized actuator & control panel.

iii) Fire dampers shall be motorized smoke & fire dampers type. It shall be supplied with spring loaded UL stamped fusible link to close fire damper in the event of rise in duct temperature. Fire damper shall also close on receipt of fire alarm signal to cut off air supply instantaneously. An electric limit switch shall also be operated by the closing of fire damper, which in turn shall switch off power supply to AHU blower motor as well as strip heaters.

iv) Fire dampers shall be CBRI tested & certified for 90 minutes rating against collapse & name penetration as per UL 555-1995 (Underwriters laboratories)

v) Fire dampers shall be compatible with the fire detection system of building & shall be capable of operating automatically through an electric motor on receiving signal from fire alarm panel.

vi) Necessary wiring from fire alarm panel up to AHU electric panel shall be provided by the department & further from AHU electric panel to fire damper shall be provided by air conditioning contractor.

4.5 VARIABLE AIR VOLUME (VAV) BOXES

i) These shall be of the low velocity variable air volume boxes without re-heat coils, and shall be of open protocol as marketed by a firm specializing in this field. The contractor shall supply and install units to the quantity and locations as specified.

ii) The unit shall be complete with damper, airflow ring, and solid-state electronic controls to provide accurate room temperature control. The damper shall be aero foil type construction with bearings.

- iii) Boxes shall be supplied with all internal attenuation treatment and acoustical damped casing necessary to achieve the required noise criteria. Casing shall be of 22G GSS minimum fitted with a completely sealed, easily removable means of access to all internal parts. Access to all boxes must be from the underside only.
- iv) The actuator shall be of 24V AC Bi-directional, direct coupled to the damper shaft. The required transformer to step down of the voltage range from 230V to 24V shall be part of the unit. The UPS power point with an isolator near the VAV will be provided by other agencies.
- v) The unit shall be complete with transformer, access panel and other accessories as per the standard. The noise level shall be less than 35Dba.
- vi) Maximum allowable static pressure to the boxes for its satisfactory operation shall not exceed 0.10WG, otherwise fan and motor selections may be affected.
- vii) Boxes shall be able to reset any air flow between 10% and the maximum air quantity that the boxes can handle without changing orifices or other parts. Air quantity limiters will not be accepted.
- viii) A suitable device shall be provided for the field adjustment of minimum airflow. All boxes shall be initially factory set at minimum air quantity of 10% and maximum quantity of 110% of the design requirements.
- ix) Under shut-off conditions, all boxes shall not have air leakage more than 2% of the maximum air quantity at 75mm static pressure.
- x) The VAVs shall be used in standalone mode complete with its own temperature sensor and controller and shall perform the function of maintaining the temperature and airflow. However, the VAVs shall be BMS compatible to enable to network the VAVs to a Network Control Unit and onto BMS. In this mode all VAV data shall be available at the BMS workstation and it shall be possible to change set points and flow settings from the BMS workstation.
- xi) All boxes shall be electrically controlled. Controllers and operators shall be supplied by the SUB-CONTRACTORS. The boxes shall be pressure independent. All controllers used for the control of VAV boxes shall be compliant with BACnet/ MODBUS protocol and be freely communicable to third party BACnet/ MODBUS IP controllers.
- xii) VAV Box shall have provision to support from floor/ wall/ ceiling and in vertical/horizontal condition.

4.6 ACOUSTIC LINING AND INSULATION

This shall be done as per details given in Para 6.8 and 6.9 (Part VI).

4.7 INSTALLATION OF METALLIC DUCT

4.7.1 DUCTING

- i) The fabrication and installation shall be in a workman like manner. Duct work shall be rigid and straight without kinks.
- ii) All exposed ducts within the conditioned space shall have slip joints. Flanged joints shall not be used.



iii) All joints shall be airtight.

iv) Ducts shall be supported independently from the building structure and adequately, to keep the ducts true to shape. The support spacing shall be not more than 2m. Where ducts cannot be suspended from ceiling, wall brackets or other suitable arrangements, as approved by the Engineer-in-charge shall be adopted. Neoprene or other vibration isolation packing of minimum 6mm thickness shall be provided between the ducts and the angle iron supports/brackets. Vertical duct work shall be suitably supported at each floor by steel structural members.

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

vi) Duct connections to the air-handling unit shall be made by inserting a double canvas sleeve 100 mm long. The sleeve shall be securely bonded and bolted to the duct and unit casing.

vii) Dampers shall be provided in branch duct connections for proper volume control and balancing the air quantities in the system, whether indicated in the drawings or not. Suitable links, levers and quadrants shall be provided for proper operation, control and setting of the dampers. Every damper shall have an indicating device clearly showing the position of the dampers at all times.

viii) Where electrical heaters are mounted in the duct, these shall be of low temperature totally enclosed type fitted with radiation fins. A removable panel for access to the heaters shall be provided in the duct. Any hole in the duct for electrical wiring must be provided with suitable bushes to avoid leakage. 6 mm thick asbestos board lining shall be provided all around the inside of the duct for a distance of 30cm on either side of the electrical heaters. A manually reset thermostatic safety switch shall be provided near the duct section having heaters.

In addition, the heaters must be interlocked with the connected fan motor of the AHU.

4.7.2 AIR OUTLETS AND INLETS

i) The locations of the air outlets and intakes shall be shown in the tender drawings and necessary openings and the wooden framework for fixing the grilles shall be provided by the air conditioning contractor. The location of these outlets/ inlets is subject to change and the approval of the Engineer-in-Charge shall be obtained before finally fixing the grilles/diffusers in position.

ii) In installing fresh air intakes, no fixing device shall be visible from the face of the frame. Where louvers are to be fixed in masonry or concrete, fixing shall be with either expanding plugs or raw plugs. Where the louvers are to be fixed in steel or wood, non-ferrous screws or bolts shall be used.

iii) Supply air outlets and return air intakes shall be anodized/ powder coated aluminum to the desired color to match the surroundings wall/ceiling. The fresh air intakes shall be anodized/ powder coated aluminum as approved by the Engineer-in-Charge. The paint color shall be approved by the Engineer-in- Charge.



iv) All damages to the finish of the structure during the installation work shall be made good by the air-conditioning contractor before handing over the installation to the Department.

4.8 BALANCING

The entire air distribution system shall be balanced with the help of an anemometer. The measured air quantities at fan discharge and at the various outlets shall be within ± 5 percent of those specified/ quoted. Branch duct adjustments shall be permanently marked after the air balancing is completed so that these can be restored to their correct position if disturbed at any time.

4.9 MEASUREMENT

i) Duct measurements (for insulated ducts) shall be taken before application of insulation.

ii) Duct work shall be measured section wise on the basis of external surface area by multiplying the axial length from flange face to flange face for each section by the corresponding duct perimeter in the centre of that section length.

iii) Uniformly tapering straight sections shall also be measured as in (ii) above.

However, for special pieces like tees, bends etc. area computations for surface areas shall be done as per the shape of such pieces.

iv) The quoted unit rate for external surfaces of ducts shall include all wastage allowances, flanges, gaskets for joints, vibration isolators, bracings, hangers and supports, inspection chambers/access panels, splitter dampers with quadrants and levers for position indication, turning vanes, straightening vanes, and all other accessories required to complete the duct installation as per the specifications. These accessories shall not be separately measured.

v) Grilles and diffusers (except linear diffusers) shall be measured by the cross sectional areas, perpendicular to the airflow, and excluding the flanges. Volume control dampers, where provided shall not be separately accounted for.

vi) Linear diffusers shall be measured by linear measurements only, and not by cross sectional areas, and shall exclude flanges for mounting of the linear diffusers. The supply air plenum for linear diffusers shall be measured as described above for ducting.

vii) Fire dampers shall be measured by their cross sectional area perpendicular to the direction of the airflow. Quoted rates shall include the necessary collars and flanges for mounting, inspection pieces with access door, fusible link/solenoid with wiring, but excluding the fire detectors, etc.

PART V - WATER PLUMBING WORK

5.1 SCOPE

This chapter covers the requirements of plumbing work in chilled water, hot water, water in condenser circuit and drains, to be executed as part of heating, ventilating and air conditioning.

5.2 PLUMBING DESIGN



Pipe sizes shown in tender documents are purely for contractor's guidance. The contractor shall be responsible for selection of sizes as per detailed engineering to be done by him. Plumbing design to be done by the Air-conditioning contractor shall conform to the following:

- i) Water velocity in pipes shall not exceed 2.5 m/sec.
- ii) Butterfly/Ball valves shall be provided at
 - a. Suction and delivery sides of pumps
 - b. Inlet and outlet of each condenser, chiller, cooling tower.
 - c. All drain connections from equipments
 - d. Inlet & outlet of every heat exchanger coil, namely for AHU's, FCU's convector etc.
- iii) Non return valve shall be provided at the delivery of each pump. This shall be of swing type.
- iv) Balancing valve shall be provided at the outlet side of chiller, condenser, heating and cooling coils to regulate the maximum flow rate up to value preset as desired.
- v) Balancing valves shall be provided, where specified, for AHU's to regulate the maximum flow rate upto a value preset as desired. A mercury manometer shall be supplied with every 10 nos. or part thereof of balancing valves, whether or not specifically indicated in the tender specifications.
- vi) Air valves shall be provided at all high points in the piping system for venting with a size of 25 mm for pipes up to 100 mm and 40 mm for larger pipes.
- vii) Plumbing drawings showing the sizes of valves, layout and other details shall be prepared and shall be got approved from the Engineer-in-Charge before the execution of the plumbing work.

5.3 PIPE MATERIALS

Pipes shall be of the following materials.

- i) Mild steel heavy class (Black steel) tube conforming to IS: 1239 for sizes up to 150mm.
- ii) Welded black steel pipe, class 2, conforming to IS: 3589, for sizes greater than 150mm. These pipes shall be factory rolled & fabricated from minimum 6mm thick M.S. Sheet for pipes upto 350mm dia. & from minimum 7mm thick M.S. sheet for pipes of 400mm dia. & above.

5.4 PIPE JOINTS

Joints in black steel pipes shall be of any of the following types.

- i) Screwed joints and union joints screwed to pipes, upto 25 mm size.
- ii) Butt welded joints for pipe sizes above 25mm. electric welding shall be used for sizes 100mm and above.

iii) Flanges joints with flanges as per IS: 6392 for all sizes. Flanges may be steel welded neck type or slip on type welded to pipe, or alternatively screwed type.

5.5 VALVES

i) The material of butterfly valves shall be as under:

Body - Cast iron

Disc - Cast Bronze or Stainless Steel

Seat - Either integral or Nitrile rubber

O-ring – Nitrile/Silicon

ii) Motorized Butterfly valves shall be made of cast iron body, seat of black nitrile rubber (tight shut-off), nylon coated S.G. iron disc, PTFE coated SS (AISI 410) shaft, complete with companion flanges, nuts, bolts, gaskets etc. as required. These valves shall conform to BS: 5155, MSS SP 67 & API 609 and shall be designed to fit without gaskets between mating flanges. The valves shall be suitable for flow in either direction and seal in both directions. The valves shall be of integral moulded design. Actuator shall have potential free contacts for status monitoring. The valves shall be complete with (Push Button for ON/OFF arrangement & ON /OFF valve indications) companion flanges, nuts, bolts, gaskets etc.

iii) Balancing valve shall be of cast iron flanged construction with EPDM/SG iron with epoxy coated disc with built in pressure drop measuring facility (pressure test cocks) to compute flow rate across the valve. The test cocks shall be long enough to protrude out of pipe insulation.

iv) Non return valves shall be of gun metal construction upto 65 mm, the metal conforming to class 2 of IS: 778. For 75 mm and above, the valve shall be of bronze or gun metal, body being of cast iron. While screwed or flanged ends may be provided upto 65 mm, flanged ends shall be provided for larger sizes.

Dual plate check valve provided as shown on the Drawings, and identified in Bill of Quantities conforming to relevant Codes and in accordance with the following Specifications:

Size Ends	Construction	
50 to 150 mm	Body material as per ASTM A216 Gr WCB	Flanged
200 mm to 450 mm	Body material as per ASTM A216 Gr WCB	Flanged

The spring and hinge/stop pin shall be SS304 and bearing PTFE material. Valves shall be suitable for not less than 10 Kg per sq. cm. gauge working pressure.

v) Air valves shall be of gunmetal body.



vi) Ball Valves shall have body of carbon steel. The ball and the shaft shall be of stainless steel. The seat shall be of PTFE. The valve shall be complete with socket weld ends.

vii) 3 way modulating valves shall be globe type with plug and seat type arrangement. Valve shall be of equal percentage characteristics. Sleeper/rotary/ball valves shall not be acceptable. Valves up to 50 mm shall be external threaded (screwed) type. Valves above 50 mm shall be of flanged type. PN rating of these valves shall not be less than 10. Kvs value (Valve flow coefficient) of selected valve shall not be less than required Kvs Value. Characteristics of valves shall be of equal percentage type. Close off rating of valve actuators shall be higher than the maximum differential pressure across the valve against which it must close. Actuators should be compatible with 0-10 V DC as well as 4-20 m Amps. Both Valve and actuators shall be of same make.

5.6 STRAINERS

i) Strainers shall be of 'Y' type or pot type as specified. 'Y' strainers shall be provided on the inlet side of each air-handling unit and pump in chilled water and condenser water circuit. Pot strainers, where specified, shall be provided in return water headers, for chilled water and condenser water if enough floor area is available in the refrigeration plant room, as an alternate to individual Y type strainers with pumps. The strainers shall be designed to the test pressure specified for the gate valves. Filtration area of Y-strainer shall be minimum four times the connecting pipe size.

ii) They shall be provided with equal size isolating gate valves on either side so that the strainers may be cleaned without draining the system.

5.7 INSTRUMENTS

i) Pressure gauge of appropriate range and 150 mm. dial size shall be provided at the following locations.

a. Supply and return of all heat exchange equipments.

b. Suction and discharge of all pump sets.

ii) The pressure gauge shall be duly calibrated before installation and shall be complete with shut off cocks.

iii) Direct reading industrial type thermometer of appropriate range shall be provided at the inlet and outlet of all heat exchange equipments. The thermometers shall be installed in separate wells.

iv) Flow meter of orifice type shall be provided for measuring the flow through each condenser and chiller.

5.8 EXPANSION TANKS & AIR SEPARATOR

EXPANSION TANK

Expansion tanks shall have full acceptance Factor and shall be ASME rated/ European standard code no. 97/23/EC pre-charged bladder-type pressure vessels. The tank shall be designed to absorb the expansion forces of heating/cooling system water while maintaining proper system pressurization under varying operating conditions. The heavy duty bladder should contain system water thereby eliminating tank corrosion and water logging problems.



MATERIALS OF CONSTRUCTION

- i) System Connection: Forged Steel
- ii) Shell: Carbon Steel
- iii) Bladder: Heavy Duty Butyl Rubber
- iv) Designed and Constructed per ASME Section VIII, Division 1

AIR SEPARATOR

Furnish and install, as shown on plans, a centrifugal type air separator. The unit shall inlet and outlet connections tangential to the vessel shell. The unit shall have an internal stainless steel collector tube with 5/32 " (4mm) diameter perforations and 63% open area designed to direct accumulated air to the compression tank on an air control system or an air vent on an air elimination via an NPT vent connection at top of the unit.

A blow down connection shall be provided to facilitate routine cleaning of the separator. Manufacturer to furnish data sheet specifying air collection efficiency and pressure drop at rated flow.

Vessel shell diameter is to be three times the nominal inlet/outlet pipe diameter, with a minimum vessel volume for sufficient velocity reduction. The air separator must be designed, constructed and stamped for 125 psig@350°F(862 kPa @177°C) in accordance with section VIII, division I of the ASME Boiler and pressure vessel inspectors. The air separator(s) shall be painted with one shop coat of light gray air dry enamel.

A manufacturer's data report for pressure vessels, Form U-1 as required by the provisions of the ASME boiler and pressure vessel code, shall be furnished for each air separator upon request.

5.9 FLEXIBLE CONNECTIONS

- i) The Flexible connections shall be flanged type expansion joint. Flanges shall be non-compressible and mechanically strong type and the Neoprene rubber shall be provided in between the flange ends.
- ii) The connections shall work for a temperature range of minus 10°C to 70°C.
- iii) The length and working pressure of bellows shall be as follows:

Nominal Bore(mm)	Length (mm)	Test Pressure (Bars)
Upto 200	150	16
Above 200	200	16

- iv) Connections shall be provided with control rods to control the excessive elongation or compression of piping systems.
- v) It shall have torsional movement upto 3° without damage.

vi) Bellows shall be single arch.

5.10 CONDENSATE DRAIN PIPING

- i) The drain piping shall be medium class galvanised steel as per relevant latest IS code.
- ii) The fittings shall be of 'R' brand or equal forged with screwed connections.
- iii) The gate valves shall be of gun metal as described earlier.
- iv) Pipe crosses shall be provided at bends, to permit easy cleaning of drain line or plugged tees.
- v) The drain line shall be provided upto the nearest drain trap and pitched towards the trap.
- vi) Drain lines shall be provided at all the lowest points in the system, as well as at equipment, or to remove condensate and water from pump glands.

5.11 G.I. Pipes & fittings for Sump

5.11.1 All galvanized steel tubes shall be conforming to IS 1239 of class specified. When class is not specified they shall be heavy class.

5.11.2 Fittings shall be of malleable iron galvanized of approved make. Each fitting shall have manufacturer's trade mark stamped on it. Fittings for G.I. pipes shall include couplings, bends, tees, reducers, nipples, unions, and bushes. Fittings shall conform to I.S.1879-(Part I to X).

5.11.3 Pipes and fittings shall be jointed with screwed joints after cutting a pipe with a hacksaw or a cutting machine care shall be taken to remove burr from the end of the pipe after reaming with a proper file.

5.11.4 Threaded joints will be made by applying non toxic pipe sealant for metal joints as per BS 5290 or with pipe sealing cord sealant as per manufacturer's recommendations used for drinking water supply. Use of red or white lead and sutli will not be permitted for screwed joints.

5.11.5 No pipes shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling.

5.11.6 Pump suction and delivery headers shall be Galvanized iron pipes/MS heavy class with matching fittings. The pipe joints shall be threaded as per manufacturer's instructions.

5.11.7 Vibration Eliminators Provide on all suction and delivery lines as shown on the drawings double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer details.

5.12 INSTALLATION

- i) The installation work shall be carried out in accordance with the detailed drawings prepared by the Air-conditioning Contractor and approved by the Engineer-in-charge.



- ii) Air-conditioning contractor shall utilize the structural provisions for Airconditioning services wherever provided by the Department in the building and make his own arrangements for additional changes.
- iii) Expansion loops or joints shall be provided to take care of expansion or contraction of pipes due to temperature changes.
- iv) Tee-off connections shall be through equal or reducing tees, otherwise ferrules welded to the main pipe shall be used. Drilling and tapping of the walls of the main pipe shall not be resorted to.
- v) Wherever reducers are to be made in horizontal runs, eccentric reducers shall be used if the piping is to drain freely, in other locations, concentric reducers may be used.
- vi) Open ends of piping shall be blocked as soon as the pipe is installed to avoid entrance of foreign matter.
- vii) All pipes using screwed fittings shall be accurately cut to the required size and threaded in accordance with IS: 554 and burs removed before laying.
- viii) Piping installation shall be supported on or suspended from structure adequately. The Air conditioning contractor shall design all brackets, saddles, clamps, hangers etc. and shall be responsible for their structure integrity.
- ix) Pipe supports, preferably floor mounted shall be of steel, adjustable for height and prime coated with zinc chromate paint and finish-coated gray. Spacing of pipe supports shall not be more than that specified below:

Nominal Pipe size (mm)	Spacing (Meters)
12 and 15	1.25
20 and 25	2.00
32, 40, 50 and 65	2.50
80, 100 and 125	2.50
150 and above	3.00

Extra supports shall be provided at the bends and at heavy fittings like valves to avoid undue stress on the pipes. Pipe hangers shall be fixed on walls and ceiling by means of metallic or rawl plugs or approved shear fasteners.

- x) Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation.
- xi) Anti vibration pads, springs or liners of resilient and non-deteriorating, material shall be provided at each support, so as to prevent transmission of vibration through the supports.
- xii) Pipe sleeves of diameter larger than the pipe by least 50 mm shall be provided wherever pipes pass through walls and the annular spaces shall be filled with felt and finished with retaining rings.
- xiii)



a) Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe with a 12 mm thick rubber pad or any other resilient material as approved by the Engineer-in-charge.

b) The space in the floor cut outs around the pipe work (after insulation work where applicable) shall be closed using cement concrete (1 :2:4 mix) or steel sheet, from the fire safety considerations, taking care to see that a small annular space is left around the pipes to prevent transmission of vibration to the structure.

c) Riser shall have suitable supports at the lowest point.

xiv) Where pipes are to be buried under ground, the top of the pipes shall be not less than 75 cms. from the ground level. Where this is not practicable, permission of the Engineer-in-charge shall be obtained for burying the pipes at lesser depth. The pipes shall be surrounded on all sides by sand cushion of not less than 15 cms. After the pipes have been laid and top sand cushion provided, the trench shall be refilled with the excavated soil and any extra soil shall be removed from the site of work by the Air conditioning contractors.

xv) All pipes and their steel supports shall be thoroughly cleaned and given one primer coat of Zinc chromate before being installed.

xvi) After all the water piping has been installed, pressure tested in accordance with clause 5.10, all exposed piping in the plant room shall be given two finish coats of paint, approved by the Engineer-in-Charge. Similar painting work shall be done over insulated pipe work, valves etc. The direction of flow of fluid in the pipes shall be indicated with identifying arrows.

xvii) 3mm gasket shall be used for flanged joints.

xviii) Cut-outs in floor slabs shall be sealed with cement concrete or steel plate after the plumbing work is done, from the fire safety point of view.

5.13 PRESSURE TESTING

i) All piping shall be tested to hydrostatic test pressure of at least one and a half times the maximum operating pressure, but not less than 10 kg/sqcm for a period not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-charge.

ii) Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.

iii) System may be tested in sections and such sections shall be securely capped.

iv) It shall be made sure that proper noiseless circulation is achieved through all the coils and other heat exchange equipments in the system. If proper circulation is not achieved due to air-bound connections the contractor shall rectify the defective connections. He shall bear all the expenses for carrying out the above rectification including the tearing up and refinishing of floors, walls etc. as required. Insulation shall be applied to piping only after the completion of the pressure testing to the satisfaction of the Engineer-in-charge.

v) Pressure gauges may be capped off during pressure testing of the installation.



vi) The contractor shall provide all materials, tools, equipments, Instruments, services and labor required to perform the tests and to remove water resulting from cleaning after testing.

5.14 BALANCING

i) After completion of the installation, all water system shall be adjusted and balanced to deliver the water quantities as specified, quoted, or as directed.

ii) Automatic control valves and three way diverting valves shall be set for full flow condition during balancing procedure. Water circuit shall be adjusted by balancing cocks provided for balancing. These shall be permanently marked after the balancing is completed so that they can be restored to their correct positions, if disturbed.

5.15 MEASUREMENT

Measurements of plumbing work shall be on following basis:

i) Piping shall be measured along the centre line of installed pipes including all pipe fittings and accessories but excluding valves and other items for which quantities are specifically indicated in the schedule of work. No separate payment shall be made for fittings and accessories.

ii) The rates for piping work shall include all wastage allowances, pipe supports, hangers, nuts and check nuts, vibration isolators, suspension where specified or required and any other item as required to complete the piping installation. None of these items will be separately measured nor paid for.

iii) Piping measurement shall be taken before application of the insulation in the case of insulated pipe work.

5.16 INSULATION

The insulation of pipes carrying hot or chilled water shall be carried out as per Part VI.

PART VI - INSULATION WORK

6.1 SCOPE

This chapter covers the requirements of thermal insulation for chilled water piping, pumps and tanks, duct work and acoustic lining in duct work and weather maker rooms. This does not cover exposed roof insulation and under deck insulation work.

6.2 MATERIAL TYPES

i) T.F. Quality expanded polystyrene insulation material shall be used for insulation of water piping, pumps and tanks. The pipe insulation should be in rigid sections in two halves and preformed to fit snugly on to pipes (upto pipe sizes for which the preformed sections are manufactured by the manufacturer of insulation). For higher pipe sizes insulation slabs shall be used. Insulation however, shall be applied in two layers.

ii) For Insulation of duct work: -Closed cell nitrile rubber.

iii) For acoustic lining of Ducting and AHU rooms: -Resin bonded glass wool.

iv) For suction line and Chiller insulation: -Nitrile rubber insulation



v) For double skin AHUs:-Polyurethane foam (PUF insulation)

6.3 MATERIAL SPECIFICATIONS

The insulation material shall satisfy the following requirements:

i) For thermal application on Chilled water pipes.

Material	Min Density Max. (Kg/cu.m)	Thermal conductivity(K.cal/hr) (°C/m at 10 deg C mean temp.)
Expanded Polystyrene (TF)	20	0.035

ii) For thermal insulation of ducts & Drain piping:

Material	Minimum Density (Kg/Cum)
Nitrile Rubber	50

iii) For acoustic lining:

Application	Material	Minimum Density (Kg./Cu.M)
Duct	Resin bonded glass wool	32
AHU room	Resin bonded glass wool	32

iv) The specification for resin bonded glass wool insulation & resin bonded mineral wool insulation shall conform to IS 8183 as amended up to date. The specification for expanded polystyrene shall conform to IS-4671 as amended up to date

v) Expansion tank Insulation: Expanded polystyrene insulation of density not less than 20kg per cum. shall be used.

6.4 INSULATION THICKNESS

The thickness of insulation shall be as indicated below unless specified otherwise in the tender specifications and it should meet the requirements mentioned in the ECBC.

i) For Chilled water pipe insulation

Pipe Size (mm)	Insulation
150 & above	75 mm thick expanded polystyrene
Below 150	50 mm thick expanded polystyrene

ii) For Condensate water pipe insulation



Pipe Size (mm)	Nitrile rubber (mm)
All sizes	9
iii) For Duct insulation	
Application	Insulation
Thermal Insulation	19 mm thick Nitrile rubber
Acoustic	25 mm thick Glass wool
iv) <u>For room acoustic lining</u> Resin bonded glass wool	50 mm
v) <u>For pumps</u> Expanded polystyrene TF quality	50mm
vi) <u>Chiller Insulation</u> Thickness of polyvinyl rubber insulation used for chiller insulation shall not be less than 25mm.	
vii) <u>Expansion tank</u> Thickness of expanded polystyrene (TF quality) insulation used shall not be less than 50mm.	

6.5 APPLICATION OF INSULATION ON PIPES (including suction line insulation)

i) The surface to be insulated shall be first cleaned and a coat of zinc chromate 'primer' shall be given. The insulation shall be fixed tightly to the surface with hot bitumen/ cold setting adhesive CPRX compound as recommended by the insulation manufacturer. All joints shall be staggered and sealed. The second layer of insulation shall be similarly applied over the first layer.

ii) The insulation shall be finished as under:

- a. For pipes laid inside the building, the insulation over the pipe work shall be finished with 0.63mm thick aluminum sheet cladding over a vapor barrier of 120gm/sqm polythene sheet with 50mm overlap and tied down with lacing wire and complete with type 3, grade-1 roofing felt strip (as per IS 1322 as amended up to date) at the joints.
- b. For pipes outside the building laid above ground the finishing over the pipe insulation shall be finished with 0.63 mm G S sheet cladding over a vapor barrier of 120gm/sqm polythene sheet with 50mm overlap and tied down with lacing wire and complete with type 3 grade-1 roofing felt strip applied by means of hot bitumen.
- c. For pipes outside the building laid underground the insulation shall be covered with 500 gauge polythene faced hessian, (the polythene facing outwards), with 50 mm overlap. All joints shall be sealed with bitumen. A layer of 0.50 mm x 20 mm G.I. wire mesh netting shall be provided over it butting all joints and it shall be laced down with GI wire, sand cement plaster (1:4) 20 mm. thick shall be provided



in 2 layers of each 10mm and shall be water proofed by applying hot bitumen & fixing tar felt over the plaster. It shall be finally finished with a coat of hot bitumen.

iii) All valves, fittings, strainers etc. shall be insulated to the same thickness and in the same manner as for the respective piping, taking care to allow operation of valves without damaging the insulation.

6.6 APPLICATION OF INSULATION ON PUMPS

Expanded polystyrene (TF quality) 50mm thicknesses shall be sandwiched between two aluminum sheets of 0.5mm thickness and properly clamped to pump in two semicircular sections.

6.7 APPLICATION OF INSULATION ON EXPANSION TANK

Insulation of expansion tank shall be expanded polystyrene (T.F. Quality) of thickness not less than 50mm. It shall be applied as under

- i) Surface shall be thoroughly cleaned with wire brush and rendered free from all dust & grease.
- ii) The two layers of hot bitumen shall be applied.
- iii) The insulation slabs will then be fixed in one layer and joints shall be sealed with hot bitumen.
- iv) The insulation slab then shall be covered with 0.63 mm x 19mm G.I. wire mesh netting which shall be fixed to insulation with brass / G.I. nails.
- v) The insulation shall then finally be finished with aluminum cladding of thickness not less than 0.5mm.

6.8 APPLICATION OF INSULATION (THERMAL) ON DUCT

Outside insulation

- i) Surface of duct on which the external thermal insulation is to be provided shall be thoroughly cleaned with wire brush and rendered free from all dust and grease.
- ii) Two coats of cold compound adhesive (CPRX compound) shall be applied over the duct. (Any other adhesive recommended by the manufacturers may also be used with the approval of the Engineer-in-charge).
- iii) The aluminum faced insulation shall then be wrapped to the duct with aluminum facing on the outer side. The joints shall then be sealed with BOPP tape.
- iv) Additional treatment on Exposed duct insulation
 - a. Apply tack coat of insulation protective coating Star bond (SB 30-36) evenly by brush @ 2 to 2.5 m²/liter (Min 0.4mm thick).
 - b. After applying tack coat embed the glass fiber or canvas cloth immediately and make it wrinkle free.
 - c. Apply first coat of Starbond(SB 30-36) on prepared surface evenly @ 2.5 to 3 m²/liter (Min. 0.4 mm thick).
 - d. Apply finish coat of Starbond(SB 30-36) @ 2.5 to 3 m²/liter (Min. 0.4 mm thick) once first coat is fully cured.

Inside insulation

- i) Surface of duct on which the thermal insulation is to be provided shall be thoroughly cleaned with wire brush and rendered free from all dust and grease.



- ii) Two coats of cold compound adhesive (CPRX compound) shall be applied on the duct surface on which insulation to be provided. (Any other adhesive recommended by the manufacturers may also be used with the approval of the Engineer-in-charge).
- iii) The aluminum faced insulation shall then be wrapped to the duct with aluminum facing on the inner side. The joints shall then be sealed with BOPP tape.

6.9 APPLICATION OF DUCT LINING (ACOUSTIC INSULATION)

Where specified in the tender specifications, ducts shall be lined internally with acoustic insulation as detailed below:

- i) The Inside surface of duct on which the acoustic lining is to be provided shall be thoroughly cleaned with wire brush and rendered free from all dust and grease.
- ii) Then 25 x 25 sq.mm section of minimum 1.25 mm thick G.I. sheet shall be fixed on both ends of the duct piece.
- iii) The insulation slabs shall then be fixed between these section of ducts using CPRX adhesive compound and stickpins.
- iv) The insulation shall then be covered with Reinforced plastic/ fiber glass tissue, sealing all joints so that no fiber is visible.
- v) The insulation shall finally be covered with minimum 0.5 mm thick perforated aluminum sheet having perforations between 20-40%.

6.10 APPLICATION OF ACOUSTIC LINING IN AHU ROOMS

- i) The wall/ roof surface should be thoroughly cleaned with wire brush.
- ii) A 610 x 610 mm frame work of 25mm x 50mm x 50mm x 25mm shape channel made of 0.6mm thick G.S.S. shall be fixed to walls leaving 610mm from floor by means of raw plugs in walls and dash fasteners in ceiling. Similar frame work shall also be fixed on ceiling by means of dash fasteners.
- iii) Resin bonded glass wool/ mineral wool as specified cut to size will be friction fitted in the frame work and covered with tissue paper.
- iv) Aluminum perforated sheet having perforation between 20-40% of thickness not less than 0.8mm shall be fixed over the entire surface neatly without causing sag/ depression in between and held with screws. Sheet joints should overlap minimum 10mm.
- v) Aluminum beading of 25mm wide and thickness not less than 1.00 mm shall be fixed on all horizontal/vertical joints by means of screws.

6.11 MEASUREMENT OF INSULATION

- i) Pipe insulation shall be measured in units of length along the centre line of the insulated pipe. The linear measurements shall be taken before the application of the insulation. For piping measurements, all valves, orifice plates and strainers shall be considered strictly by linear measurement along the centre line of the pipes, and no special rate shall be applicable for insulation of any accessories, fixtures or fittings whatsoever.
- ii) Duct insulation and acoustic lining shall be measured on the basis of surface area along the centre line of insulation thickness. Thus the surface area of externally thermal insulated or acoustically lined duct shall be based on the perimeter at the centre of thickness of

insulation, multiplied by the centre-line length of ducting including tapered pieces, bends, tees, branches etc. as measured for bare ducting. In the case of tapering pieces, their average perimeter shall be considered.

PART VII - CONTROLS

7.1 SCOPE

This chapter covers the requirements of equipment safety controls, refrigerant flow controls, system controls, and variable speed drive (VSD). For chilling units all the controls shall be microprocessor based.

7.2 EQUIPMENT SAFETY CONTROLS

7.2.1 Compressor:

7.2.1.1 Compressor shall be provided with the following safety controls:-

i) High discharge pressure (HP) safety (cut out) to stop the compressor automatically, in case discharge pressure exceeds a preset safe value. This safety shall operate when discharge head pressure exceeds the set point.

Only manual resetting shall be provided for this safety.

ii) Low suction pressure (LP) safety (cut-out) to stop the compressor automatically, in case suction pressure falls below a pre-set value. This safety shall operate when the suction pressure falls below the set point. Automatic resetting shall be provided for this safety, with adjustable cut-in and cut-out pressures. This safety shall be used for pumping down the system for shutting off the refrigeration plant.

iii) Oil pressure (O.P) safety (cut-outs) to stop the compressor, in case lubricating oil pressure falls below a safe set value. A time delay mechanism shall also be provided, so as to permit running of the compressor upto a maximum period of 90 seconds, with the oil pressure differential below the set value and allow it to continue normal operation if the pressure differential builds up to the set value within that time, or otherwise shut-down the compressor. Only manual resetting shall be provided for this safety.

iv) High bearing oil temperature cut-out (for centrifugal compressor only). This shall be provided with a manual reset only.

v) High lubricating oil temperature cut-out (for centrifugal compressor only). This shall be provided with a manual reset only.

vi) Time delay mechanism on the starting gear to limit short cycling regardless of malfunctioning of controls.

The cut-outs (i) to (v) mentioned above shall operate when the respective controlled variable crosses the set point to trip the compressor. Audio visual alarm shall be provided to indicate such operations. A manual reset shall be provided for them.

7.2.1.2 Safeties mentioned above shall operate when the respective controlled variable crosses the set point to trip the compressor.

7.2.1.3 Audio visual alarm shall also be provided to indicate such operations.

7.2.2 Condenser



The safety control for a condenser shall comprise a safety pressure relief valve on the shell. This shall operate to relieve the pressure at the set point without prior leakage. For small condensers, a fusible plug may be provided to melt at a predetermined temperature.

7.2.3 Chiller

I) An antifreeze shall be provided with water chiller, set at a few degrees above the freezing point. This shall operate, when the temperature of water in the chiller falls below the set point to trip the compressor motor. The reset provided for the safety shall be manual.

II) Flooded type of chiller in addition, shall be provided with safety pressure relief valve.

7.2.4 Refrigeration Plant

i) In addition to the safety controls as above for the individual components of a refrigeration plant, the following safety controls shall also be provided for the plant.

a) Compressor motor over current cut-out.

b) Condenser water flow switch.

c) Chilled water flow switch.

d) Condenser air flow switches in the condenser fan discharge (in case of air-cooled condensers).

ii) The above controls, on operation, shall trip the compressor motor, and these shall be provided with manual reset arrangement.

iii) The compressor motor shall also be interlocked electrically with,

a) Condenser water pump in case of water cooled condenser, and condenser fan with air cooled condensers,

b) Chilled water pumps in case of chilled water system.

c) Antifreeze thermostat in case of chillers.

iv) Indicating lamps shall also be provided on the control panel for indicating operation of the safeties and interlocks.

7.3 REFRIGERANT FLOW CONTROLS

A refrigeration plant shall be provided with controls, necessary for starting, stopping and modulating the flow of refrigerant in the plant so as to satisfy the load requirements. These comprise solenoid valve, thermostatic expansion valve, float valve, compressor capacity controls etc. and other special controls if specified in a particular work.

7.3.1 Solenoid Valve

a) For screw type compressors liquid line solenoid valve shall be provided in the liquid line of the system, ahead of the expansion valve, to allow or to stop the flow of liquid refrigerant to an evaporator, or a section of sectionalized evaporator. This shall be operated by snap-acting thermostat and it shall also be provided with a test switch to enable manual energizing.



b) Discharge gas valves shall be provided in the following applications as required: Hot gas defrosting: normally this solenoid valve shall remain closed, but it shall open up to feed the evaporator with hot gas for defrosting when required, especially in cold storage applications.

c) Solenoid valves shall be direct acting in smaller sizes and pilot operated for larger sizes, as required. The size of the valves shall be determined by the desired flow rate of refrigerant through them and the pressure drop across the same (and not by the size of the refrigerant line).

7.3.2 Thermostatic Expansion Valve

Thermostatic expansion valve shall be provided in DX type refrigeration plant to modulate the flow rate of liquid refrigerant entering the evaporator in response to the extent of superheat of refrigerant gas leaving the evaporator, so that only a metered flow is ensured matching the load. The number of expansion valve shall be such that the specified accuracy of temperature control of the system can be achieved and that no valve is expected to operate below 35% of its rated capacity. The sizes shall be selected suitably so as to avoid hunting. Adjustable super heat control and external equalizer port shall be provided for each valve. Each expansion valve shall be easily removable for cleaning and adjusting.

7.3.3 Float Valve

Float valve shall be provided in refrigerant plant with flooded type chiller for maintaining the liquid level in chiller under all conditions of load at a rate commensurate with the rate of vaporization. This can be provided either on low pressure side or on high pressure side. When provided as low side float valve, this shall be located as a part of the chiller or accumulator.

7.3.4 Compressor Capacity Control

The capacity control arrangement shall be in accordance with 2.2A.7 for centrifugal type compressors and 2.2B.8 for screw compressors.

7.4 SYSTEM CONTROLS

i) The requirements for maintaining the inside design conditions as specified in the tender specifications for the work shall be met by appropriate system controls and control elements. The system shall satisfy the requirements of both full load and partial load conditions. Details of complete control elements shall be indicated by the tendered in the tender.

ii) Control shall be affected by 2 way diverting valve in chilled water coil. For heating using hot water coils, now control through them shall also be achieved by using 2 way valves.

iii) The size of 2 way diverting valves shall be selected so as to match the coil where in the flow is to be regulated. The make and size shall be indicated in the Technical particulars in the tender.

iv) Operation of the modulating proportional motor of 2 way diverting valve shall be controlled by proportional type thermostat.

7.5 OPERATIONAL CONTROLS AND INTERLOCKS

- i) The operation of refrigeration plant shall be either manual or automatic, as specified. The plant shall be started by an ON/OFF switch. Additionally, in the case of an automatic plant, an auto/manual switch shall also be provided.
- ii) The automatic operation shall be effected through the monitoring of return chilled water temperature, or the room conditions, as the case may be. In multi-unit installations, one unit shall be arranged to be loaded fully before the next unit is switched on automatically. A similar operation system shall be followed in shutting off of the unit. Change over from one operating unit to another shall be possible through the status switch of the plant to be shut down by change to manual position and thus overriding its anti-cycle timer. It should be possible to introduce the changed unit by running it to speed and changing over the status switch to "auto" position.
- iii) Pump down shut down shall be provided through low pressure (LP) safely irrespective of the status switch position, auto/manual.
- iv) It should be possible to start the compressor motor only after the cooling tower fan motor, chilled water and condenser water pumps are operated.
- v) The compressor motor shall be able to be started or run, only after all the safeties as per Para 12.2 are satisfied.
- vi) The blower motor shall be interlocked with strip heaters (where provided) such that power supply to strip heaters will become ON, only after the blower has been started and run to full (designed) speed.
- vii) Where only the blower motor and not heaters is connected to standby generating set in any particular application, a timer shall be provided, such that the heaters may get energized, only after a period of time, after the blower is run.
- viii) In the event of signal from high limit safety of heaters the power supply to the blower motor and the heater bank shall automatically and instantly be switched off.
- ix) The power supply to all AHUs of a building shall be cut off on receipt of a signal from the Fire Alarm System of that particular building.
- x) Interlocking shall be provided for Air Washer Panels and fire dampers of a building with the Fire Alarm System of that particular building to stop the Air Washers & close the fire damper in case of Fire.

7.6 REQUIREMENTS OF CONTROL ELEMENTS

The system control elements comprise controlling elements such as thermostats, three way valves etc. as required for individual applications.

7.6.1 THERMOSTATS

Thermostats shall be electric fixed differential type as indicated below, with sensing element located in the return air stream. All thermostats shall be supplied with the standard mounting boxes as recommended by the manufacturer. The profile, mounting arrangement and exact location of the thermostat shall be such as to suit the site.

- i) Thermostat shall have temperature adjustments WARM-NORMAL-COOL settings and fan switch. Switching off must break fan circuit.

7.6.2 PRESSURE INDEPENDENT/BALANCED/HIGH-RANGEABILITY CONTROL

VALVES - AHU

Control valves for air handling units shall be 2way, globe type, pressure independent/balanced/ high rangeability, type of Brass/Cast Iron/S.G. Iron construction, of PN16 rating with flanged connections. The valve shall have linear stroke of minimum. The valves shall have an operating pressure rating of 150% of the pump operating head. The actuator shall be electronic, motorized, modulating type operating on 24VAC and 0-10Vdc or 4-20mA control signal. The actuator shall have provision for 0-10Vdc position feedback signal and manual operation.

7.7 VARIABLE SPEED DRIVE (VSD)

7.7.1 Air quantity flow control

The VSD System shall function to supply variable air quantity in the air-conditioned area in response to the load variations including that due to variations in ambient conditions and filter cleanliness conditions, to maintain the inside designed temperature, RH and pressure conditions in conjunction with the humidifier and reheaters. During the day hours, as per the time interval selected, the VSD System shall regulate the speed of the AHU to maintain the temperature within maximum designed temperature and positive air pressure inside the air-conditioned area. The positive air pressure shall be maintained by keeping a difference of minimum 15% in the –airflow between the supply and exhaust air. However, under any circumstances during the day hours, the air flow rate will not fall below the 60% of the rated CFM of the AHU or 15 air changes, whichever is higher. During the rest of the night hours, the Programmable timer shall give a signal to the VSD to run the AHU at a predetermined reduced speed so as to provide only 25% of the normal CFM or the minimum CFM achievable closest to 25% but not below 25% of the normal CFM.

Due to the clogging of the air filter if the inside temperature conditions are not achieved even at 100% AHU speed then the VSD will close an N.D. contacts to activate an alarm. The VSD shall have the provision to switch over to the manual mode as and when required. The system shall comprise of dedicated Variable Speed Drives (VSDs) designed for HVAC applications to accept 2 feedback signals (from temperature sensor installed in the AC area and programmable timer controller) and have 2 programmable set points (inside temperature conditions, and 60% of the normal CFM condition as stated above) using HVAC terminology, to regulate the speed of the AHU motors in response to the variations in load and filter cleanliness conditions to maintain temperature and Air flow differential in supply and exhaust conditions. In case, any additional sensor (s) including wiring etc are required to meet the system requirements the cost of that shall be deemed to be included in the cost of the VSD. The VSD control shall have:

- a) RFI (Radio frequency interference) Filters for EMC (Electromagnetic compatibility) compliance.
- b) Voltage Vector Control technology to generate advanced sinusoidal output voltage, 100% true RMS value of the fundamental voltage at rated speed and nominal torque, cause no motor de-rating and keep motor temperature limits within permissible class B limits.



- c) Displays in user's friendly Alpha Numeric Characters for all operating parameters, programming parameters and faults.
- d) Built in energy meter
- e) Built in run time counter
- f) Local control panel (key pad)

The system shall also comprise a suitable programmable timer & PLC with required electronic components, to allow 2 feedback signals (Temperature & Minimum CFM) to be passed on to the VSD during the day hours. In the night hours only one signal from the programmable timer shall go to the VSD to run it at pre-determined reduced speed. The room I space air temperature and air flow shall be sensed by a temperature and air flow transmitters, which shall generate suitable DC signal to provide feedback to the VSD, which in turn shall regulate the speed of the AHU fan to maintain the designed conditions as described above.

VSD shall be designed, with built-in PID controller, control panel (keypads & display), IP 20 enclosure for use on standard centrifugal fans. The VSDs should not cause any de-rating of the connected motors and must ensure that class B temperature levels of the connected motors are never exceeded, The display should be in alpha-numeric characters and programming facility should be in user-friendly HVAC terminology. The VSDs should be able to accept up to 2 feedback signal from temperature & air flow transmitter simultaneously and to program 2 set points in it.

The system shall also have following features incorporated

- Heat sink over temperature protection
- Under voltage protection
- Over voltage protection
- Alpha-numeric display facilities
- On indication
- Trip indication
- Selectable display of various parameters line voltage, frequency, speed, power, torque, motor temperature percentage, VSD temperature percentage, KWH.
- Raise and lower speed push button in local mode
- Frequency range variation from 0 to 50 Hz.
- Remote start and stop facility including indications thereof with necessary hardware and terminal blocks, including toggle switch etc. to over ride remote start & stop at the time of maintenance/repairs.
- Off delay facility through timer or PLC with 30 sec to 120 sec. time delay, to be connected to air flow switch.

Safeguard facility against single phasing.

Tripping of AHU blower motors in response to the fire alarm Signal from AFAS. Inter locking of Exhaust and AHU blowers such that power supply gets fed to exhaust blower only when the supply air flow is there.

7.7.2 Chilled water flow control

Variable Speed Drive (VSDs) for controlling the chilled water flow rate in the secondary circuit shall be provided. Requirement and Specifications of VSD system shall be as follows:



The VSD System shall function to supply variable chilled water flow in the secondary circuit of air-conditioning system in response to the load variations including that due to variations in ambient conditions to maintain the inside designed temperature conditions. However, under any circumstances, the secondary chilled water pump speed shall not fall below the 30% of the nominal speed or any other suitable minimum speed as per the system requirement. The VSD shall have the provision to switch over to the manual mode as and when required and facility for the manual speed variation from VSD itself. The system shall comprise of dedicated Variable Speed Drives (VSDs) designed for HVAC applications to accept two feedback signals (from differential pressure transmitters installed across the two farthest, most significant AHUs of the zone to select either maximum of the two or average of the two (as selected by the user) feedback signals using HVAC terminology, to regulate the speed of the secondary chilled water pump motors in response to the load variations. In case, any additional sensor (s) including wiring etc. if required to meet the system requirements the cost of that shall be deemed to be included in the cost of the VSD. The VSD shall have:

The VSD system and controller shall be in such a way that the master controller can work with all other VFDs in case of problem even in master VFD.

- RFI (Radio frequency interference) Filters for EMC (Electromagnetic compatibility) compliance.
- Voltage Vector Control technology to generate advanced sinusoidal output voltage, 100% true RMS value of the fundamental voltage at rated speed and nominal torque, cause no motor de-rating, and keep motor temperature limits within permissible class B limits.
- The VSDs shall have D.C. link reactors/ harmonic filters integrated to minimize power line Harmonics. There shall be reactors in both the positive and negative rails.
- An automatic energy optimization feature shall be provided as standard in the frequency converter. This feature shall reduce output voltage, further to quadratic V/f characteristics, when the motor is lightly loaded and minimize the motor losses.
- The VSD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% torque for upto 5seconds (for high inertia and high friction load).
- The VSD shall include Automatic Motor Adaptation (AMA) to optimize motor performance, improve start capabilities and compensate for motor cable variances. The AMA shall be carried out at motor stand still with no need for detaching the pump from motor.
- Unlimited output power circuit switching must be possible without the need for central circuit interlocking and without causing damage to the VSD.
- Auto-derating of maximum drive current shall be incorporated in VSD to allow continued operation at reduced speed in case of VSD over temperature phase loss or mains imbalance without damaging the VSD.
- Displays in user's friendly Alpha Numeric Characters for all operating parameters, programming parameters, faults, Built in energy meter.
- In run time counter.
- Local control panel (key pad)

The system shall also comprise a suitable PLC if required, with electronic components.

VSD shall be designed, with built-in PID controller, control panel (keypads & display), IP 20 enclosure for use on standard centrifugal pumps. The VSDs should not cause any de-rating of the connected motors and must ensure that class B temperature levels of the connected motors are never exceeded. The display should be in alphanumeric characters and programming facility should be in user-friendly HVAC terminology. The VSDs shall be able to accept up to two feedback signals from differential Pressure transmitters simultaneously and to program set points in it. The system shall have following features incorporated:



- Heat sink over temperature protection
 - Under voltage protection
 - Over voltage protection
 - Protections against input transients, loss of A.C. line phase, short circuit, ground fault, frequency converter over temperature.
 - Alpha-numeric display facilities
 - On indication
 - Trip indication
 - Selectable display of various parameters like output line voltage, output frequency, speed, power, motor temperature percentage, heat sink temperature, VSD temperature percentage, KWH, hours run, differential pressure.
 - Raise and lower speed push button in local mode.
 - Frequency range variation from 0 to 50 Hz.
 - Remote start and stop facility including indications thereof with necessary hardware and terminal blocks, including toggle switch etc. for over ride of remote start & stop of at the time of maintenance/repairs.
- Safeguard facility against single phasing.

7.7.3 Where building management system and air quantity flow control/ chilled water flow control through VFD are provided for same application, control panel for sequencing of VFD shall not be required.

APPENDIX

PROFORMA FOR RESU & NOTES ON TEST INSTRUMENTS AND CAPACITY COMPUTATIONS

Sr. No.	ITEM	TEST RESULTS		
	Ambient Conditions	D.B Temp.		-deg C



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		W.B Temp		-deg C
		%RH		
	Compressors	R.P.M		
		Suction Pressure		-Kg/Sq.cm
		Discharge pressure		-Kg/Sq.cm
		Oil pressure		-Kg/Sq.cm
	Compressor Motors	R.P.M		
		Voltage		-Volts
		Current		
		(i)at 100% load		-amps
		(ii)at partial load		
		(a)		-amps
		(b)		-amps
		(c)		-amps
	Water Chiller	Water flow rate		-LPM
		Water temperature		
		(i)Entering		-deg C
		(ii)Leaving		-deg C
		Water pressure		
		(i)Entering		-Kg/Sq.cm
		(ii)Leaving		-Kg/Sq.cm
	Condensers	Water flow rate		-LPM
		Water temperature		
		(i)Entering		-deg C
		(ii)Leaving		-deg C
		Water pressure		
		(i)Entering		-Kg/Sq.cm
		(ii)Leaving		-Kg/Sq.cm
	PUMP	R.P.M.		
		Motor current		-amps
		Suction Pressure		-Kg/Sq.cm
		Discharge pressure		-Kg/Sq.cm
	Cooling Towers	Water temperature		
		(i)Entering		-deg C
		(ii)Leaving		-deg C
		Wet bulb approach		-deg C
		Fan motor current		-amps
		Fan motor voltage		-Volts
		Fan motor		R.P.M
	Air Handling Units	Total air quantity		



		Across coil		-Cu.m/min
		Coil face area		-sq.m
		Air temperature		
		(i)Entering(D.B)		-deg C
		(ii)Entering(W.B)		-deg C
		(iii)Leaving(D.B)		-deg C
		(iv)Leaving(W.B)		-deg C
		Water pressure		
		(i)Entering		-Kg/Sq.cm
		(ii)Leaving		-Kg/Sq.cm
		Water temperature		
		(i)Entering		-deg C
		(ii)Leaving		-deg C
		Water flow		rate -LPM
	Fresh Air intakes	Face area		-sq.m
		Air quantity		-Cu.m/min
	Room Conditions at the Working Plane (No. of Readings Should Be Taken And Average Out)	Temperature		
		(D.B)		-deg C
		(W.B)		-deg C
	Controls	FUNCTION OF EACH CONTROL SHALL BE TESTED AND REPORT FURNISHED		

NOTES

A. Test Instruments

1. All instruments for testing shall be provided by the air conditioning contractor.
2. Thermometers used for measurement of temperature of *water* / refrigerant shall have graduation of 0.1 deg C and shall be got calibrated from N.P.L. or any recognized test house before hand.
3. Thermometers used in the psycho meters shall have graduations of 0.2 deg C and shall be calibrated as at (2) above.
4. Pressure gauges shall also be got calibrated before hand from a recognized test house.
5. Orifice type of flow meters shall be used for measuring flow rate through the condensers and chillers.

B. CAPACITY COMPUTATIONS

1. Condensing unit:

The capacity shall be computed from the water temperatures and water flow rate measurements of the condenser water and the compressor motor current readings. A reference may be made, if necessary to the manufacturer's motor performance characteristics for arriving at the B.H.P. consumption.

2. Water chilling unit:



The capacity shall be computed from the water temperature and water flow rate measurements of the chiller. Heat rejection from the condenser shall be computed from the water temperature and water flow rate measurements at the condenser.

3. Cooling Tower:

Water quantity measured at the condenser and the temperature of water at the cooling tower shall be recorded. Wet bulb approach shall be checked against design data recorded in the tender documents.

4. Air handling unit (chilled water type):

The capacity shall be computed from the water temperature and water flow measurement. A tolerance of + 5% from the tender documents value shall be acceptable in the capacity so computed. Air quantity shall be measured in the supply duct and checked with the quantity specified in the tender documents. A tolerance of $\pm 10\%$ in the air quantity shall be acceptable. The enthalpy difference of air entering and leaving the coil shall be computed from air temperature and recorded.

5. Air handling unit (Dx type);

The capacity shall compute from the air quantity measured in the supply air duct and the enthalpy difference between the air entering leaving coil. Air quantity measured shall be checked with that recorded in the tender documents. A tolerance of $\pm 10\%$ from tender documents value shall be acceptable.

6. For the purpose of system capacity, the refrigeration tonnage obtained from the main refrigeration plant will be accepted.

7. If due to any reason, internal load mentioned in the tender specifications is not available psychometric computations for actual load conditions will, be done and the plant, if found satisfactory will be accepted.

ADDITIONAL CONDITIONS

1.0 General

1.1 This specification covers manufacture, testing as may be necessary before dispatch, delivery at site, all preparatory work, assembly and installation, final testing, commissioning, operation & maintenance of plant for six years including one year guarantee period for the following work.

1.2 Name of Work: : **Balance work of HVAC system in PHY- 2 (1D) & CSE-2 (1A) Buildings at IIT Indore (At Risk & Cost)**”.

1.3 The work shall be executed as per Above given specifications, CPWD General Specifications for HVAC Works 2004, CPWD General Specifications for Electrical Works Part I, II & IV as amended upto date, relevant IE rules, relevant IS and as per directions of Engineer-in-Charge. These additional specifications & conditions are to be read in conjunction with above and in case of variations; specifications given in the Additional



specifications & conditions shall apply. However, nothing extra shall be paid on account of these as the same are to be read along with schedule of quantities for the work.

2.0 Inspection and testing: Initial Inspection at works and final inspection and testing at site shall be carried out as per chapter XII, CPWD General Specification for HVAC works 2004 as amended to date.

3.0 Compliance with Regulations and Indian standards, Indemnity & Insurance All works shall be carried out in accordance with relevant regulation, both statutory and those specified by the Indian Standards as detailed in Para 1.2 & 1.3 of CPWD General Specifications for HVAC work -2004.

PART-III



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TECHNICAL BID

List of Documents to be submitted within the period of bid submission:

- (a)** Online deposited receipt/acknowledgement against EMD.
- (b)** Certificate of Registration for GST.
- (c)** Certificate of Registration for EPF.
- (d)** Certificate of Registration for ESIC.
- (e)** Certificate of Registration for PAN Card.
- (f)** Certificate of Registration for company/firm.
- (g)** Certificate of Registration for Building & other construction works (BOCW).
- (h)** Certificate of Registration for labor license.
- (i)** Valid 'A' or 'B' class electrical contractor's license issued from Govt. of M.P. or Govt. of India.
- (j)** Duly signed & stamped of complete downloaded tender document with other required document mentioned in the tender

(B) Data Sheets to be filled up by the Tenderers/ Bidders

Sl. no.	Information	Format of submission	Compliance
1	Obligation / Compliance To Be Insured By Contractor	Annexure- "A"	Yes/No
2	Tax	Annexure- "B"	Yes/No
3	Indemnity by contractor	Annexure- "C"	Yes/No
4	Joint Venture Details (if applicable)	Annexure- "D"	Yes/No
5	Certificate in prescribed format	Annexure- "E"	Yes/No
6	Letter of Transmittal	Annexure- "F"	Yes/No

Note:

- 1 If necessary, additional sheets may be added to the forms.
- 2 Some of the forms will require attachments. Such attachments should be clearly marked as follows: Attachment I to Form # Attachment 2 to Form #. etc.

Annexure- “A”

Obligation/Compliance to be insured by Contractor

Sr. No.	Items	Compliance of Contractor to be filled by Contractor	
		YES	NO
1	Registration		
2	Compliance of provisions of Child Labor Act, and Workmen compensation Act		
3	To ensure treatment in case of accident / injuries suffered in Performance of work including wages and compensation under WC Act.		
4	Send accident report to Regional Labor Commissioner (RLC)		



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Annexure –“B” TAX

Attach copy of current last three years' income tax returns details.



Annexure- "C" INDEMNITY

(To be filled by Contractor)

I on behalf of M/s hereby agree and undertake that I have understood all the safety rules and procedures and all staff working on behalf of M/s..... will follow all safety rules and procedures. I declare that I M/s will be responsible for any safety violations/ accident etc. IIT Indore will not be responsible in case of any accident / incident and will not compensate financially or otherwise.

I hereby declare that I am sole responsible on behalf of M/s.....

..... for giving such declaration.

Name of Indemnifier

Signature of Indemnifier

Stamp/Seal of the Indemnifier /Contractor



Annexure- "E"

CERTIFICATE

(to be provided on letter head of the firm)

I hereby certify that the above firm has not been ever blacklisted by any Central/State Government/Public Undertaking/Institute on any account.

I also certify that the above information is true and correct. In every respect and in any case at a later date, if it is found that any details provided above are incorrect, any contract given to the above firm may be summarily terminated and the firm blacklisted.

Date:

Place:

Signature of Contractor

Annexure-“F”

LETTER OF TRANSMITTAL

From:

To

The Project in Charge,
IIT Indore (MP).

Name of work: - “Balance work of HVAC system in PHY- 2 (1D) & CSE-2 (1A) Buildings at IIT Indore”

Sir,

Having examined the details given in Press Notice and bid documents for the above work, I/ we hereby submit the relevant information.

1. I / we hereby certify that all the statements made and information supplied in the enclosed forms A to E and accompanying statement are true and correct.
2. I / we have furnished all information and details necessary for eligibility and have no further pertinent information to supply.
3. I / we submit the requisite certified solvency certificate and authorize PIC, IIT Indore to approach the Bank issuing the solvency certificate to confirm the correctness thereof. I / we also authorize PIC, IIT Indore to approach individuals, employers, firms and corporation to verify our competence and general reputation.
4. I / we submit the following certificates in support of our suitability, technical knowledge and capability for having successfully completed the following eligible similar works:

Name of work

Certificate from

- | | |
|---------|-------|
| 1. | |
| 2. | |
| 3. | |

CERTIFICATE: It is certified that the information given in the enclosed eligibility bid are correct. It is also certified that I/We shall be liable to be debarred, disqualified/ cancellation of enlistment in case any information furnished by me / us found to be incorrect.

Enclosures:-

Seal of bidder

Date of submission

SIGNATURE(S) OF BIDDER(S)



(C) Data Sheets to be filled up by the Tenderers/ Bidders

Sl. no.	Information	Format of submission	Compliance Yes/No
1	Financial Information	Form - "A"	Yes/No
2	Solvency Certificate	Form - "B"	Yes/No
3	Experience of Similar Nature of Works	Form - "C"	Yes/No
4	Performance Reports of above referred works in Form 'C'	Form - "D"	Yes/No
5	Structure & Organization details	Form - "E"	Yes/No
6	List of the projects under execution or awarded	Form - "F"	Yes/No
7	Compliance Sheet	Form - "G"	Yes/No



FORM 'A'

FINANCIAL INFORMATION

- I Financial Analysis - Details to be furnished duly supported by figures in balance sheet / profit & loss account (after tax) for the last five years duly certified by the Chartered Accountant, as submitted by the applicant to the Income Tax Department (Copies to be attached).

Financial Year	15-16	16-17	17-18	18-19	19-20
Gross Annual turnover on construction works					
Profit/Loss					

II.

Financial arrangements for carrying out the proposed work.

Signature of Chartered Accountant with Seal.
BIDDER(S)

SIGNATURE OF



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Solvency Certificate from Bankers of bidders in the prescribed Form “B”.

FORM ‘B’

FORM OF BANKERS’ CERTIFICATE FROM A SCHEDULED BANK

This is to certify that to the best of our knowledge and information that M/s / Shri..... having marginally noted address, a customer of our bank are / is respectable and can be treated as good for any engagement up to a limit of Rs. (Rupees.....).

This certificate is issued without any guarantee or responsibility on the bank or any of the officer.

(Signature)
For the Bank

Note (1) Bankers certificates should be on letter head of the Bank, addressed to tendering authority.

(2) In case of partnership firm, certificate should include names of all partners as recorded with the Bank.

FORM 'C'

DETAILS OF ELIGIBLE SIMILAR NATURE OF WORKS COMPLETED DURING THE LAST
SEVEN YEARS ENDING PREVIOUS DAY OF LAST DATE OF SUBMISSION OF
TENDERS

S. No.	Name of work/project and location	Owner or sponsoring organization	Cost of work in crores of rupees	Date of commencement as per contract	Stipulated date of completion	Actual date of completion	Litigation/ arbitration cases pending/in progress with details* Name and address telephone	Number of officer to whom reference may be made	Whether the work was done on back to back basis—Yes/No
1	2	3	4	5	6	7	8	9	10

* Indicate gross amount claimed and amount awarded by the Arbitrator.

Signature of bidder(s)



FORM 'D'

PERFORMANCE REPORT OF WORKS REFERRED TO IN FORMS "C"

1. Name of work/project & location :
2. Agreement no. :
3. Estimated cost :
4. Tendered cost :
5. Date of start :
6. Date of completion :
 - (i) Stipulated date of completion :
 - (ii) Actual date of completion :
- 7 (a) Whether case of levy of compensation for delay has been decided or not? : Yes / No
- (b) If decided, amount of compensation levied for delayed completion, if any. :
8. Performance Report
 - (1) Quality of work : Outstanding/Very Good/Good/Poor
 - (2) Financial soundness : Outstanding/Very Good/Good/Poor
 - (3) Technical Proficiency : Outstanding/Very Good/Good/Poor
 - (4) Resourcefulness : Outstanding/Very Good/Good/Poor
 - (5) General Behavior : Outstanding/Very good/Good/Poor

Dated:

Executive Engineer or Equivalent

FORM 'E'



STRUCTURE & ORGANISATION

- 1 Name & address of the bidder
- 2 Telephone no./Telex no./Fax no.
- 3 Legal status of the bidder (attach copies of original document defining the legal status) :
 - i. An Individual
 - ii. A proprietary firm
 - iii. A firm in partnership
 - iv. A limited company or Corporation
- 4 Particulars of registration with various Government Bodies (attach attested photocopy)

Organization /Place of registration/Registration No.

 - 1.
 - 2.
 - 3.
- 5 Names and titles of Directors& Officers with designation to be concerned with this work.
- 6 Designation of individuals authorized to act for the organization
- 7 Has the bidder or any constituent partner in case of partnership firm, Limited Company /Joint Venture ever were convicted by the court of law? If so, give details.
- 8 In which field of E&M Engineering construction the tenderer has specialization and interest.
- 9 Any other information considered necessary but not included above.

Signature of bidder(s)



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FORM 'F'

List of the projects under execution or awarded

S. No.	Name of work/project and location	Owner or sponsoring organization	Cost of work in crores of rupees	Date of commencement as per contract	Stipulated date of completion	Upto date percentage progress of work	Slow progress if any and reasons thereof.	Name and address / telephone	Number of officer to whom reference may be made	Remarks
1	2	3	4	5	6	7	8	9	10	

Certified that the above list of works is complete and no work has been left out and that the information given is correct to my knowledge and belief.

Signature of bidder(s)

FORM 'G'

Sr. No.	Description	Compliance	Remarks
1	Name of the Contractor/Agency		
2	Address & Contact number		



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3	Name of person, who has signed the tender		
4	Details of EMD (Receipt/Acknowledgement) (copy should be attached)	YES/NO	
5	GST Registration number (copy should be attached)	YES/NO	
6	EPF registration number (copy should be attached)	YES/NO	
7	ESIC registration number (copy should be attached)	YES/NO	
8	Permanent Account Number (copy should be attached)	YES/NO	
9	Company/Firm Registration Number (copy should be attached)	YES/NO	
10	Building & other construction works (BOCW) Registration (copy should be attached)	YES/NO	
11	Labour License Registration (copy should be attached)	YES/NO	
12	Valid "A" or "B" Class Electrical Contractor license. (copy should be attached)	YES/NO	
13	Duly signed & stamped of complete downloaded tender document. (copy should be attached)	YES/NO	

PART-IV



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FINANCIAL BID

PRICE BID

PRICE BID - Schedule of price bid in the form of BOQ format:

1. The below mentioned Financial Proposal/Commercial bid format is provided as BoQ along with this tender document at <https://eprocure.gov.in/eprocure/app>
2. Bidders are advised to download this BoQ.xls as it is and quote their offer/rates in the permitted column and upload the same in the commercial bid.
3. Bidder shall not tamper/modify downloaded price bid template in any manner. In case if the same is found to be tampered/modified in any manner, tender will be completely rejected and EMD shall be forfeited.
4. Any element of cost, taxes, duties levies etc. not specifically indicated in the BOQ, shall not be paid by the purchaser. If GST amount is not quoted in the BOQ (Financial Bid), the total cost will be treated as inclusive of GST. No further communication will be entertained later or else the EMD will be forfeited.
5. The tender shall remain valid for acceptance for 180 days, from the date of tender opening.

OTHER CONDITIONS FOR PRICE BIDS

1. No unilateral revision in price will be admissible.
2. INCOTERMS (in case of imported item) should be clearly mentioned on the bid
3. Rates should be quoted in the accounting units (A/U) mentioned in this tender. Rates must be quoted clearly on free delivery basis at IIT Indore and total value is also indicated in words.
4. Any optional indicated in techno-commercial bids must be priced separately.
5. In case spares/accessories are applicable, their list and price should be clearly indicated separately.
6. The price must be stated for each item separately. The percentage of reduction, in the unit price should also be quoted, should an order to that extent be placed with you.

Signature of the Tenderer
Name of the Firm:
Contact No.:
Email:
Seal:



Schedule of Quantity

Sl. No.	Item Description	Quantity	Units
1	2	3	4
1.00	<u>Hi-Wall Type Split AC units</u>		
1.01	Installing, testing and commissioning of AIR COOLED HI-WALL SPLIT AIR CONDITIONING UNITS with R-407C / 410A refrigerant as described in specifications. 2.0 TR	2.00	Nos.
2.00	<u>VAV BOXES WITH CONTROLS</u>		
2.01	Testing & Commissioning of VAV boxes as per Specifications and requirements:	150.00	Nos.
2.02	Installation Testing & Commissioning Of Thermostat for VAV Boxes including supply of PVC conduit, modular Box and control wiring.	150.00	Nos
3.00	<u>Tube Axial Flow Fans with starter panel</u>		
3.01	Installation, testing and commissioning of Tube Axial flow fan as per the approved drawings and specifications enclosed. Starter panel installation, testing and commissioning is included. (For Lift well pressurisation) Air Flow : 6700 CFM St. Pressure : 25 mm WC	2.00	Nos.
4.00	Testing and commissioning of air handling units along with starter panel	17.00	Nos.
5.00	<u>VAV BOXES WITH CONTROLS</u>		
5.01	Testing & Commissioning of VAV boxes as per specification and requirements.	117.00	Nos.
5.02	Installation Testing & Commissioning Of Thermostat for VAV Boxes including supply of PVC conduit, modular Box and control wiring.	117.00	Nos
6.00	<u>Tube Axial Flow Fans with starter panel</u>		
6.01	Installation, testing and commissioning of Tube Axial flow fan as per the approved drawings and specifications enclosed. Installation, testing and commissioning of starter panel is included. (For Lift well pressurisation) Air Flow : 6300 CFM St. Pressure : 25 mm WC	2.00	Nos.
7.00	Testing and commissioning of air handling units along with starter panel	16.00	Nos.
8.00	Installation of VAV boxes as per the approved drawings	8.00	Nos.



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9.00	Installing, testing and commissioning of AIR COOLED HI-WALL SPLIT AIR CONDITIONING UNITS with R-407C / 410A refrigerant as described in specifications. 2.0 TR	2.00	Nos.
10.00	Assembling of AHU	1.00	Nos.
11.00	GSS Ducting(Site Fabricated):		
11.01	Supply & installation of site fabricated GSS sheet metal rectangular ducting complete with neoprene rubber gaskets, elbows, splitter dampers, vanes, hangers, supports etc. as per approved drawings and specifications of following sheet thickness complete as required. Thickness 0.80 mm sheet	150.00	sq.m
11.02	Installation of factory fabricated oval/ Elliptical sheet metal ducts with single wall internal smooth metal liner in accordance with the approved shop drawings and specifications. The ducts shall be insulated with 19mm thick closed cell elastomeric insulation(Nitrile Rubber). Thickness 0.80 mm sheet	25.00	sq.m
12.00	Fixing of powder coated extruded aluminium Return Air Grills with louvers but without volume control dampers complete as required including minor civil work and gap sealing with silica gel	28.00	sq.m
13.00	Supply installation of powder coated extruded aluminium Supply Air Grills with louvers but without volume control dampers complete as required including minor civil work and gap sealing with silica gel	21.00	sq.m
14.00	Fixing,testing and commissioning of fire dampers along with actuator in supply air duct/main branch and return air path as and where required of required sizes including power and control cable connection	2.60	sq.m
15.00	Supply, installation, testing & commissioning of thermal insulated flexible duct of following sizes duly supported at regular interval as per site requirement etc. complete as required as per specifications. 200 mm dia.	18.00	Rmt



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16.00	Supply, installation, testing and commissioning of GI volume control duct damper complete with neoprene rubber gaskets, nuts, bolts, screws linkages, flanges etc, as per specifications	5.10	Sqm
17.00	Sealant for duct at all collars of the duct and duct joints	1.00	Lot
18.00	Acoustic Lining of Ducts:		
18.01	Fixing of acoustic lining of supply air duct and plenum with 25 mm thick resin bonded glass wool having density of 32 kg/m ³ , with 25 mm X 25 mm GI section of 1.25 mm thick, at 600 mm centre to centre covered with inforced Plastic tissue paper and 0.5 mm thick perforated aluminum sheet fixed to inside surface of ducts with admium plated nuts, bolts, stick pins, CPRX compound etc. complete as required and as per specifications.	16.20	sq.m
19.00	Thermal Insulation:		
19.01	Supplying & Installation of following thickness duly laminated aluminum foil of mat finish closed cell Nitrile rubber (class "O") insulation on existing duct after applying two coats of cold setting adhesive (CPRX compound). The joints shall sealed with 50 mm wide and 3 mm thick self adhesive nitrile rubber tape insulation complete as per specifications and as required. The thickness of insulation shall meet the ECBC requirements. 19 mm thick insulation.	25.00	sq.m
19.02	Supplying & Installation of following thickness duly laminated aluminum foil of mat finish closed cell Nitrile rubber (class "O") insulation on existing duct after applying two coats of cold setting adhesive (CPRX compound). The joints shall sealed with 50 mm wide and 3 mm thick self adhesive nitrile rubber tape insulation complete as per specifications and as required. The thickness of insulation shall meet the ECBC requirements. 25mm thick insulation	165.50	sq.m
20.00	Insulated Valves Installation of following valves, strainers, gauges in the chilled water piping duly insulated to the same specifications as the connected piping and adequately supported as per specifications.		



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20.01	Butterfly Valve Manual BV with C I body, SS disc, nitrile sheet & O-ring & PN 16 pressure rating for chilled water/hot water circulation as specified 65 mm	1.00	Nos.
21.00	AHU Controls Installation of Pressure independent type 2 way Balancing and modulating Control valves in a single Unit of Valve.		
21.01	Size : 65 mm	2.00	Nos.
21.02	Size : 50 mm	13.00	Nos.
21.03	Size : 40 mm	3.00	Nos.
22.00	Pressure Gauges Installation of pressure gauges complete with siphon and nipple welding as required as per site conditions. Supply of sockets to be considered.	62.00	Nos.
23.00	Temperature Gauges Installation of temperature gauges complete with all accessories such as thermowell and compression fitting as per site conditions. Supply of nipples and its welding etc. to be included as per the site requirements.	12.00	Nos.
24.00	Automatic Purge & Drain Valves Installation of 15mm valve for air venting and drain purposes. Necessary supply and welding of nipples to be considered as required in the site conditions.	11.00	Nos.
25.00	Supply and Installation of medium class G.I. condensate drain pipes duly insulated with 9 mm thick nitrile rubber on wall/ Floor/ Ceiling of following size along with necessary clamps, fittings such as bends,tees etc. adequately supported as per specifications and as required.		
25.01	50 mm Ø	20.00	Mtrs.
25.02	40 mm Ø	0.00	Mtrs.
25.03	25 mm Ø	146.25	Mtrs.
26.00	Installation of Y - STRAINER of Ductile CI Body flanged ends with stainless steel strainer for chilled / hot water circulation including insulation as specified.		
26.01	65 dia	1.00	Nos.
26.02	50 dia	1.00	Nos.



27.00	Insulation for Chilled Water Piping Laying/ fixing of fire retardant quality expanded polystyrene moulded pipe section of density 20 kg/cu.m after a thick coat of cold setting adhesive (CPRX compound) wrapping with 500g polythene and finally applying 0.63mm aluminium sheet cladding complete with type3 , grade 1 roofing feltstrip(as per IS:1322 as amended up to date) at joints repairing of damage to building etc. as per specifications and as required complete in all respect. The thickness of insulation shall meet the ECBC requirements.		
27.01	Size : 300 mm	29.00	Rmt
27.02	Size : 250 mm	18.00	Rmt
27.03	Size : 65 mm	78.10	Rmt
27.04	Size : 50 mm	20.20	Rmt
27.05	Size : 40 mm	11.80	Rmt
28.00	Insulation for Valves Supplying and fixing of insulation with Aluminium Cladding of the same specifications as that of piping for following valves, strainers, gauges in the chilled water plumbing and adequately supported as per specifications. Butterfly Valve		
28.01	Size : 65 mm	34.00	Nos.
28.02	Size : 50 mm	26.00	Nos.
28.03	Size : 40 mm	6.00	Nos.
29.00	Insulation for Valves Supplying and fixing of insulation with Aluminium Cladding of the same specifications as that of piping for following valves, strainers, gauges in the chilled water plumbing and adequately supported as per specifications. Y-strainer		
29.01	Size : 65 mm	17.00	Nos.
29.02	Size : 50 mm	13.00	Nos.
29.03	Size : 40 mm	3.00	Nos.



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30.00	Insulation for Valves Supplying and fixing of insulation with Aluminium Cladding of the same specifications as that of piping for following valves, strainers, gauges in the chilled water plumbing and adequately supported as per specifications. AHU Control (2-way PIBCV valve)		
30.01	Size : 65 mm	17.00	Nos.
30.02	Size : 50 mm	13.00	Nos.
30.03	Size : 40 mm	3.00	Nos.
40.00	Aluminium cladding: Supply and fixing 500g polythene with proper netting wire and 0.63mm aluminium sheet cladding complete etc. as per specifications and as required complete in all respect to the installed pipeline on which expanded polystyrene has already been installed.	130.00	Sqm
41.00	Supply and laying of cabling for all PICV valves and installation of actuator	33.00	Sets
42.00	Termination of power cabling for all the AHUs on both sides / single side as per the site requirement	33.00	Nos.
43.00	Termination of control cable for limit switch & marine light for AHUs at both ends	33.00	Nos.
44.00	Supply, laying and termination of flexbile wire in GI flexible conduit and 6A plug for VAV box from nearby power socket	267.00	Sets



Make of Material

Make of Material:

Sr. No.	Material / Item	Brand & Manufacturer/ Supplier – 1	Brand & Manufacturer/ Supplier – 2	Brand & Manufacturer/ Supplier – 3	Brand & Manufacturer/ Supplier – 4
1	G.I. Sheets	SAIL	TATA	JINDAL	
2	GSS Factory Fabricated Ducts/ Duct Flanges	ROLASTAR	ZECO	DUCTOFAB	ECODUCT
3	Spiral Round/Oval ducts	SPIRO	DUSTECH	7 STAR	
4	Duct Support	HILTI	KANWAL		
5	Al. Sheets	HINDALCO	BALCO		
6	Grills/ Diffusers/Fire Dampers/Louvers/Volume Control Dampers/ Back Draft Dampers	AIR MASTER	TITUS	PRECISE	
7	‘TF’ Quality expanded polystyrene	BEARDSELL	STYRENE	TOSHIBA	
8	Glass Wool insulation	UP TWIGA	OWENS CORNING	KIMMCO	
9	Closed Cell Nitrile rubber insulation	ARMACELL	K- FLEX	VIDOFLEX	A-FLEX