BABA FARID UNIVERSITY OF HEALTH SCIENCES
Sadiq Road, Faridkot-151203 (Pb.) INDIA Phone: 01639-256232, 256236, Fax: 01639-256234
Website: www.bfuhs.ac.in

Streo (B&R) No. 28
Name of Contractor : _____

Name of Work : Supply installing, Testing & Commissioning of HVAC Services for Modular Operation Theaters Floor of Super Speciality Block in GGS Medical College & Hospital, Faridkot.

Estimated cost : **Rs 99,59,515/-**

(Form F-1)

PERCENTAGE RATE E-TENDER AND CONTRACT FOR WORKS

This agreement made this _____ day of _____ between _____ _____hereinafter called the "contractor") of the one part and [Vice Chancellor of Baba Farid University of Health Sciences, Faridkot through **The Registrar Baba Farid University of Health Sciences, Faridkot**) of the other part**:** Whereas the contractor has offered to execute the work **Supply installing, Testing & Commissioning of HVAC Services for Modular Operation Theaters Floor of Super Speciality Block in GGS Medical College & Hospital, Faridkot Approx. Cost Rs. 99,59,515.00 Earnest Money Rs. 1,99,200/- Time Limit 6 Months** and the University has accepted his tendered offer for the execution of above mentioned work.

NOW THIS AGREEMENT WITNESS AS FOLLOWS:

- In this agreement, words and expression shall have the same meanings as are respectively assigned to them as per the general conditions of contract hereinafter referred to:
- The following documents shall be deemed to form and be construed as part of this Agreement :
  - i) The "Notice inviting E-Tender"& "Instructions to tenderers" as at Annexure 'A' to this agreement.
  - ii) 'Percentage Rate/Item rate tender for works' as at annexure 'B' to this agreement.
  - iii) 'Conditions of contract' as at annexure 'C' to this agreement.
- The work will be executed strictly according to specifications & drawings relating to the work as indicated in the Notice Inviting e-Tender'. The schedule of items of work to be carried out will be as per approved 'Notice Inviting Tender'.
- All correspondence and modifications of e-tendered offer and acceptance letter will form part of this agreement.
- In considerations of the payments to be made by the University to the contractor in respect of completed work or item of work, the contractor hereby covenants with the University to execute the work in conformity in all respects with the provisions of this Agreement.
- The University hereby covenants to pay the contractor, in consideration of execution of work, the price in the manner as specified in this Agreement.

In witness there of the parties here to set their respective hands and seals on the day and year first above written.

In the presence of — Signature of Contractor

Name and Address — Address _____

1._____ — _____

2._____ — _____

Signed sealed &delivered by_____ in the capacity of _____

Name and Address — Registrar

1._____ — BFUHS, Faridkot

2._____ — _____

_____ — For & on behalf of

Vice Chancellor, BFUHS, Faridkot

ANNEXURE 'A'

BABA FARID UNIVERSITY OF HEALTH SCIENCES, FARIDKOT

Notice Inviting Tender and Instructions to Tenderers

1. Online Tenders in the Prescribed form P.W.D No F-1, are hereby invited on behalf of THE Vice Chancellor, BFUHS, Faridkot for **Supply installing, Testing & Commissioning of HVAC Services for Modular Operation Theaters Floor of Super Speciality Block in GGS Medical College & Hospital, Faridkot Approx. Cost ; Rs. 99,59,515.00 , Earnest Money Rs. 1,99,200/, Time Limit 6 Months**

2. The agency can purchase tender online on https//etender.punjabgovt.gov.in from 28-05-2021 at 9.00 am and Last date time for on-line submission of bids on **18-06-2021** upto 05.00 PM and date & time of opening of Technical bids on **21-06-2021** at 11.00 am. The opening date of financial bids of the technical qualified bidder will be informed on the university website. P**ayment through online mode only @ Rs 3000/+GST 18% (3540/-) (Rs. three thousand five hundred forty Only) each tender form (non refundable,)**

3. The time allowed for completion of the work will be **6 Months** after the date of issuance of acceptance Letter to the contractor.

4. The Earnest money amounting to **Rs. 1,99,200/-** deposit must be submitted in the shape of a on-line payment**.** The bidder who will not submit the earnest money upto the last date and time fixed for the submission of tender will be considered as In-valid and his/ her bid will be rejected without any prior notice.

5. The contractor whose tender is accepted shall be required to furnish security at the rate of 5% (five percent) of the cost of the work, by deductions from the running bills (three percent of the total cost to cover liability of defects and short comings and two percent of total cost for the winding up the contract satisfactory) The earnest money if realized from the bank will be treated as part of the security deposit.

6. The offer shall remain open for Acceptance for a period of ninety days from the date of opening of the Tender. The earnest money shall be forfeited if the tenderer withdraws or modifies his offer within the validity period or fails to sign the (Formal contract) agreement after acceptance of his offer or fails to commence the work or within ten days of issue of acceptance letter. After the forfeiture of earnest money the contract shall be immediately nullified.

7. On acceptance of the tender, the contractor shall be either himself remains available at site of work or arrange the availability of an accredited representative, fully authorized in writing at the site of work to receive instructions from the Engineer-in-Charge or his representative and to ensure prompt compliance thereof.

8 . The undersigned does not bind himself to accept the lowest rate or any tender and receive instructions accepting the whole or part of the tender and tenderer shall bound to perform the same at the quoted rates.

9. Sale tax or any other tax on the material or the turnover shall be payable by the contractor and the University will not entertain any claim in this respect.

10. Before filling his tender the contractor shall visit the site and satisfy himself as to the conditions prevalent there especially regarding accessibility to the site, nature and extent of the ground working conditions stacking of materials, installation of tools plants etc accommodation and movement of labour, supply of water and power for satisfactory completion of the work contract. No claim whatsoever on such accounts shall be entertained by the University in any circumstances.

11. The contractor shall comply with the provisions of the apprentice Act 1961 minimum wages Act 1948 Workman's compensation Act 1923 contract labour (Regulation and abolition1970). Payment of wages Act 1936. Employers liability act 1938 maternity Benefits Act 1961 and the industrial disputes 1947 as applicable and the rules and regulations issued there under form time Failure to do so shall amount to breach of the contract and the Engineer in Charge may his discretion to terminate the contract. The contractor shall also be liable for any pecuniary liability arising on account of violation by him of the provisions of the Act.

12. The tenderer shall bear all costs associated with the preparation and submission of his tender and the University shall in no case be liable for these costs.

13. Each tenderer shall submit only one tender either by himself or as in a joint venture. A tenderer who submits or participates in more than one tender will be disqualified.

14. Unless otherwise stated the contact shall be for the whole work as described in schedule of item of works and the drawings, including the contractor shall be bound to complete the whole as described in the schedule of item of works and the drawings, including the additional items if any, as per drawings and instructions. The certificate of completion as issued by the Engineer-in-Charge shall be the conclusive proof of completion of work.

15. The following documents shall accompany the tenders. **(Scanned copies of all bid documents uploaded on the e-procurement portal)**

(i) Partnership deed or Registration Certificate of the firm company as the case may be.

(ii) Tenderer should be approved contractors of Punjab PWD (B&R) or specialized agency dealing with providing "HVAC work".
Satisfactorily completed in the last five years and as a prime contractor, where the Contract involved execution of all main items of work described in the bid document, provided further that all other qualification criteria are satisfied)

one similar work of value not less than 80% of the estimated cost

or

two similar works each of value not less than 50% of the estimated cost of work

(iii) Power of Attorney as required under rule of joint venture.

(iv) 3 year ITR return with profit loss statement with computation and certified by FCA/CA.

(v) EMD, Pan Number, GST Certificate, Affidavit/undertaking

16. Incomplete tender or tenders not fulfilling any of conditions specified above are liable to be rejected without assigning any reason.

ANNEXURE-B

PERCENTAGE RATE RATE TENDER

I/We hereby offer to execute for the Vice Chancellor, BFUHS, Faridkot for the work, specified in the underwritten Memorandum within the time specified in such memorandum at F-1 percent below/ above the rate entered in the Schedule referred to in Para five of the 'Notice Inviting Tender' and annexed here to and in accordance, in all respects, with the specifications, designs drawings, and instructions in writing referred to in Para five and in clause 13 of the " Conditions of Contact" and with such material as are provided for and in all respects in accordance with such conditions so for as applicable.

Memorandum

a)	General Description	**Supply installing, Testing & Commissioning of HVAC Services for Modular Operation Theaters Floor of Super Speciality Block in GGS Medical College & Hospital, Faridkot.**
b)	Estimated Cost	*Rs. **99,59,515**/-*
c)	Earnest money	*Rs. **1,99,200**/-*
d)	*Performance Guaranty*	*5% Performance Guaranty in shape of bank guarantee*
e)	Percentage if any to be deducted from bills	*Security @ 5% will be deducted from all the running bills.*
f)	Time allowed for completion from the date of issue of Acceptance letter to the Contractor	*6 months (six months)*

Should this offer be accepted in whole or, in part, I/We hereby agree to abide by all fulfill all the terms and provisions of the said conditions of contract annexed hereto and all the terms and provisions contained in the detailed "Notice Inviting Tender " and /or in default there to forfeit and pay to Baba Farid University of Health sciences, Faridkot, in office the sum of money mentioned in the said conditions.

A sum of Rs. **1,99,200** /- the earnest money deposit must be submitted shape of online payment. I/We agree that the full value of Earnest money will be forfeited without prejudice to any other right or remedies to the University in office should I/we:

- Withdraw or modify my/our offer during the period of validity or
- fail to sign the contract agreement after acceptance of the after or
- fail to commence the work within ten days of the issue of acceptance of my/our offer, otherwise the said earnest money shall be retained by him towards security deposit against Clause (d) of above memorandum.

Date the_____ day of_____20_ Signature of the contractor

Witness……..

Address_____ Address_____

_____ _____

_____ _____

Occupation……

Telephone…….

The above offer is hereby accepted by me on behalf of the Governor of Punjab

Date the_____ day of_____20_ Signature of the contractor

ANNEXURE-C

CONDITIONS OF CONTRACT

Definitions:

- The “contract” means the document forming the tendered offer and acceptance thereof constituting binding contract between the Registrar, BFUHS, Faridkot and the contractor. The tender documents including the conditions, the drawings design, the specifications supplemented with instructions issued from time to time by the Engineer-in-charge and shall be binding on the parties in the stated order of precedence. All these documents taken together with the tendered offer and its acceptance shall be deemed to form the contract and shall be complementary to one another.
- The "Common Schedule of Rates" shall mean a printed document containing rates of different items of works pertaining to different branches of P.W.D. i.e. Irrigation, B&R (Buildings & Roads Branch) and the Public health branch and approved by the Committee of Direction of chief Engineers of these P.W.D. branches and the Punjab Govt.
- The "Completed works" shall mean, work completed in all respects as per laid down specifications, drawings, approved N.I.T and to the entire satisfaction of the Engineer-in-charge.
- The “Contractor” shall mean the individual or firm or company whether incorporated or not, undertaking the work and shall include the legal personal representative, or the persons comprising such firm or company or the successors of such firm or company as well as the assignees of such individual or firm or company whose tendered offer has been accepted.
- The '"completion date" is the date when the Engineer-in-charge certifies that the work can be put to use, alter receipt of an intimation from the contractor regarding its completion.
- The "Communication" between parties is the written and signed letters notices, reminders, memoranda and instructions recorded in the instructions book or book kept at site.
- The “Days & months” are calendar days and calendar months.
- The "Engineer-in-charge" means the Engineer Deputed by University, Who shall supervise the work and administer the contract with the assistance of his authorized subordinates.
- The “Department” means Baba Farid University of Health Sciences, Faridkot.
- The "Site" shall mean the land and or other places on in to or through which the work is to be executed under the contract or any adjacent land, path or street which may be allowed to be used for the purpose of carrying out the contract.
- The "Schedule of material" shall mean the list of materials which are to be used on the work will be the liability of the contractor as per Annexure-E
- The "Start Date" is the date when contract came into existence upon the issue of "Letter of Acceptance" by the Registrar, BFUHS/Engineer-in-charge.
- The “Schedule of Items of Work" shall mean the Items of Work to be executed at site of work to be executed at site of work pertaining to the work allotted to the contractor.
- The "Works or Work" shall unless the context otherwise requires, mean what the contractor is required to execute and hand over to the University Authorities.

Note:- In interpreting these ""Conditions of Contract" singular also means plural, male means female and vice versa.

CLAUSES OF CONTRACT

Clause - I PERFORMANCE GURANTEE & SECURITY

The contractor, whose tender is to be accepted shall furnish:-

- A Bank Guarantee of Schedule Bank in the prescribed form (Specimen form attached) in favour of the Registrar, BFUHS, Faridkot for an amount of 5% of the amount of contract valid up to six months beyond the date of completion (Time Limit) to cover the amount of liquidated damages and or the compensation of the breach of contract. No payment for work done of any kind shall be released till such Guarantee is furnished. The performance guarantee will be released immediately on completion of work and accepted by the Engineer in Charge as satisfied O.K. Work.
- A cash security of 5% of the amount of the contract inclusive of the Earnest money initially deposited with the bid to cover the cost that may be involved in removal of defects, imperfections, or taking remedial measures in the work, which has been executed to be progressively deducted @ 5% in all payments after affording credit for the initial Earnest money 60% of the security will be refunded after 06 months of the completion of work as certified by the Engineer-in-Charge with respect to satisfactory removal of all defects, imperfections, short comings and taking remedial measures, that may be necessary and after recording of final measurements of work done, for which the certificate of the Engineer-in-charge would be conclusive.
- The remaining amount of security shall be released after the expiry of Twelve months or one rainy season whichever is later from the date of completion of work and after removal of all defects, imperfections and shortcoming that may be noticed during this period and after satisfactory winding up of the contract as provided in clause-6A the entire satisfaction of the Engineer-in-charge.

- Where the contractor requested for first & Final bill (without any running Bill) on completion of work contractor need not furnish performance guarantee as the contract has already been performed. Clause-2.

Clause - 2 COMPENSATION FOR DELAY

The time allowed for carrying out the work shall be the essence of the contract and shall be strictly observed. It shall be reckoned from the date on which the order to commence the work is given to the contractor who shall ensure all due diligence to achieve progress of work not less than indicated below :

- On lapse of 25% contractual Time 20%
- On lapse of 50% contractual Time 50%
- On lapse of 75% contractual Time 80%
- On lapse of full contractual Time 100%

In case of default, the contractor shall not withstanding issuance of prior notice in this regard pay prospectively as liquidated damages an, amount of up to 1% of the amount of contract or such lesser amount that the Engineer-in-charge may levy, for every week that the work remains uncommented after 10 days of the issue of acceptance letter or the minimum progress of work stated above is not achieved or the work remains unfinished after the completion date. In case of continued default or shortfall in progress, The Engineer-in-charge may go on enhancing the levy of liquidated damages prospectively each time limited to 1% of the total estimated amount of work per week of further default subject to maximum unit of 5% of the amount of the contract.

Clause – 2A DISPUTE SETTELMENT

If over the works, any dispute arises between the two parties, relating to any aspects of this agreement, the parties shall first attempt to settle the dispute through mutual and amicable consultation.
In the event of agreement not being reached, the matter will be referred for arbitration by sole Arbitration not below the level of retired/ Serving Superintending Engineer of PWD (B&R) Punjab, to be appointed by the **Registrar, BFUHS, Faridkot**. The Arbitration will be conducted in accordance with the Arbitration and Conciliation Act 1996. The decision of the Arbitrator shall be final and binding on both the parties

Clause - 3 BREACH OF CONTRACT LEAVY OF DAMAGES

The Engineer-in-charge may without prejudice to other right and remedies, under the provisions of the contract or otherwise after issuing a notice in writing and getting the final bill prepared absolutely determine the contract after levying compensation for damages of five percent of the amount of the contract, if the contractor, commits breach of contract under any clause of the contractor in any of the following cases:-

- If the contractor suspends the execution of the work and inspire of having been given a notice in writing by the Engineer-in-charge fails to resume the work within ten days of the issue of the said notice.
- If the contractor, having been given a notice in writing by the Engineer-in-charge, fails to rectify, reconstruct or replace any; defective work or continues the execution or work in an inefficient, improper, un-workman like manner or not in accordance with sound Engineering practices or without complying with the directions and requirements within a period of 10 days of the issue of said notice.
- If the contractor being a company shall pass a resolution or a court shall make an order to the effect that the company shall be wound up or if a receiver or a manager on behalf of the credit or shall be appointed or if circumstances shall arise which entitle the court of creditor to appoint a receiver or manager or to make a winding up order.
- If the contractor being a company of acts or defaults mentioned in Clause 21 & 24 thereof.

Provided further, that in case action under clause 2 as aforesaid levy of liquidated damages is also taken, total amount of liquidated damages and compensation for breach of contract under both the clauses shall be limited to 7.5 percent *of* the amount of the contract or the amount available with the Deptt. Including Bank Guarantee whichever is less. The requisite amount for which the contractor may become liable shall be released by encashing the Bank Guarantee furnished by the contractor, as specified in clause I above and/or from other amount due to the contractor in respect of this work or any other work, under taken for the University Authorities.

- After the termination of the contract under this clause, the department shall be at liberty to
- Get the balance work executed through some other contractual agency or through departmental means or to
- Abandon the balance work altogether or to
- Modify the design and scope of the work in any manner. The contractor shall have no claim against the department for treating the work in any manner deemed fit.

Clause-4 LIABILITY OF CONTACTOR AND POWERS TO TAKE OVER AND DISPOSE OFF CONTRACTOR PLANT

In any case, in which any of the powers conferred upon the Engineer-in-charge by clause-3 hereof, shall have become exercisable and shall not be exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall, not withstanding, be exercisable in the event of any future case or default on the part of the contractor, for Which by any clause or clauses, hereof, he is declared liable to pay compensation and the liability of the contractor for past and future compensation remain unaffected.

In the event of the Engineer-in-charge putting in force all or any of the powers vested in him under the proceedings clauses, he may, if he so desires, after giving a notice in writing to the contractor take possession of any or all took materials and stores in or upon the works or the site thereof belonging or produced by him or intended to be used for execution of the work in any part hereof paying or allowing for the same in account at the contract rates or in case of these not being applicable at current market rates certified by the Engineer-in-charge whose certificate there of shall be final. Otherwise, the Engineer-in-charge may, be giving a notice in writing to the contractor or his agent at the site of work, require him to remove such tools, plants materials or stores from the premises within the time specified in notice. In the event of the contractor, failing to comply with any such requisition. The Engineer-in-charge may get them removed at the contractor's expense or sell them by auction or private sale on account of the contractor and at his risk in all respects. The certificate of the Engineer-in-charge as to the expenses of any such removal and the amount of proceeds and expenses of any such sale shall be final & conclusive against the contractor.

Clause-5 EXTENSION OF TIME

If the contractor shall desire an extension of the time for completion of the work on the ground of his having been unavoidably hindered in its execution or any other ground, he shall apply in writing to the Engineer-in-charge (with corresponding time extension in Performance Bank Guarantee) within thirty days of the date of hindrance (but before the expiry of the time limit) on account of which he desires such extension as afore said and Engineer-in-charge shall, if in his opinion be necessary or proper, No application for extension of time received late or any officer other than the Registrar/Engineer-in-charge shall be considered valid if the contractor fails to apply for extension as aforesaid and the work is not completed within the time limit, the contract shall be determined absolutely after action under clause 2 and 3 above.

Clause-6 COMPLETION CERTIFICATE

Within ten days of the completion of work, the contractor shall give notice of such completion to the Engineer-in-charge and within 30 days of the receipt of such notice, The Engineer-in-charge shall inspect the work and if there is no defect in the work, shall furnish the contractor with a certificate of completion, otherwise a provisional certificate of completion indicating the defects (a) to be rectified by the contractor and or (b) for which payment will be made at reduced rates shall be issued. However, no certificate provisional or otherwise shall be issued, nor shall the work be considered to be completed until the contractor shall have removed, from the premises on which the work shall be executed, all scaffolding, surplus material, rubbish and all huts and sanitary arrangements set up for his labour on the site and cleaned off the dirt from all wood work doors and windows, walls, floor or other parts or the building, in upon or about which the work is to be executed or of which he may have had possession for the purpose of execution thereof and not until the works shall have been measured by the Engineer-in-charge if the contractor shall fail to comply with the requirements of his clause to the removal of scaffolding, surplus material and rubbish, all huts and sanitary arrangements and cleaning off as aforesaid

before the date fixed for the completion of work, the Engineer-in-charge may at the expense of the contractor get so cleared such dirt as afores and the contractor shall forth with did pay the cost of all expense so incurred shall have no claim in respect of any such scaffolding or surplus materials as aforesaid except for any sum actually released by the sale proceed thereof.

Clause -6A WINDING UP OF THE CONTRACT

On completion of the work, the contractor shall hand over the same to the Engineer-in-charge or his authorized representative free from all defects, shortcomings or imperfections. He shall clear the site of Supply installing, Testing & Commissioning of HVAC Services for Modular Operation Theaters Floor of Super Speciality Block in GGS Medical College & Hospital, Faridkot all temporary works pits, godowns. offices, sanitary, scaffolding, debris, waste materials, and installations. He shall also furnish the following documents duly signed by him or his authorized representatives:-

- Completion drawings showing the work as finally constructed.
- Variation statement showing the altered items, if any, against those provided in the original drawings.
- Original site instructions book.
- Original registers for various quality control tests as specified,
- Cement consumption register.

Clause -7 PAYMENTS ON INTERMEDIATE CERTIFICATES REGARDED AS ADVANCES

No payment shall be made for a work estimated to cost less than 5% of Tender cost (Approx.), till after the whole of the work shall have been completed and a certificate of completion given. But in the case of works estimated to cost more than 5%, the contractor shall on submitting a bill there of be entitled to receive a monthly payment proportionate to the part there of the time limit that executed to the satisfaction or the Engineer-in-charge whose certificate of the sum payable Shall of final and conclusive against the contractor. But all such intermediate payments shall be regarded as payments by way of advance against the final payment only and not as payments for work actually done and completed, and shall not be preclude the requiring of bad. un-sound, imperfect or unskilled work to be removed and taken away and reconstructed or re-erected or by considered as an admission of the performance of contract or any part thereof in any respect of the accruing of any claim, nor shall it conclude, determine or effect in any way the power of the Engineer-in-charge under these conditions or any of them as so the final settlement and adjustment of the accounts otherwise or in any other way, very or affect of the contract. The final bills shall be submits by the contractor within one month of the date fixed for completion of the work, otherwise the certificate of the Engineer-in-charge as regards measurements and the total amount payable for the work shall be final and binding.

Clause – 8 BILLS TO BE SUBMITTED MONTHLY

A bill shall be submitted by the contractor each month on or before the tenth day or any other date fixed by the Engineer-in-charge accompanied by the following documents:-

- Measurements and quantities of items of work done since last bill.
- Up to date statement of materials received, from the stores showing the recoveries made up to last bill in question, both in terms of quantity and value.
- Copies of quality control tests on specified form at covering the work done since last bill.
- Copies of instructions recorded in the site instruction book containing the instruction and compliance made thereof, covering the work done since last bill.

A bill which is not accompanied with the above documents shall not be entertained.

The Engineer-in-charge shall get the bill verified if possible within 30 days from its presentation and the contractor shall be required to sign the corrections made, if any in token of its as acceptance, before releasing or adjusting the payable amount.

If the contractor does not submit the bill within time limit or delays its submission or acceptance of corrections after verifications the entire responsibility for non-payment or delay in payment shall rest with him.

Clause-9 BILLS TO BE ON PRINTED FORMS/EXTRA ITEMS

The contractor shall submit all bills on the printed forms can be had on application from the office of the engineer-in-charge and the rates in the bills shall always be entered at the rates specified in the tender or in the case of any extra work ordered in pursuance of these conditions and not mentioned or provided for in the lender, at the rates hereinafter provided for such work.

The contractor shall deliver in the office of Engineer-in-charge on or before the 10th day of every month during the continuance of the work covered by this contract, a return showing details of any work to be charged of extra with value based upon the rates and prices mentioned in the contract shall include in such return particulars of all demands of whatever kind and who so ever arising, which at the date thereof he has in respect of or in any manner arising out of execution of work. The contractor shall be deemed to have waived off all claims not included in such return and will have no right to enforce any such claims not so included, whatsoever be the circumstances.

Clause-10 STORES SUPPLIED BY GOVERNMENT (DELETED)

Clause-10A SECURED ADVANCE

The contractor, on signing an indenture in the form to be specified by the Engineer-in-charge Shall be entitled to be paid during the execution of work, upto 75% of the estimated value of any materials, which are in the opinion of the Engineer-in-charge non-perishable under para 2.105 of PWD code coupled in accordance with the requirements with rule 7.37 of D.F.R. (Financial Hand Book No.3) of the contract and which have been procured and adequately stored against damage but which have not been incorporated in the works at the time of making the advance.

Clause-11 WORK TO BE EXECUTED IN ACCORDANCE WITH SPECIFICATIONS DRAWINGS ORDER ETC.

The contractor shall execute the whole and every part of the work in the most substantial and workman like manner both as regards materials, and labour and otherwise in every respect in strict accordance with the Punjab PWD specifications latest Edition. The contractor shall also conform exactly fully and faithfully to the designs, drawings and instructions in writing relating to the work signed by the Engineer-in-charge and lodged in his office and to which the contractor shall be entitled to have access during the office hours or on the site of work. The contract shall be furnished free of have access during the office hours or on the site of work The contract shall be furnished free of charge one copy of all such drawings and such specification as are not included in the printed Punjab P.W.D specification. He shall, if he so requires, be entitled at his own expense to make or cause to make copies of the drawings designs, specifications and instructions as aforesaid for ensuring the requisite quality of construction, the material used in works shall be subject to quality control tests for materials and workman-ship test as laid down in Punjab PWD. Specifications as amended from time to time or the relevant standards laid down by the Bureau of Indian standards/Hand Book of quality control for construction of Roads and runway I.R.C latest edition or instructions issued under the orders of the **Registrar Baba Farid University of Health Sciences, Faridkot** & by the Engineer-in-charge. The contractor shall provide all help and assistance in proceeding with required tests.

The contractor shall set up a quality control field laboratory equipped at least with the test equipment indicated in to these "Conditions of Contract" Annexure-1 and employ trained staff to carry out periodical test as per directions and procedures laid down by the Quality control cell of the PWD (B&R). The records shall be maintained in the prescribed forms and copies thereof covering the work done each month shall be submitted with the bills.

Clause-11A REMOVAL OF EMPLOYES/WORK MEN

The Engineer-in-charge shall have full powers at all times to object to the employment of any workmen, foremen, or other employees on the work by contractor, and if the contractor shall receive notice in writing from the Engineer-in-charge requiring the removal of any such person from the work, the contractor shall comply with the orders forth with. No such workman foreman or other employees, after his removal from the works by order of the Engineer-in-charge shall be re-employed or reinstated on the work by the contractor at any time except with the previous approval in writing of the Engineer-in-charge for requiring the removal of any such workman, foreman or any other employee.

Clause-12 ALTERATION IN SPECIFICATION AND DESIGNS

The Engineer-in-charge shall have the power to make any alterations, omissions from additions to on substitutions for the original specifications, drawings, designs and instructions that may appear to be necessary or advisable during the progress of work, and the contractor shall be bound to carry out the work in accordance with any instructions which may be given to him in writing signed by the Engineer-in-charge. Such alternations/additions or substitutions shall not invalidate the contract and any altered, additional or substituted work shall be carried out by the contractor on the same conditions in all respects on which he agreed to do the main work and at the same rates as are specified in tender for the main work. The time of completion of the work shall be extended in the proportion that the altered additional or substituted work bear to the original contract work and the certificate of the Engineer-in-charge shall be conclusive as to such proportion. The rates for such additional altered or substituted work shall be determined in accordance with the following provisions in their respective order.

- If the rate of the additional, altered or substituted work are specified in the contract for the work the contractor is bound to carry out the additional, altered, or substituted work at the same rates as are specified in the contract for the work.
- If the rates for the additional, altered or substituted work are not specifically provided in the contract for the work, the rates will be derived from the rates for a similar class of work as are specified in the contract for the work.
- If the rates cannot be determined as provided in (i) and (ii) above, then such work shall be paid at the rates entered in common schedule of the rates minus/plus the percentage rate at which the bid has been accepted.
- If the rates for the altered, additional or substituted work cannot be determined in the manner specified in Clause (i) (ii) (iii) above, then the contractor shall within seven days of the date of receipt of the order to carry out the work in form the Engineer-in-Charge of the rate which he intends to charge for such class of work supported by analysis of the rate in support of rates/claimed. The Engineer-in-charge shall determine the rate or rates *on* the basis of prevalent market rates and pay the contractor accordingly.

However the Engineer-in-charge by notice in writing, will be at liberty to cancel the order given to the contract to carry out such class of work and arrange to carry out in such manner as he may consider advisable, provided always that if the contractor shall have commenced work or incurred any expenditure in regards thereto before the rate shall have been so determined, then in such case he shall be entitled to be paid in respect of the work carried out or expenditure incurred by him prior to the date of the determination to the rates of dispute, the decision of the superintending Engineer of the circle shall be final.

Clause-13 NO COMPENSATION FOR ALTERATION OR RESTRICTION IN WORKS

If at any time, after the commencement of the work the University Authority shall for any reason what-so-ever does not require the whole or part of as specified in the contract to be carried out, the Engineer-in-charge shall give notice in writing of the fact to the contractor, who shall have no claim to any payment or compensation what-so-ever on account of any profit or advantage which he might have derived from the execution of the work in full, but which he did not derive inconsequence of the full amount of the work having been made in the original specifications, drawings, designs and instructions, which shall involve any curtailment of the work originally contemplated.

Clause-14 ACTION AND COMPENSATION PAYABLE IN CASE OF BAD WORKS.

If it shall appeal to the Engineer-in-charge, or his subordinate in-charge of the work that any work has been executed with unsound, imperfect, unskillful workmanship or with materials of any inferior description or that any articles or material provided by the contractor for the execution of work are unsound or of a quality inferior to that contracted *for* or otherwise not in accordance with the contract, the contractor shall on demand in writing by the Engineer-in-charge specifying the work, materials or articles complained of, not withstanding that the same have been inadvertently passed, certified and paid for, forthwith rectify or as the case may be remove the materials or articles so specified and provide other proper and suitable materials or articles at his own proper charge & Cost. In the event of his failing to do so, within a period so specified by the Engineer-in-charge In his demand aforesaid the contractor shall be liable to pay compensation rate of one percent of the estimated amount for every week not exceeding ten weeks, while his failure to do so shall continue and in the case of such failure, the Engineer-In-Charge may rectify or remove and execute the work or remove and replace with others, the materials or articles complained of as the case may be at the risk and expenses in all respects of the contractor.

Clause-15 WORKS TO BE OPEN TO INSPECTIONS

All work under or in course of execution or executed in pursuance of the contract shall at all times be open to the inspection and supervision of the Engineer-in-charge and his senior subordinates and The contactor shall at all times during the usual working hours or at all other times at which reasonable notice of the intention of the Engineer-in-charge or his senior subordinates to visit the work shall have been given to the contractor, other himself be present to receive orders and instructions or have a responsible agent duly accredited in writing, present for that purpose. Orders given to a contractor's agent shall be considered to have the same force as if they had been given to the contactor himself.

Clause-16 NOTICE TO BE GIVEN BEFORE WORK IS COVERED UP

The contractor shall give not less than 10 days notice in writing to the Engineer-in-charge or his subordinate-in-charge of the work before covering up or otherwise placing beyond the reach of measurement, any work in order that the same may be measured and correct dimensions thereof may be taken before the same is so covered up or placed beyond the reach of measurement and shall not cover up or place beyond the reach of measurement any work without the consent in writing of the Engineer-in-charge or his subordinates in charge of the work if any work shall be covered up or placed beyond the reach or measurement without such notice having been given or consent obtained, the sum shall be uncovered at controllers expense or in default there of no payment or allowance shall be made for such work or of the material with which the same was executed.

Clause-17 LIABILITY FOR DAMAGE AND IMPERFECTION FOR ONE YEAR

If the contractor or his workmen shall break, deface, injure or destroy any part of a building in which he may be working or any building, road, fence, enclosure or green grass land, water pipes, cables, drains, Electric or Telephone posts or wires, trees or cultivated ground continuous to the premises on which the work or any part of it is being executed or if any damage shall happen to the work, while in progress from any cause what-so-ever or any defect, imperfection or other faults appear in the work within one year from the date of completion certificate issued by the Engineer-in-charge.

the contractor shall make good at his own expense or in default, the Engineer-in-Charge may cause the same to be made good by other workmen and deduct the expenses incurred both on labour and material (for which the certificate of the Engineer-in-Charge shall be final) from any sums that may be then due or at any time thereafter may become due to the contractor form his security deposit.

Clause-18 CONTRACTORS TO SUPPLY MATERIAL PLANT SCAFFOLODINGS

The contractor shall arrange and supply at his own cost all materials (except such specific materials as may be issued from the stores of the Engineer-in-charge) plant tools, appliances, implements, ladders, cordage tackle, scaffoldings, water and power supply and temporary work requisite or proper and effective execution of the work. Whether original, altered or substituted and whether included in the specification other documents forming part of the contract or referred to these conditions or not all which may be necessary for the purpose of satisfying or complying with the requirements of the Engineer-in-Charge as to any matter which under these conditions he is entitled to be satisfied or which he is entitled to require together with the carriage there of to and from the work. The contractor shall also supply free of charge the requisite number of persons with the means and material necessary for the purpose of setting out works on counting weighing and assistance in the measurements or examination at any time or from time to time of the work or materials. Failing his so doing the same may be provided by the Engineer-in Charge at the expense of the contractor and this expense may be deducted from any amount due to the contractor under the contract or from his security deposit. The contractor shall also provide necessary fencing and lights required to or other proceeding at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and cost which may be awarded in any such suit, action or proceedings to any such person or which may with the consent of the contractor be paid to compromise any claim by any such person.

Clause-19 LABOUR LAWS

The contractor shall comply with all the provisions of minimum wages Act 1948. Workman's Compensation Act 1923. contract labour (Regulation and abolition) Act 1970 and the rules framed there under, the payment of wages Act 1936, Employees liability Act 1938. Maternity Benefits Act 1961. The apprentices Act 1961 and rules framed there under and the Industrial Disputes 1947. He shall also make satisfactory arrangements for labour huts, protection of health and sanitary arrangements for the workmen employed on the work.

In every case in which by virtue of provisions of the Contract Labour (Regulation and Abolition) Act 1970 and of the contract labour rules. Government is obliged to pay any amount of wages to a workman employed by the Contractor in execution *of* the works or to incure any expenditure in providing welfare and health amenities required to be provided under the above said act and the rules under PWD Contractor's labour Regulations or under the framed by the Government from, time to time, for the protection of health and sanitary arrangement for workers employed by The Approved Contractors. The Government will recover

from the contractor the amount of wages so paid or the expenditure so incurred under without prejudice to the rights of the Government under section 20 sub section (2) and section 21 sub section (4) of the contract labour (Regulation and abolition) Act 1970. Government shall be at liberty to recover such amount or any part thereof the deducting it from the security deposit or from any sum due by Government to the contractor whether under this contract or otherwise. Government shall not be bound to contest any claim made against it under section 20 sub section (I) and section 21 sub section (4) of the said Act expect on the written request of the Contractor and upon his giving to the Government full security for all costs of which the Government might become liable in contesting such claim.

Clause-20 CONTRACTOR LIABLE FOR PAYMENT OF COMPENSATION TO INJURED WORKMEN OR IN CASE OF DEATH.

In every case in which by virtue of the provision of the section 12, sub section (I) of the workman's compensation Act 1922, the Government is obliged to pay compensation to a workman employed by the contractor in execution of work, the University authority will recover from the contractor the amount of compensation so paid and without prejudice to the rights of Government under section 12, sub Section (ii) of the said Act. The University authority shall be at liberty to recover such amount of any part thereof by deducting it from the security deposit or from any sums due by the University to the contractor whether under section 12 Sub Section (1) of the said Act except on the written request of the contractor and upon his giving to Government full security for the costs for which the University might become liable in consequence of contesting such claim.

Clause-2I WORK NOT TO BE SUB LET

The contractor shall not be assigned or sub let without the written approval of the Engineer-in-charge. Employment of labour *on* piece rate basis shall, not however, be deemed sub-letting. If the contractor shall assign or sublet his contract or attempts to do so without the approval as aforesaid or become insolvent or commence any or solvency proceedings or make am composition with his creditors or attempt to do so, if any bribe, gratuity, gift, loan, perquisite, reward or advantage, pecuniary or otherwise, shall either directly or indirectly be given, promised or offered the contractor or any of his servants or agents to any public such officer or person shall become in any way directly or indirectly interested in the contract, the Engineer-in-charge may absolutely there-upon terminate the contract as specified in clause 3 and in the event the said course being adopted, the consequences specified in the said clause 3 shall ensure.

Clause-22 COMPENSATION CONSIDERED REASONABLE WITHOUT PREFERENCE TO ACTUAL LOSS.

All sum payable by way *of* compensation under any of these clauses shall be considered as reasonable competition to be applied to the use of Government without reference to the actual loss or damage sustained and whether or not any damage shall have been sustained,

Clause-22A DEDUCTIONS OF GOVT. DUES ON ANY ACCOUNT WHATSOEVER TO BE PERMISSIBLE.

Any excess payment made to the contractor inadvertently or otherwise under this contract or on any account whatsoever, and any other sum found to be due to the Government, by the contractor in respect of this contract or any other contract work on order or on any account what-so-ever may be deducted from any sum payable by the Government to the contractor either in respect of this contract or any other work order or contract or on any account by any other department of the Government.

Clause-23 CHANGE IN CONSTITUTION

Where the contractor is a partnership firm, the proir approval in writing of Engineer-in-charge shall be obtained before any change is made in the constitution of the firm where the contractor is an individual or a Hindu Undivided Family business concern, such approval as aforesaid shall likewise be obtained before the contractor enters into any partnership agreement, where under the partnership firm would have the right to carry out the work hereby undertaken by the contractor. If prior approval as aforesaid is not obtained, the contractor shall be deemed to have been assigned in contravention of clause 21 hereof and the same action may be taken and the same consequences shall ensure as provided in the said clause-21

Clause-24 DIRECTIONS OF THE ENGINEER-IN-CHARGE

All work to be executed under the contractor shall be executed under the direction and subject to the approval in all respects of Engineer-in-charge authorized by the University, who shall be entitled to direct at what point or points and in what manner they are to be commenced and from time to time carried out.

Clause-25 DISPUTES AND ARBITRATION

- If any dispute or difference of any kind what-so-ever, shall arise between the Government its authorized representative and the contractor in connection with or arising out of this contract or the execution of work there under.
- Whether before its commencement or during the progress of work or after the termination abandonment or breach of the contract, it shall, in the first instance, be referred for settlement to the Engineer-in-charge of the work and he shall with in a period of Sixty days after being requested in writing by the contractor to do so convey his decision to the contractor. Such decision in respect of every matter so referred shall subject to arbitration as hereinafter provided, be final and binding upon the contractor. In case the work is already in progress, the contractor shall proceed with the execution of the work on receipt of the decision by the Engineer-in-charge as aforesaid with all due diligence whether any of the parties requires arbitration as hereinafter provided or not.
- If the Engineer-in-charge has conveyed his decision to the contractor and no claim for arbitration has been filed by the contractor within a period of sixty days from the receipt of the letter of communicating the decision, the said decision shall be final and binding upon the contractor and will not be subject matter of arbitration at all.
- If the Engineer-in-charge fails to convey his decision within a period of sixty days after being requested as aforesaid the contractor may within further sixty days of the expiry of the final 60days from the date on which the said request was made by the contractor refer the dispute for arbitration as hereinafter provided.

- All disputes or differences in respect of which the decision is not final and conclusive shall at the request of either party made in a communication sent through registered A.D post be referred to the sole arbitration of Retired/Serving Superintending Engineer, PWD (B&R) Branch to act as an arbitrator on receipt of a request from either party.
- Registrar, BFUHS, Faridkot shall have the authority to change the arbitrator on an application by the either contractor or the Engineer-in-charge requesting change of arbitrator giving reasons thereof either before the start of the arbitration proceedings or during the cause of such proceedings. The arbitration proceedings would stand suspended as soon as an application for change of Arbitrator filed before the Registrar and a notice thereof is given by the applicant to the Arbitrator. The Registrar after hearing both the parties may pass a speaking order rejecting the application or accepting to change the Arbitrator simultaneously, appointing a technical officer not below the rank of Superintending Engineer as under the Contract. The New Arbitrator so

appointed may enter upon the reference a fresh or he may continue the hearings from the point where these were suspended before the previous Arbitrator.

- The reference to the Arbitrator shall be made by the claimant party within one hundred twenty days from the date of dispute of claim arising during the execution of work. If the claim pertains to rates or recoveries introduced in the final bill the reference to the Arbitrator shall be made within six calendar months from the date of payment of the final bill to the contractor or from the date of registered notice is sent to the contractor to the effect that his final bill is ready by the Engineer-in-charge (whose decision in this respect shall be final and binding) whichever is earlier.
- It shall be an essential term of this contract that in order to avoid furious claims, the party invoking arbitration shall specify the disputes on facts and Calculations stating the amount claimed under each claim and shall furnish a "deposit-at-call" for ten percent of the amount claimed, on a scheduled bank in the name of the Arbitrator, by his official designation who shall keep the amount in deposit till the announcement of the award. In the event of an award in favour of the claimant, the deposit shall be refunded to him in proportion to the amount awarded with respect to the amount claimed and the balance, if any shall be foresaid and paid to the other party,
- The provisions of the India Arbitration Act 1996 or any other statutory enactment there under or modification thereof and for time being in force shall apply to the arbitration proceedings under this clause.
- The Arbitrator shall award separately giving his award against each claim and dispute and counter claim raised by either party giving reasons for his award. Any lump-sum award enforceable shall not be legally enforceable.
- The venue of arbitration shall be such a place or places as may be fixed by the Arbitrator in his sole discretion. The work under the contract shall continue during the arbitration proceedings.
- The stamp fee due on the award shall be payable by the party as desired by the Arbitrator and in the event of such party's default, the stamp fee shall be recoverable from any other sum due to such party under this or any other contract.
- Neither party shall be entitled to bring a claim for arbitration, if it is not filed as per the time period, already specified or within six months of the following :-
  - Of the date of completion of the work as certified by the Engineer-in-charge.
  - Of the date of abandonment of the work or breach of contract under any of its clauses, or
  - Of its non-commencement or non resumption of work within 10 days of a written notice for commencement or resumption as applicable or
  - Of the cancellation, termination or withdrawal of the work from the contractor in whole or in part and/or revision or for enclosure of the contract or
  - Of receiving an intimation from Engineer-in-charge that the final payment due or recovery from the contractor has been determined, for the purpose of payment/adjustment whichever is the latest.

  If the matter is not referred to arbitration within the period prescribed above all the rights and claims of either party under the contract shall be deemed to have been forfeited and absolutely barred by time for arbitration and even for civil litigation.
- No questions relating to this contract shall be brought before any civil court without first invoking and completing the arbitration proceedings, if the issue is covered by the scope of Arbitration under this contract. The pending of arbitration proceedings, shall not disentitle the Engineer-in-charge to terminate the contract and to make alternate arrangements for completion of the work.
- The arbitrator shall be deemed to have entered on the reference on the day he issues notices to the parties fixing the first date of hearing. The arbitrator may from time to time, with the consent of the parties enlarge the initial time for making and publishing the award.
- The expiry of the contractual time limit, whether originally fixed or extended, shall not invalidate the provisions of this clause.

Clause-25-A EXTRA ORDINARY CLAIMS

No claim for payment of an extra-ordinary nature, such as claims for bonus, for extra labour employed in completing the work before the expiry of the contractual period at the request of Engineer-in-charge or
claims for compensation where work has been temporarily brought to a stand-still though no fault of the
contract shall be allowed unless and to the extent that the same shall have been expressly sanctioned by the
Baba Farid University of Health Sciences, Faridkot Under the signature of one its Vice Chancellor.

Clause -26 (a) STORAGE OF CEMENT AND RECORD OF CONSUMPTION

Cement bags if issued by the department shall be stored in godowns to be constructed by the contractor. Godown shall be provided with a single door with two locks. The keys of one lock each shall remain with the authorized representative of the department and the contractor at the site of work. Cement shall be taken out of the store according to daily requirement with the knowledge of both the parties and the account shall be maintained in the Performa as the Annexure II to these condition of contract.

(b) VARIATION IN CONSUMPTION OF MATERIALS.

Variation in consumption of material will be regulated as per amended para 27.4 of P.W.D Specification 1963 appended as Annexure "D'

(c) DETERIORATION PILFERAGE OF MATERIALS.

In case any quantity of cement steel or any other commodity issued to the contractor by the Engineer-in-charge for use (directly on the aforesaid work) or manufacture of material required in connection these with is disposal of by him or lost or allowed to get deteriorated the cost of such quantity of that material shall without prejudice to other rights and remedies available to the Government be recovered from the contractor at double the rate at which it is agreed to be supplied to the contractor

Clause-27 LUMP SUM IN ESTIMATE

When the estimate on which a bid is made include lump sums in respect of part of the work the contractor shall be entitled to payment in respect of the items of work involved at the same rates as are payable under this contract for such items. If the part of the work in question is not, in the opinion of the Engineer-in-charge capable of measurement, the Engineer-in-charge may at his discretion pay the lump sum amount entered in the estimate and the certificate in writing from the Engineer-in-charge shall be final and conclusive against the contractor with regard to any sum or sum payable to him under provision of this clause.

Clause-28 SPECIFICATION

In the case of any class of work for which there is no specification as mentioned in clause 11, the work shall be carried out in accordance with the specifications laid down by the Bureau of Indian Standards and in the event of there being no such specification, the work shall be carried out in all respects in accordance with the instructions and requirements of the Engineer-in-Charge.

Clause-28 –A (a) CONCRETE WORK

All the concrete work shall have to be done with mechanical mixer unless permitted otherwise by the Engineer-in-lncharge All R.C.C work shall be compacted with a mechanical vibrator driven by petrol/diesel

or electricity. All R.C.C work and plain cement concrete of mix 1:3:6 (M-10), and richer mixer, only Ghaggar coarse sand or Pathankot sand having a fineness modulus between 2.5 to 3.5 shall be used. Test samples shall be taken during the execution of work as per stipulations of the Bureau of Indian Standards. The compressive strength of test samples shall meet the requirements of relevant standards laid down by the B.I.S. The contractor shall set up a field testing laboratory with necessary equipment and appointed staff for carrying out the test at his cost.

(b) CURING OF CEMENT WORK

The contractor shall ensure proper curing of all work involving use of cement strictly as per stipulation of the Punjab PWD Specifications. Since proper curing during the critical period has a direct bearing on the strength and safety of cement work, the Engineer-in-Charge shall, in the case of any default on the part of the contractor, take prompt action to arrange adequate curing at the cost of the contractor without issue any prior notice in this respect to avoid lapse of critical period of curing. The certificate of the Engineer-in-Charge would be final and binding in this respect and the cost incurred shall be recovered from the contractor.

(c) PITS AT SITE PROHIBITED

No pits shall be dug by the contractor at or near the site of work for taking out earth for use in work. In case of default, the pits so dug shall be got filled by the department at the cost of the contractor, charging additional amount of fourteen percent towards departmental charges.

(d) CO-ORDINATION WITH OTHER AGENCIES

The contractor shall maintain close co-ordination and afford necessary facilities to other agencies executing other works like Electrification, Horticulture, Water supply, Sewerage and external service etc. No claim for additional payment on this account shall be entertained.

Clause 29-A (a) STATUTORY LEVIES

The rates as offered and accepted in this contract are inclusive of all taxes and statutory levies as income fax, Octroi/Terminal Tax, Sales tax/turn over tax, royalty , contribution under Employment State Insurance and local taxes payable under the respective statutes (ESI contribution etc.)

(b) INCOME TAX

Income tax shall be deducted at source as per provisions of the Income Tax Act and a certificate such deduction made in each financial year shall be furnished to the contractor by the disbursing officer.

(c) SALES AND OTHER TAXES

Sales tax turnover tax or any other tax shall also be deducted from the bills of the contractor if so directed by the authorities concerned.

(d) LOCAL LAWS AND LEVIES

The contractor shall comply with the proper bye-laws and legal orders of the local body or public authority under the jurisdiction of which the work is executed and pay all fees and charges for which he may be liable. Nothing extra shall be payable on this account.

(e) DAILY PAYMENT IN EMERGENCY

In case of emergency, the contractor shall be required to pay his labour every day and in case of default, the requisite payment shall be made by the Government and the amount shall be recovered from the
contractor.

Clause-30 VARIATION IN PRICES

Deleted

To compensate for the general rise or fall in prices of labour and material (excluding the material supplied at fixed rates by the department accordance with clause (10) the contractor's payment shall be adjusted for such increase or decrease as per provision detailed below subject to the condition that compensation for escalation in price shall be available only for work done during the stipulated period of the contract including such period for which the contract validly extended under the provisions of clause 5 of the contract without any action under clause 2 and also subject to the condition that no such compensation shall be payable for a work which the stipulated period or completion in six months or less.

The amount certified in each payment certificates shall be adjusted by applying the respective price adjustment factor to the net amount due for payment after recovery or material issued at fixed rates exhibited in the "Notice Inviting tender" as under.

P = 0.35 + 0.65 x Im / Io

Where P, is the adjustment factor for the portion of the contract price.

Im= Im is the official whole sale price index published by the Ministry of Economic affairs at the end of the calendar month prior to preparation of the bill.

Lo= lo is the official whole sale price index published by the Ministry of Economic affairs at the end of the calendar month previous to the one in which the bids comprising the contract were received.

If the value of the index is changed or amended after it has been used in a calculation for a particular payment a correction shall be applied and an adjustment made in the next payment certificate. The index value is deemed to take into account of all changes in cost due to fluctuation and nothing extra shall be payable or deductable on account of variation in prices. The contract shall furnish documentary evidence of the whole sale price index from time to time to facilitate calculation for variation in prices.

Clause-30 A No escalation is to be paid for the work done in first 6 month irrespective of the time period specified .

Clause-30 B The date of tender for the purpose of escalation will be reckoned as the date on which final financial bid in submitted or rate negotiated whichever is later.

Clause-31 (A) TECHNICAL STAFF

The contractor shall employ the following technical construction staff on a whole time basis during the execution of work and shall submit names and attendance certificate on the 10^{lh} of each calendar month.

- One graduate Civil Engineer & Electrical Engineer having relevant experience of not less than three years for work amounting to more than Rs. 50.00 lacs.
- One graduate Civil Engineer & Electrical Engineer or qualified diploma holder having relevant experience of not less than three years of works amounting up to Rs. 50.00 lacs.

The technical staff shall be available at site at all times.

In case the contractor fails to employ the above minimum technical staff or fails to submit the names and attendance certificate of such staff, ^recovery shall be made from his bills at the rate of twice the average pay of the corresponding staff working with the Public Works Department.

PERFORMANCE TEST

The contractor shall give a satisfactory performance test of the entire installation as per standard specifications before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for this test.

(B) CONSULTANTS FOR QUALITY CONTROL

It is expected that every contactor will have proper quality staff and procedures in order to ensure quality, They are also expected to improve their procedures in line with I.S.O 9002 and get the

certification. For all works amounting to more than Rs. 2.00 Crore. The contractor shall engage a competent and independent quality control consultant approved by registrar/Engineer-in- incharge of work to exercise effective control over the construction operate in the field so as to produce quality work. The fully equipped laboratory shall be set up at site of work and trained staff shall be employed by the said consultant. The contractor shall supply to the Engineer-in-Charge a copy of his agreement and the fee for quality control should generally be between 0.5% and 1.5% at the contract value. The payment to the quality consultant shall be made by the Engineer-in-charge direct as per the copy of the agreement supplied by the contractor. This payment will be recoverable from the contractor. The consultant will guide the contractor for production of quality works at all stages and shall maintain records reports and test results, so as to indicate the extend of quality Engineer-in-Charge regularly. The contractor shall also attach a copy of these reports, tests and checks with his bill without which no payment shall be made. The Engineer-in-charge can also order the change of consultant if in his opinion they are not performing competently. The Engineer-in-charge will be free to conduct surprise, random or in site checks so as to have a cross check on quality control consultant, the Engineer-in-charge may order employment of a consultant at the cost of the contractor or may order the department staff to carry out the quality control checks and a deduction at the rate of 1.5% of the total cost of the work shall be deducted from the bill of the contractor even if the actual expenditure incurred on private consultant or department quality control is less, Nothing in this clause shall reduce the over all responsibility of the contractor quality and he shall remain liable for any defect in the execution.

Clause-32 ACTS OF GOD

No claim whatsoever shall be entertained for any loss or damage caused by rain, floods or any other natural causes or other acts of God.

Clausc-33 JURISDICTION

The jurisdiction of Civil Court for matter under dispute shall be on the basis of the location of the office of the Engineer-in-charge.

Clause-34

The terms and condition of the Agreement have been explained to me us and I/we certify that I/We clearly understand the same.

Clause-35

The contractor will submit photograph of the work showing physical progress of the work every month.

FAIR WAGES CLAUSE

a) The contractor shall pay not less than fair wages to the labourers engaged by him on the work

EXPLANATION

- Fair wages means wage whether for time of piece work notified at the time of inviting tenders for the work and where such wages have not been notified the wages prescribed by the P.W.D. B&R Branch .Punjab (I) for the district in which the work is done.
- The contractor shall notwithstanding the provision of any arrangements to the contrary, cause to be paid fair wages to labourers indirectly engaged on the work, as the labourers have been directly employed by him.
- In respect of all labour directly or indirectly employed on the work for the performance of the contractor shall comply with or cause to be complied with the Punjab (1) P.W.D. Contractor's labour Regulation made by the Government from time to time in regard to payment of wages, wage period deduction from wages, recovery of wages not paid and deduction unauthorized made, maintenance of wages register, wage cards publication of wages and other terms of employment, inspection and submission of periodically returns and matters of such like nature.
- The Engineer-in-charge shall have the right to deduct from the money due to the contractor, any amount required or estimated to be required for making good the loss suffered by a worker while working by reason of non-fulfillment of the conditions of the contract for the benefit of the workers nonpayment of wages or deduction made from his or their wages, which are not justified bs the terms of the contract for non-observation of their regulation referred to in clause (c) above.
- Viz-a-Viz the Punjab (1) Government the contractor shall be primarily liable for all payment to bemade under and for the observance of the regulations aforesaid without prejudice to his right to claimindirectly from his sub-contractors.
- The regulation shall be deemed to be a part of this contract and any breach thereof shall be deemed to be a breach of this contract.

The Registrar Baba Farid University of Health Sciences, Faridkot

CONTRACTOR'S LABOUR REGULATIONS

- **Short Titles:**
  The regulations may be called Punjab (1) Public Works Department Contractor's Labour Regulations.
- **Definitions:**
  In the regulations, unless otherwise expressed or indicated, the following words and expressions shall have the meaning hereby assigned to them respectively that is to say :

- "Labour" means workers employed by Punjab (1) Public Works Department Contractor directly or indirectly through sub contractor or other person or by an agent on his behalf.
- "Fair Wages" means wages whether for time or piece works notified at the time of inviting tenders for the work and where such wages have not been so notified, the wages prescribed by the Punjab(l) Public Works Department for the district in which the work is done.
- “Contractor" shall include every person whether a sub contractor or headman or agent employing labour on the work taken on contract.
- "Wages" shall have the same meaning as defined in the payment of wages Act, 1936 and include time
- and piece rate wages.

- **Display of notice regarding wages etc.:**
  The contractor shall, before the commence his work on contract, display and correctly maintain, and continue, to display and correctly maintain, in a clean and legible condition at conspicuous place on the work, notice in English and in the local Indian language spoken by the majority of the workers, giving the fair wages notified or prescribed by the Punjab (1) Public Works Department and the hours of the work for which such wages are earned.

- **Payment of Wages :**

  Wages due To every worker shall be paid to him direct.
  All wages shall be paid in current coin or currency or in both.

5. **Fixation of Wages Period :**

- The Contractor shall fix wage periods in respect of which the wages shall be payable.
- No wage period shall exceed one month.
- Wages of every workman employed on the contract shall be paid before expiry often days after the last day of the wage period in respect of which the wages are payable.
- When the employment of any worker is terminated by or on behalf of the contractor, the wages earned by him shall be paid before the expiry of the day succeeding the one on which the employment is terminated.

- All payments of wages shall be made on a working day.

6. Wage Book and wages slips etc :

The contractor shall maintain a wage book of each worker in such form as may be convenient, but the same shall include the following particulars.

a) Rate of daily or monthly wages.
b) Nature of work on which employed.
c) Total amount payable for the work during each wage period
d) Total amount payable for the work during each wage period
e) All deductions made from the wages-with an indication in each of the ground for which the deduction is made.
f) Wage actually paid for each wage period.

(i) The contractor shall maintain a wage slip for each worker employed on the work

(ii) The authority competent to accept the contract may grant exemption from the maintenance of wage Book and wage slip to a contractor who, in his opinion may not directly or indirectly employ more than 100 persons on the work.

7. Fines and deductions which may be made from wages :

(i) The wages of the worker shall be paid to him without any deduction of any kind expect the following

a) Fines

b) Deduction for absence from duty i.e. from the place from which the place of his employment he is required to work. The amount of deductions shall in proportion to the period for which he was absent.

c) Deduction for damage to or loss of goods expressly entrusted to the employed person for custody, or for loss of money he is required to account, where such damage or missing is directly attributes to his neglect or default.

d) Any other deductions which the University may from time to time allow.

- No fine shall be imposed on a worker and no deduction for damage or loss shall be made from his made until the worker has been given an opportunity showing cause against such fines or deductions.
- The total amount of fines which may be imposed in any one wage period on a worker shall not exceed an amount equable to half an anna in a rupee of the wage payable to him in respect of that period.
- No fine imposed on any worker shall be recovered from him by installments, or after the expiry of 60 days from the date on which it was imposed.

8. Register of fines etc.

- The contractor shall maintain register of fines and of all deductions for damages or loss made.
- The contractor shall maintain a list, in English and in the local Indian Language clearly defining acts and omissions for which penalty or fines can be imposed. He shall display such list and maintain it in a clean and legible condition in conspicuous place on the work.

9. Preservation of books :

The wage book, the wage slips and the register under these regulations shall be preserved for 12 months after the date of last entry made in them.

10.Powers of Labour Welfare Offers to made investigation or enquiry.

The Labour Welfare Officers or any other person authorized of Punjab (1) Government on their behalf shall be have to make enquires with a view to **a** ascertaining and enforcing due and proper observances of the wages clause and the provisions of these regulations. He shall investigate into any compliant regarding the default made by the contractor or sub contractor in regard such provision.

11.Report of Labour Welfare Officer.

The labour welfare officer or any other person authorized a aforesaid shall submit a report of the results of his investigations or enquiry to Engineer-in-charge, indicating the extent if any, to which the default has been committed and the amount of the recoverable in respect of the acts of omission and commission of the labour with a note that necessary deduction from the contractor's bill be made and the wages and the other dues be paid to the labour concerned.

12.Appeal against the decision of Labour Welfare Officer:

Any person aggrieved by the decision and recommendations of the Labour Welfare Officer or other person so authorized may appeal against such decision to the Labour Commissioner but subject to such appeal, the decision of the officer shall be final and biding upon the contractor.

12(a). No party shall be allowed to be represented by a lawyer during any investigations, enquiry. A appeal or any other proceedings under these regulations.

13. Inspection of Registers:

The contractor shall allow inspection of the wage book and slips to any of his workers or to his agents at a convenient time and place after due notice is received or to the Labour Welfare Officer or any other person authorized by the Punjab (I) Government in this behalf.

14. Submission of returns

The contractors shall submit periodical returns as may be specified from time to time.

15. Amendments

The Punjab (1) Government may, from time to time, add or amend these regulations and on, any question as to the application, interpretation or effects of these regulations, the decision of the Labour Commissioner to Punjab (1) Government, *or* any other person authorized by the Punjab Government in that behalf shall be final.

16. Registration of work

The contractor shall require registration of workers in the building and other construction workers (RECS) act 1996 and extension of benefits to such workers under the act.

ANNEXURE-1.1

1. For all works costing above Rs. 100.00 lakhs two parts should be used and prepare the bids as under.

1.2. DOCUMENTS COMPRISING THE BID

1.2.1 The bid to be submitted by the bidder shall comprise the following in two separate parts:

Part I: Technical Bid - (Scanned copies of all bid documents uploaded on the e-procurement portal)

(a) Earnest money (Bid security).

(i) Qualification Information and supporting documents as specified..

(ii) Certificates, undertakings, affidavit/undertakings as specified

(iii) Any other information pursuant to instructions.

(iv) Undertaking that the bid shall remain valid for the period specified

Part II: Financial Bid

(i) Financial Bid (percentage rate at par, below or above the estimated cost written both in figure and words in the prescribed

2. After opening the envelope of conditions, the contractors may be asked to evaluate the financial implication of their own conditions They may be asked to increase or decrease their financial bid so as to include the cost of all conditions so that the tender becomes unconditional.

3. The original financial bid or supplementary financial bid as above should then be opened to determine the lowest bidder

4. Conditional tenders shall not be accepted.

5. The contractor shall have the qualification as per Annexure "G" & qualification information to be submitted.

Information to Bidders [I.T.B.]

Sr. No	***Subject***	***Description***	
1.	Name of the Employer	Vice Chancellor, Baba Farid University of Health Sciences, Faridkot	
	Assignee	Engineer in charge Baba Farid University of Health Sciences, Faridkot	
2.	The last five years are	2016..-2017, 2017-18 2018..-2019 2019..-2020, 2020-2021	
3.	The "similar work" means	Similar kind of frame of work	
4.	The minimum value of one similar work is	80% = Rs. 79,67,612.00	
5.	The minimum value of two similar works is	50% = Rs. 49,79,757.00	
6.	Base Year for Price Level	2020-21	
7.	Rate of inflation may be taken as for updating the price level of current financial year.	8% simple interest	
	The sale of bid	From 28-05-2021 to18-06-2021 time 9.00 to 5.00 PM at website http//eprocepunjab.gov.in	
8.	The technical bid will be opened in	21-06-2021 at 11.00 Am (time and date)	
9.	Address of the Employer	Vice Chancellor, Baba Farid University of Health Sciences, Faridkot Registrar , Baba Farid University of Health Sciences, Faridkot	
	Address of the Engineer	University Works Deptt., Baba Farid University of Health Sciences, Faridkot	
10.	The bid should be submitted latest by	18-06-2021 at 5.00 pm (date and time)	
11.	The financial bid will be opened in the office of	Registrar , Baba Farid University of Health Sciences, Faridkot on (to be intimated later on)	
12.	The Bid Security in favour of Payable at	Registrar , Baba Farid University of Health Sciences, Faridkot Faridkot	

ANNEXURE-E

LIST OF APPROVED MAKES

1. Cement	:	PPC conforming to IS 1489-part-1 OR with the approval of Engineer.
2. Reinforced Steel	:	Fe 500/ Fe 550 conforming to IS 1786-2008 OR with the approval of Engineer.
3.Bitumen		Bitumen grade 85/25 from IOC/ HPCL/ BPCL refineries.
4. Any other:		The University will at liberty to take samples from such material and get tested from an approved laboratory at the cost of the contractor and the material shall be allowed to be consumed only if these tests conducted are in order.
Note :-		For recovery purpose the rate" be taken as follows:-
Cement :	:	P.P.C Rs. 291.63 Per bag of 50 kg
Steel :		Tor Steel/TMT Steel Fe-500 ISI marked Rs. 50394.96/-Per mt. Structural Steel ISI Marked Rs. 44795.52/-Per mt.

Note:

- The department will at liberty to take samples from such material and get tested from an approved laboratory at the cost of the contractor and the material shall be allowed to be consumed only if these tests conducted are in order.

2. As all the material are to be arranged by the contractor, the relevant clauses in the agreement/DNIT relating to the stores to be issued by department will not be applicable.

ANNEXURE – 1

List of essentials equipment and machinery to be arranged by the contractor free of cost

a) For Construction

1.	Steel shuttering	1000	Sqm.
2.	Weigh batching Concrete mixer	1	Nos.
3.	Concrete vibrators	1	Nos.
4.	Bar cutting and bending machine	1	Nos.
5.	Pump sets	1	Nos.
6.	GI pipe line with specials	50	Mtrs.
7.	Flexible pipe line	100	Mtrs.
8.	Theodolite	1	Nos.
9.	Dumpy level with leveling staves	1	Nos.
10	Plan table sets	1	Nos.

b) For Field laboratory

1.	Compression testing machine	1	No.
2.	Concrete cube moulds 150x150x150mm	6	Nos.
3.	Slump cones	1	No.
4.	Graduated cylinder	1	No.
5.	Set of sieves for coarse aggregate (40,20,10 & 75 mm)	1	Sets
6.	Set of sieves for fine aggregate (10,4,7.5,2,36.1.1,8mm & 600.300,150 micron).	1	Sets
7.	Weighing scale (pan type with weights)	1	Nos.
8.	Core Cutters for soil with accessories	_____	Nos.
9.	Electronic moisture meter for timber	1	No.
10.	Latest BIS codes for wood work, flooring masonary	1	No.

ANNEXURE – II

Cement Register
Particular of issue

Particular of receipt of _____

Date	Qty. Opening balance	Receipt	Total	Consumed	Closing balance	Work done	Signature of contractors/ representative	Signature of J E	Check by Engineer- in-charge
1	2	3	4	5	6	7	8	9	10

Contractor witness Registrar

ANNEXURE-D

ITEM NO 5

(Para 27.4 of P.W.D Specifications 1963)

On the completion of any work whether executed on through rates, labour rates of Department labour, the consumption shall be prepared for such materials, the actual quantities issued to work shall be compared with shall be compared with theoretical worked out quantities on the basis of consumption factor given in chapter 27 of common schedule of rates. The consumption of materials for different items will normally, confirm to the quantities given in that chapter, However if there is any excess or short consumption of materials, the following procedure should be adopted unless otherwise specified.

(a) Excess consumption of material

No action shall be taken if the actual consumption does not exceed the theoretical consumption the percentage detailed below.

(i) For works costing up to Rs. 2 lacs 5% of total theoretical quantity.
(ii) For works costing from Rs. 2 lacs to 5 lacs 4% of total theoretical quantity.
(iii) for works costing more than Rs. 5 lacs 3% of total theoretical quantity.

This variation will not be taken as matter of routine and will have to be properly justified in each case by Engineer-in-charge. If the actual consumption exceeds the theoretical consumption by more than the permissible limits given above, recovery shall be made for the excessive consumption of material beyond the permissible limits detailed above at penal rate provided in the contract from the contract and disciplinary action may be taken against the University/department officials, as the case may be where the excess consumption in the opinion of the Registrar, BFUHS, Faridkot is substantially high, he shall bring such case to the notice of University higher authority for further action whose decision in all such cases will be final.

(b) FOR SHORT CONSUMPTION OF MATERIALS

Where the actual consumption of materials is short by percentage detailed below or less, no action shall be taken when the works is executed on the labour rate or departmentally.

- For works costing up to Rs. 21acs 5% of total theoretical quantity
(ii) For works costing from Rs. 2lacs to 5;lacs 4% of total theoretical quantity.
- Far works costing more than Rs. 51acs 3% of total theoretical quantity

This variation will not be taken as matter of routing and will have to be properly justified in each case by the Engineer-in-charge where the work is done on through rate basis, the recovery of costs of material, thus saved shall be made from the contractor at the issue rate, when the consumption of material is short by more than the permissible percentage detailed above and the work is being done on through rate basis, the rates of the items shall be reduced or where it is not possible to determine the exact item on which short materials has been the cost of the material shall be recovered from the contractor at issue rate upto permissible limits and at panel rates there after provided in the contract. When the work is done departmentally or on labour rates and the consumption is short by more than the permissible percentage detailed above, the Registrar shall investigate the cause of such short consumption and shall bring to the notice of the Vice Chancellor of this University. All such cases, for such action against defaulting officials and contractors as he may deem fit. The decision of the Vice Chancellor of this University in this matter shall be final. It shall also be determined whether the stability of structure is affected adversely by short consumption of materials and in case where it is likely to be ml

the work shall be rejected. The decision of the Vice Chancellor of this University in this regards shall be final.

(c) For major projects involving weight batching actual variation will be ascertained and fixed by project authorities.

(d) *The cost of work shall be considered as based on C.S.R. 2010* plus ceiling premium.

Contractor Witness Registrar

SPECIMEN

A FORM OF PERFORMANCE BANK GUARANTEE

Name of Employer

_____

Address of Employer

WHEREAS (Name and Address of contractor) _____ (hereinafter called dated _____"has undertaken, in Pursuance of contract No _____ _____ to execute (Name of contract and Brief description of works) _____ Called "the contract."

AND WHEREAS it has been stipulated by you in the said contract that the contractor shall furnish you with a bank Guarantee by a recognized bank for the sum specified therein as security for compliance without obligations in accordance with the contract:

AND WHEREAS we have agreed to give the contractor such a Bank Guarantee :

NOW THEREFORE we here by affirm that we are the Guarantor and responsible to you, on behalf of the contractor up to a total amount of Guarantee _____ (in Words) _____we undertake to pay, you upon your first written demand and without cavil or argument any sum or sums within the limits of amount of Guarantee _____as aforesaid without your needing to prove or to show grounds or reasons for\our demand for the sum specified therein.

We hereby waive the necessary for your demanding the said debt from the contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the contract of the works to be performed there under of any on the contract documents which may be made between you and the contract shall in any way release us from any liability under this guarantee and we hereby waive notice of any such change, addition or modification.

This Guarantee is valid until the date .....months after the issuing of the maintenance certificate.

Signature and seal of Guarantor_____

Name of Bank _____

Address _____

Date_____

Contractor Witness Registrar

ADDITIONAL CONDITIONS:-

1. The Contractor shall quote the overall excess or below or at par the NIT amount. Item rate will not be accepted. For payment purpose the quoted percentage shall be applicable uniformly to the rates of items described in the bill of quantity.

2. The prime Civil contractor will engage/identify his sub contractor for execution of Mettaled Road work, internal Public Health works, internal Electrical works having valid enlistment for executing the road work/water supply/sanitary engineering works, electrical works and he should have satisfactorily qualification criteria of similar nature of work as per contractor data. An undertaking will be given by the prime contractor in this regard as per Annexure-F

3. The description of all the above items is subject to all notes and clarification included in the Common Schedule of Rates-2020 and of Pb. PWD specification latest edition corrected up to date.

4. Agenda & Corrigendum issued by the Chief Engineer Pb. PWD B& R from time to time upto date will be applicable for the purpose of measurement/Payment.

5. The payment will be made after deducting Income Tax, VAT, Labour Cess as applicable by the rules.

6. The contractor shall carryout the mixed design if required for the relevant item of concrete from a reputed institution/laboratories as approved by the Engineer at his own expenses. Prior approval of Engineer is to be taken before the samples (Cement, Coarse & Fine Aggregates) sent to the institution/laboratories for mix design. The design mix required may be with or without admixtures. The decision of Engineer-In-Charge final and binding above. Nothing extra will be paid on this account.

7. Cost of binding wire, wastage of steel is included in the rate and shall not be paid separately.

8. The material will be arranged by the contractor

9. Amount/Quantity of any item can be increased or any item can be omitted or Substituted as per actual requirement at site of work as per approval of the Engineer-In – Charge. No claim in this regard will be entertained.

10. Nothing extra will be paid due to loss/damages caused by rains, floods, war, epidemic strike of the department officials or any other Act of God or any other cause what so ever.

11. The quantities given against respective item are arbitrary subject to actual as per approved designs/Drawings.

12. The work is required to be completed strictly as per the scope of NIT approved drawing irrespective of Qty, and amount of agreement as desired by the Engineer-In-charge.

13. No claim on account of paucity of funds, change in Priority or any other causes what so ever will be entertained and the Contractor/firm will have no right to go on for Arbitration on this account.

14. In persuent to clauses of NIT of GCC: The rate quoted by the contractor shall be deemed to be inclusive of all taxes/GST, levies, etc. including their variations as notified by the concerned authority from time to time, and also of all the new taxes and levies that may be imposed that the Contractor will have to pay for the performance of this Contract. The Engineer on behalf of the Employer will perform such duties in regard to the deduction of such taxes at source as per applicable law. Nothing extra will be paid on this account.

15. Due to implementation of GST, VAT will be read as GST in the bidding document.

Contractor Witness Registrar

Contractor Witness Registrar

SPECIAL CONDITIONS OF CONTRACT

1 General: These special conditions are intended to amplify the General Conditions of Contract, and shall be read in conjunction with the same. For any discrepancies between the General Conditions and these Special Conditions, the more stringent shall apply. Notwithstanding the sub-division of the documents into separate sections and volumes, every part shall be deemed to be supplementary to and complementary of every other part of each shall be read with and into the contract so far as it may be practicable to do so Where any portion of the general conditions of contract is repugnant to or at variance with any provision of the special conditions of contract, then unless a different intention appears, the provision(s) of special condition of contract shall be deemed to override the provision(s) of general conditions of contract only to the extent that such repugnance or variance cannot be reconciled with the general conditions of contract and shall be to the extent of such repugnance of variations, prevail; it being understood that the provisions of general conditions of contract shall otherwise prevail.

2. Scope of Work: The general character and the scope of work to be carried out under this contract are illustrated in Drawings, Specifications and Schedule of Quantities. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Customer / consultant /Architect. The contractor shall furnish all labour, materials and equipment (except those to be supplied by the customer) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete air conditioning system as described in the Specifications and as shown on the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings / Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The central Heating, Ventilation and Air-Conditioning (HVAC) system shall comprise of following:

a. Air cooled scroll chillers
b. Water circulating pumps
c. Air handling units
d. Hot water generator
e. Air distribution and filtration system
f. Exhaust air system
g. Refrigerant & drain piping inclusive of all fittings.
h. Vibration isolators for all HVAC equipment.
i. Automatic controls and instruments.
j. Wiring and earthing from MCC panels to various refrigeration, air conditioning and mechanical ventilation equipment, control wiring and interlocking.
k. Balancing, testing and commissioning of the entire HVAC and mechanical ventilation installation.
l. Test reports, list of recommended spares, as-installed drawings, operation and maintenance manual for the entire HVAC installation.

3. Associated Civil Works: Following civil works associated with HVAC installation are excluded from the scope of this contract. These shall be executed by other agencies in accordance with approved shop drawings of and under direct supervision of the air conditioning contractor.

- Water proofing of floors and roofs.

- Cutting holes, chases and the like through all types of structural walls, and finishing for all services crossings, including sealing, frame work, fire proofing, providing sleeves, cover plates, making good structure and finishes to an approved standard.
- Foundations for all HVAC equipment.
- False ceiling works
- Underdeck / overdeck insulation.

4. Associated Services Works

4.1 All associated ELECTRICAL WORKS listed below are excluded from the scope of this contract. These shall be installed by other agencies in accordance with approved shop drawings of, and under direct supervision of the air conditioning contractor.

- Providing power supply with earthing at the incoming of control panel.
- Providing power and earthing at each inline/exhaust fan at locations called for on air conditioning Contractor's shop drawings.
- Providing 15 amps power outlet within 2 meter reach of each single phase equipment at locations called for on air conditioning Contractor's shop drawings.

4.2 All associated PLUMBING WORKS listed below are excluded from the scope of this contract. These shall be installed by other agencies, in accordance with approved shop drawings of, and under direct supervision, of the air conditioning contractor.

- Providing sump pumps and necessary piping for drainage of machiness located below ground level.
- Providing floor drains in air handling unit rooms.
- Disposal of condensate drain from AHU / fan coil units beyond the condensate drain riser.

5. Project Execution and Management: The Contractor shall ensure that senior planning and erection personnel from his organisation are assigned exclusively for this project. They shall have minimum 3 years experience in this type of installation. The Contractor shall appoint one Project manager. He shall be assisted on full time basis by erection engineers & supervisors. The entire staff shall be posted at site on full time basis.

The project management shall be through modern technique. The Contractor's office at site shall be fully equipped with fax, modem, computers, plotter etc. Erection engineer and supervisors shall be provided with mobile communication system so that they can always be reached.

For quality control & monitoring of workmanship, contractor shall assign at least one full-time engineer with minimum 5 years relevant experience, who would be exclusively responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the air conditioning installation.

The Contractor shall arrange to have mechanised & modern facilities of transporting material to place of installation for speedy execution of work.

6. Performance Guarantee: The contractor shall carry out the work in accordance with the Drawings, Specifications, Schedule of Quantities and other documents forming part of the Contract.

The contractor shall be fully responsible for the performance of the selected equipment (installed by him) at the specified parameters and for the efficiency of the installation to deliver the required end result.

The contractor shall guarantee that the HVAC system as installed shall maintain the inside conditions in the air-conditioned spaces as described under "Basis of Design" in the specifications.

Complete set of drawings is available in the Owner / Consultant office and reference may be made to same for any details or information. The contractor shall also guarantee that the performance of various equipment individually, shall not be less than the quoted capacity; also actual power consumption shall not exceed the quoted rating, during testing and commissioning, handing over and guarantee period.

7. Bye-Laws and Regulations: The installation shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

8. Fees and Permits: The contractor shall obtain all permits / licenses and pay for any and all fees required for the inspection, approval and commissioning of their installation.

9. Drawings: The HVAC Drawings issued with tenders, are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The interiors drawings and details shall be examined for exact location of equipment, controls, grilles and diffusers. The contractor shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed. Maximum headroom and space conditions shall be maintained at all points. Where headroom appears inadequate, the contractor shall notify the Owner / Architect / Consultant before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and contractor shall rectify the same at his own cost. The contractor shall examine all interior, structural, plumbing, and electrical and other services drawings and check the as-built works before starting the work report to the Owner / Architect / Consultant any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Owner / Architect / consultant without additional cost to the Owner. The data given in the Drawings and Specifications is as exact as could be procured, but its accuracy is not guaranteed.

10 Technical Data: Each tenderer shall submit along with his tender, the technical data for all items. Failure to furnish complete technical data with tenders may result in summary rejection of the tender.

11. Shop Drawings:

11.1 All the shop drawings shall be prepared on computer through AutoCAD System based on Drawings, site measurements and Interior Designer's Drawings. All heat load calculations shall be done using latest software. Within one week of the award of the contract, contractor shall

furnish, for the approval of the Owner / Architect / Consultant, two sets of detailed shop drawings of all equipment and materials including layouts for Plant room, AHU rooms, fan rooms, fan coil units, ventilation fans; CFD analysis report for jet fans detailed ducting drawings showing exact location of supports, flanges, bends, tee connections, reducers, guide vanes, silencers, distribution grids, volume control dampers, collars, grilles, diffusers; detailed piping drawings showing exact location and type of supports, valves, fittings etc; acoustic lining and external insulation details for ducts, pipe insulation etc; electrical panels inside / outside views, power and control wiring schematics, cable trays, supports and terminations. These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Owner / Architect / consultant. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment / materials / works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings. Minimum 6 sets of drawings shall be submitted after final approval along with softcopy.

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

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

11.2 Shop drawings shall be submitted for approval four weeks in advance of planned delivery and installation of any material to allow Owner / Architect / Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved program.

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

11.4 Samples of all materials like grilles, diffusers, controls, insulation, pre-moulded pipe section, control wires etc shall be submitted to the Owner / Architect / Consultant prior to procurement. These will be submitted in two sets for approval and retention by Owner / Architect / Consultant and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation.

11.5 Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

11.6 Where the contractor proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, piping, wiring or any other part of the mechanical, electrical layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the Owner / Architect / Consultant. Any delay on such account shall be at the cost of and consequence of the Contractor.

Where the work of the contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Owner/Architect/Consultant, the contractor shall prepare composite working drawings and sections at a suitable scale, not less than 1:100, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner.

11.7 Within two weeks of approval of all the relevant shop drawings, the contractor shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers) imported and local spare parts and tools, covering all equipment and materials in this contract. The Owner / Architect / Consultant shall make recommendation for acceptance of anticipated variation in contract amounts.

12. Quiet Operation and Vibration Isolation: All equipment shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Owner / Architect / Consultant. In case of rotating machinery sound or vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the Contractor at his own expense. The contractor shall guarantee that the equipment installed shall maintain the specified NC levels.

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

14. Materials and Equipment: All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved manufacturers as per attached list.

15. Manufacturers Instructions: Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, such instructions shall be followed in all cases.

16. Electrical Installation: The electrical work related to air conditioning services, shall be carried out in full knowledge of, and with the complete coordination of the contractor. The electrical installation shall be in total conformity with the control wiring drawings prepared by the contractor and approved by the Owner/Consultant. All air conditioning equipment shall be connected and tested in the presence of an authorized representative of the contractor. The system shall be commissioned only after the contractor has certified in writing that the electrical

installation work for air cooling services has been thoroughly checked, tested and found to be totally satisfactory and in full conformity with the contract Drawings, Specifications and manufacturer's instructions. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the electrical installation work for air conditioning services, lies solely with the contractor.

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

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

18. Balancing, Testing And Commissioning : Balancing of all air and water systems and all tests as called for the Specifications shall be carried out by the contractor through a specialist group, in accordance with the Specifications and ASHRAE Guide lines and Standards. Performance test shall consist of three days of 10 hour each operation of system for each season. Cost of performance witness test of major equipment such as chillers, at factory with two personnel from Owners / Consultant shall be included. The results for summer, monsoon and winter air conditioning in quadruplicate shall be submitted for scrutiny. Four copies of the certified manufacturer performance curves for each piece of equipment, high lighting operational parameters for the project, shall be submitted along with the test certificates. Contractor shall also provide four copies of record of all safety and automatic control settings for the entire installation. The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Owner / Architect / Consultant. All tests shall be carried out in the presence of the representatives of the Owner / Architect / Consultant.

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

20. Operating Instruction & Maintenance Manual: Upon completion and commissioning of system the contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and Owner / Architect / Consultant and two for Owners Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment.

21. On Site Training: Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labor and helpers for operating the entire installation for a period of fifteen (15) working days of ten (10) hours each, to enable the Owner's staff to get aquatinted with the

operation of the system. During this period, the contractor shall train the Owner's personnel in the operation, adjustment and maintenance of all equipment installed.

22. Maintenance during Defects Liability Period

22.1 Complaints: The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

22.2 Repairs: All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Owner.

23. Uptime Guarantee: The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

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

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the Owner / Architect / Consultants review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.

The tenderer shall include a list of other projects where such an Operation Assistance has been provided.

24. Partial Ordering: Owner through the Owner/Architect/Consultant reserves the right to order equipment and material from any and all alternates, and /or to order high side and / or low side equipment and materials or parts thereof from one or more tenderer.

25. Soft Water and Power Requirement: The contractor shall submit with their tender, their requirement of soft make-up water and power at each of their equipment / system wise / floor wise / section wise.

26 The following documents shall generally constitute the contract agreement:

a) Invitation to tenders.

b) Special conditions of contract, tender documents and drawings.

c) Complete correspondence with the successful bidder and owner shall be consolidated in one letter by the bidder.

d) Any other document necessary for completion of contract agreement.

27. Copy of the latest income tax clearance certificate must be submitted alongwith the offer.

28. Storage at site: Plant room/ AHU rooms, if available, can be used by the contractor for storage of equipments/ materials brought to site for execution of the work. However, watch and ward of the same shall be at contractor's risk.

29. CONFORMITY WITH STATUTORY ACTS, RULES, STANDARDS AND CODES

i) All components shall conform to relevant Indian Standard Specifications, wherever existing, amended to date. A list of such standards is appended in Appendix `B'.

ii) All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 2003 and Indian Electricity Rules, 1956 amended to date. They shall also conform to CPWD General Specifications for Electrical works, Part-I: Internal, 2005 and Part-II: External, 1994 and Part IV (Sub-station) 2007, amended to date.

30 SAFETY CODES AND LABOUR REGULATIONS

i) All the safety procedures outlined in the safety codes listed in Appendix-C shall be complied with.

ii) In respect of all labour employed directly or indirectly on the work for the performance of the air conditioning contractor's part of work, the contractor at his own expense, will arrange for the safety provisions as per the statutory provisions, 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.200/- for each violation. In addition the Customer / consultant, shall be at liberty to make arrangements and provide facilities as aforesaid and recover the cost from the contractor.

iii) The contractor shall provide necessary barriers, warning signals and other safety measures while laying pipelines, ducts cables etc. or wherever necessary so as to avoid accident. He shall also indemnify CPWD 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 customer shall not be responsible for any accident occurred or damage incurred or claims arising there from 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.

31 DISPATCH OF MATERIALS TO SITE AND THEIR SAFE CUSTODY

The contractor shall dispatch materials to site in consultation with the Customer / consultant. Suitable lockable storage accommodation shall be made available free of charge temporarily. Watch & ward however, shall be the responsibility of contractor. Program of dispatch of material shall be framed keeping in view the building progress. Safe custody of all machinery and equipment supplied by the contractor shall be the responsibility of the contractor till final taking over by the customer.

32 CO-ORDINATION WITH OTHER AGENCIES

The contractor shall co-ordinate with all other agencies involved in the work so that the work of other agencies is not hampered due to delay in his work. Ducting, piping, cabling or any other work, which directly affect the progress of building work, shall be given priority.

33 QUALITY OF MATERIALS AND WORKMANSHIP

i) The components of the installation shall be of 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. The entire installation shall be such as to cause minimum transmission of noise and vibration to the building structure.

iii) All equipments and materials 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.

34 CARE OF THE BUILDING

Care shall be taken by the contractor during execution of the work to avoid damage to the building. He shall be responsible for repairing all such damages and restoring the same to the original finish at his cost. He shall also remove all unwanted and waste materials arising out of the installation from the site of work from time to time.

TECHNICAL SPECIFICATIONS

TERMS AND DEFINATIONS

The following terms have been used in the tender specifications and drawings etc.

ISI	Bureau of Indian standards
ASHRAE	American society of Heating Refrigeration and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
BS	British Standard
CMH	Cubic Meter per hour
USGPM	US gallons per Minute
RPM	Rotations per minute
BTU/Hr.	British Thermal unit per hour
Kcal/ Hr	Kilo calories per hour
SAG	Supply air Grill
RAG	Return Air Grill
FD	Fire damper
FAD	Fresh air damper
DP	Drain Point
SAD	Supply air diffuser
RAD	Return air Diffuser.

LIST OF BUREAU OF INDIAN STANDARDS CODES

Following relevant IS codes shall apply read in concurrence with their latest amendments.

IS:226-1975	Specification for structural steel
IS:277-1992	Specification for galvanised sheet (plain and corrugated)
IS:325-1978	Specification for three phase induction motors
IS:554 – 1975	Dimensions for pipe threads where pressure tight joints are required on the threads.

IS:655-1963	Specification for metal duct
IS 659-1964 (1991)	Safety code for air-conditioning (resived)
IS:660-1963 (1991)	Safety code for mechanical refrigeration
IS:778-1984	Specification for copper alloy and gate , globe & check valves for water works
IS:780-1984	Specification for sluice valves for water works (50 to 300 mm size)
IS:800-1984	Code of practice for general construction in steel
IS:808-1964	Specification for rolled steel beam channel and angle section
IS:816-1969	Code of practice for metal arc welding for general purpose in mild steel
IS:823-1964	Code of procedure for manual metal arc welding of mild steel
IS:1239-1979 (Part 1) 1990	MS tubes, tubulars and other wrought steel fittings
IS:1239-(Part 2) –1992	MS tubes tubulars and other wrought steel fittings
IS:1536 - 1976	Flanges configuration
IS:1554-(Part 1) –1976	Specs for PVC insulated (heavy duty electrical cables)
IS:2253-1974	Designation for types of construction and mounting arrangement of rotating electric machine.
IS:2312-1967	Specs for propeller type AC ventilating fans
IS:2379 - 1963	Colour code for the identification of pipelines
IS : 3103-1975	Code of practice for Industrial Ventilation
IS 4064 - (Part -II) 1978	Specific requirements for the direct switching of individual motors.
IS: 4736 - 1968	Hot-dip zinc coatings on steel tubes
IS: 4894-1987	Test Code for Centrifugal Fan.
IS : 7240-1981	Application & Finishing of thermal insulation material
IS:8544 (Part-I to IV) 1979	Starters
IS:9224 (Part II) - 1979	HRC cartridge fuse links upto 650 volts.
IS:3069-1965	Glossary of terms, symbols and unit relating to thermal insulation material
IS:3346-1980	Method for the determination of thermal conductivity thermal I insulation materal (two slab, guarded hot plate method)
IS:3588-1966	Specification for electric axial flow fans
IS:3589-1981 and 1991	Seamless or electrically welded steel pipes for water, gas and sewage (168.3 to 2032 mm outside dia)
IS:3724-1966	Specs for cartridge type heating elements (non embedded type)
IS:4158-1967	Specs for solid embedded type electric heating elements
IIS:4671-1984	Specs for expanded polystyrene for thermal insulation purpose
IS:4691-1984	Degree of protection provided by enclosure for rotating electrical machine
IS:4722-1968	Specs for rotating electrical machine
IS:4729-1968	Measurement and evaluation of vibration of rotating electrical machine.
IS:4831-1968:	Recommendation on units and symbols for Refrigeration
IS:4894-1987	Specs for centrifugal fans
IS:5111 -1993	Testing of Refrigerating compressors.
IS:5512:(Part 1) –1984	Specs for swing check type (non return) for water works purposes.
IS:6272-1971:	Specs of industrial cooling fans

IS: 6392-1971	Specs for steel pipe flanges
IS:6168-1976	Code of practice for treatment of water for industrial cooling system
IS:7616-1975	Method of testing panel type air filters for air conditioning and ventilation purposes
IS;8623 1977	Specs of factory built switch / control section.
IS:8623(Part3) 1993:	Specs for low voltage switchgear and control gear assemblies
IS: 8789- 1978	Values of performance characteristics for three phase induction motor
IS:9137-1978	Code for acceptable tests for centrifugal, mixed flow and axial pumps class C
IS:9338-1964	Specs for CI screw down stop valves on stop and check valves for water works purpose
IS-13947 (Part-1)1993	Specs for low voltage switchgear and control gear.

In case of any revision in above BIS code the REVISED one shall only be applicable.

GENERAL MECHANICAL REQUIREMENTS

This chapter deals with the general mechanical requirements specifically applicable to HVAC. The additional requirement given in any chapter is in addition to the bare minimum stated in this chapter and shall be complied with.

1 SUBMITTALS

Under provisions of the NIT sample approval for all major items like grills, diffusers, valves, insulation, sheet etc is necessary before the commencement of the project. The products mentioned in the Approved list of manufacturers shall only be acceptable.

2 BROCHURES

Submit manufacturer's product data and brochure including complete description of the item with illustrations, rating charts, accessories, dimensional data, capacities stated in the terms specified in the NIT and Performance curves, wherever applicable like fans and pumps.

3 REGULATORY REQUIREMENTS

Liaison / Approvals from the bodies mentioned below (or any other), if required shall be taken by the contractor on behalf of the client and at his own cost. BIS / Local Fire Authority / LOCAL CODES.

4 PROJECT / SITE CONDITIONS

- Mechanical layouts indicated on drawings are diagrammatical. Co-ordination (final) shall be required with other trades prior to installation. Install all works as shown on the drawings, unless prevented by project conditions.
- Prepare drawings showing proposed rearrangement of work, if required as per site requirement, to meet the project conditions. Obtain permission from of engineer in charge before proceeding.

- Place anchors, sleeves and supports prior to pouring concrete on installation of masonry works.
- Keep roads and site clear of debris and scrap.

5 GENERAL INSTALLATION FEATURES

- Piping / ducting installation requirements are specified in other section. The Drawings indicate the general arrangement of piping, valves, fittings, ducts and specialties. The following are specific connection requirements:
- Arrange piping installations adjacent to units to allow unit servicing and maintenance.
- Connect piping to all equipment with flanges enabling easy removal of the coil.
- Connect condensate drain pans using drain pipe and extend to nearest floor drain. Construct deep trap connection to drain pan and install cleanouts at changes in direction.
- Make final duct connections with flexible connections.
- Connect unit components to ground in accordance with the National Electrical Code.

SPECIFICATIONS FOR PAINTING & IDENTIFICATION

1 Identification of Services: Pipe work and duct work shall be identified by colour bands 150 mm. wide or colour triangles of at least 150 mm / side. The bands of triangles shall be applied at termination points, junctions, entries and exits of plant rooms, walls and ducts, and control points to readily identify the service, but spacing shall not exceed 4.0 meters. For pipe work services and its insulation the colours of the bands shall comply with BS. 1710:1971. Basic colours for pipe line identification:

Pipe Line Contents	BS.4800 Colour Reference	Colour.
Water	12 D 45	Green
Air	20 E 51	Blue
Drainage	00 E 53	Black

Colour code indicator bands shall be applied as colour bands over the basic identification colour in the various combinations as listed below:-

Pipe Line Contents	Colour Bands as per BS. 4800
Water Services :	
Cooling	00 E 55
Fresh / drinking	18 E 53
Condensate	04 D 45/14 E 53 / 04 D 45
Chilled	00 D 55/14 E 53 / 00 D 45
Central Heating Services :	
Below 100^{o} C	18 E 55/04 D 45/18 E 53
Cold Water Storage Tanks :	00 E 55/18 E 53/00 E 55
Hot Water Supply	00 E 55/04 D 45/00 E 55
Drainage and other fluids :	Basic Colour only

In addition to the colour bands specified above all pipe work shall be legibly marked with black or white letters to indicate the type of service and the direction of flow, identified as follows :-

Medium Temperature Hot Water	MTHW
Low Temperature Hot Water	LTHW
Chilled Water	CHW
Condenser Water	CONDW
Condensate	CN

Pipe shall have the letters F and R added to indicate flow and return respectively as well as directional arrows. Valve Labels and Charts: Each valve shall be provided with a label indicating the service being controlled, together with a reference number corresponding with that shown on the Valve Charts and "as fitted" drawings. The labels shall be made from 3 ply (black / white/ black) Traffolyte material showing white letters and figures on a black background. Labels to be tied to each valve with chromium plated linked chain. A wall mounted, glass covered plan to the approval of the Engineer in charge shall be provided and displayed in each plant room showing the plant layout with pipe work, valve diagram and valve schedule indicating size, service, duty, etc.

SPECIFICATIONS FOR NOISE CONTROL

1 Scope: The scope of this section comprises of the supply, installation, testing and commissioning of noise and vibration control equipment and accessories.

2 General: Mechanical services shall generally be designed and installed with provisions to contain noise and the transmission of vibration, generated by moving plant and equipment at source where illustrated on the tender drawings and plant and equipment schedules to achieve acceptable noise rating specified for occupied areas. In addition to the provisions specified in the Specification, particular attention must be given to the following details at time of ordering plant and equipment and their installation :-

- All moving plant, machinery and apparatus shall be statically and dynamically balanced at manufacturers works and certificates issued.
- The isolation of moving plant, machinery and apparatus including lines equipment from the building structure.
- Where duct work and pipe work services pass through walls, floors and ceilings, or where supported shall be surrounded with a resilient acoustic absorbing material to prevent contact with the structure and minimise the outbreak of noise from plant rooms.
- The reduction of noise breakout from plant rooms and the selection of externally mounted equipment and plant to meet ambient noise level requirement of the Specifications.
- Electrical conduits and connections to all moving plant and equipment shall be carried out in flexible conduit and cables to prevent the transmission of vibration to the structure and nullify the provisions of anti-vibration mountings.
- All duct connections to fans shall incorporate flexible connections, except in cases where these are fitted integral within air handling units.

- Duct work connections to the fan inlets / outlets shall be concentricity aligned so that the flexible connections are not subjected to any strain and not used as a means of correcting bas misalignment.
- All resilient acoustic absorbing materials shall be non flammable, vermin and rot proof and shall not tend to break up or compress sufficiently to transmit vibration or noise from the equipment to the structure.
- Where practicable, silencers shall be built into walls and floors to prevent the flanking of noise the duct work systems and their penetrations sealed in the manner previously described.
- Where this is not feasible, the exposed surface of the duct work between the silencer and the wall subjected to noise infiltration shall be acoustically clad as specified.

ANTI-VIBRATION MOUNTINGS.

All items of rotating and reciprocating plant and equipment shall be isolated from the structure by the use of anti-vibration materials, mountings or spring loaded supports fixed to either concrete bases, inertia blocks or support steels as indicated. Centrifugal fans and motors within air handling units shall be isolated from the frame of the air handling unit by suitable anti-vibration mountings. Fan discharge air connections shall be fitted with approved flexible connections internally isolating the fan scroll from the air handling unit casing. Centrifugal pumps shall be mounted on reinforced concrete sub-base, anti-vibration mountings and concrete filled steel upper plinth. The Contractor shall be responsible for issuing the steel upper plinth and mountings to the Contractor for building-in.

Enclosed Spring Mounting (Caged or Restrained Springs or cushy foot mounting): Each mounting shall consist of cast or fabricated telescopic top and bottom housing enclosing one or more helical steel springs as the principle isolation elements, and shall incorporate a built- in leveling device. The springs shall have an outside diameter of not less than 75% of the operating height, and be selected to have at least 50% overload capacity before becoming coil bound. The bottom plate of each mounting shall have bonded to it a neoprene pad designed to attenuate any high frequency energy transmitted by the springs. Mountings incorporating snubbers of restraining devices shall be designed so that the snubbing damping or restraining mechanism is capable of being adjusted to have no significant effect during the normal running of the isolated machine. Restrained isolator shall be provided on chillers subject to approval by the manufacturers.

Neoprene-In-Shear Mountings: Each mounting shall consist of a steel top plate and base plate completely embedded in oil resistant neoprene. Each mounting shall be capable of being fitted with a leveling device, and bolt holes in the base plate and tapped holes in the top plate so that they may be bolted to the floor and equipment where required.

INSPECTION

All major equipments such as chillers, Air handling units, panels, fans shall be got inspected by the engineer in charge at works by the contractor, if he so desires at tenderer's cost, including performance testing of one chiller at factory test bed. All routine and Type tests shall be carried out and the test reports shall be submitted for approval before dispatch. The engineer in charge is free to witness any or all tests. In any case the OEM test certificates shall be submitted to the engineer in charge for verification of the same before the payments for the same can be processed. The contractor shall inform the engineer in charge well in time about the date of readiness of the equipment for inspection and testing. The inspection process shall be as under:

Equipment like DX units, Air handling units, fans, Pumps, Panel

- Salient features such as model and make shall be checked as per the contract requirement and shall be related with name plate/performance curves.
- The manufacturer's test certificate shall be furnished and verified.
- The test certificates shall be correlated with the equipment serial no.

Electric Motor

- The motor shall be of approved make. The OEM's test certificates shall be furnished and verified with the name plate and serial no. The requirement shall be as per technical data submitted.

Pipes and valves

- Make, wall thickness for the pipe shall be checked at random for 5% of pipe lengths and shall be correlated with relevant IS codes.
- The valves shall be accompanied with the OEM TC. The valves shall be checked for the finish and dimensions randomly. For strainers the quality and dimensions of sieve plate shall be checked.

Ducting

- The GI sheet to be used shall be physically checked for gauge as per IS 277. The bend test shall be performed at site. Randomly one sample of each gauge shall be checked chemically for composition and galvanizing by a reputed lab and report shall be submitted before starting work at site.

Insulation

- All type of insulation material shall be physically checked for quality, thickness as per tender specification.
- The samples shall be checked for density at site. The same shall be correlated with the OEM test certificates.
- The material shall be having required thermal conductivity which will be verified from TC.

TESTING

After completion of phase wise and entire installation as per specifications in all respects, the contractor shall demonstrate trouble free operation of the phase wise / entire installation simultaneously for a period of 96 hours spread over a period of 4 days continuous. The test readings shall be recorded in a mutually acceptable format. All tests shall be carried out by the AC contractor at his own expenses. However necessary utilities such as power and water shall be provided by the owner free of cost. The tests shall include but will not be limited to the following:

- To check satisfactory functioning of all equipment installed such as chillers, pumps, cooling towers, AHU/FCU, panels Blowers etc.
- Clean all equipment to remove foreign material and construction dirt and dust with Vacuum cleaner.

- Verify that the equipment is secure on mounting and supporting devices and that connections for piping, ductwork and electrical are complete.
- Verify proper thermal overload protection is installed in motors, starters, and disconnects.
- Perform cleaning and adjusting specified as per OEM.
- Check proper motor rotation direction and verify fan wheel / pump free rotation and smooth bearing operations.
- Reconnect drive system and align belts.
- Lubricate bearings, pulleys, belts, and other moving parts with factory recommended lubricants.
- Set outside-air / supply air dampers to minimum outside-air setting.
- Install temporary throw away filters for initial run and finally install clean filters.
- Verify manual and automatic volume control, and fire dampers in connected ductwork system are in the full-open position.
- Replace fan and motor pulleys as required to achieve design conditions.
- Measure and record motor electrical values for voltage and amperage.
- Shut unit down and reconnect automatic temperature control operators.
- Cooling / heating capacity of various fan coil units shall be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements shall be by a calibrated rotating vane anemometer and temperature measurements by accurately calibrated mercury-in-glass thermometers. Computed ratings shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current, whereas, noise level at various locations within the conditioned spaces shall be measured by a sound pressure level meter.

NOTE:

- All measuring instruments such as thermometer, Psychrometer, Pressure gauges, anemometers, Flow meter, dB Meter, Tong tester, etc or any other necessary instrument shall be arranged by the contractor at his own expense.
- The instruments shall be new and shall have a valid calibration certificate from a renowned test lab.
- The plant shall be run initially and all equipments shall be adjusted to give desired results as per contract. Thereafter the plant shall be test run for 96 hours as described above and the readings shall be demonstrated in the required format. The test shall be witnessed by the owners and engineer in charges representative. In case the conditions are not achieved during the initial run test the plant shall be readjusted and the new dates for tests shall be determined. The entire test shall be repeated and satisfactory results shall have to be obtained. Only after satisfactory test the installation shall be taken over by the customer and warranty period for one year shall commence.
- In addition to the above test seasonal tests for 3 days during summer/monsoon shall be done for demonstrating the design parameters shall be conducted by the contractor as per the provisions of NIT. These dates shall be mutually discussed.
- The test readings shall be suitably adjusted for the absence of Peak ambient conditions, fouling factor, and available load.
- The snag list prepared jointly after initial test shall be attended to by the vendor during a maximum of 30 days from the start of warranty period. Failure to do so shall result in corresponding increase of warranty period.

SYSTEM DESIGN

1 General

The OT Floor in the super specialty block needs to be air conditioned.

2 DESIGN CODITIONS

Outside Design Temperature

	Dry Bulb Temperature	Wet bulb temperature
Summer	43.3^{O} C	23.8^{O} C
Monsoon	35^{O} C	28.3^{O} C
Winter	7.2^{O} C	5^{O} C

INSIDE CONDITIONS

Summer :	24 ± 1^{O} C (75 ± 2^{O} F)	RH 55 +/-5%
Winter :	22 ± 1^{O} C (72 ± 2^{O} F)	RH 55 +/-5%

Hours of Operation : 24 x 7 continuous

Roof Insulation : All exposed roof shall be insulated.

Exposed Glazing : All glass exposed to sun shall have suitable shading device

Occupancy : as per table attached

Light load : 1.5 W/Sqft

Equipment Load : as per table attached

Fresh Air : As per table attached

Filtration : 3 stage (pre Fine and HEPA)/ 2 Stage (pre and Fine)

3 ESTIMATED LOAD AND SCHEME

Based on the above design data the total peak Load of the Building is 100 TR

To take care of the above load it is proposed that 2 nos (1 working and 1 standby) Air cooled Scroll Chillers with is installed at the Terrace as shown in the attached drawing. These machines shall work in conjunction with Chilled water pumps, Monsoon Reheat and winter heating shall be provided using a Hot water generator. There shall be provision for Double skin AHU. All AHUs shall have Thermal break profile to avoid condensation.

Plant machinery in the plant room shall be placed on PCC / RCC foundation and provided with anti-vibratory supports. All foundations shall be protected from mechanical damage by providing epoxy coated angle nosing. All pipes shall be supported in a manner, which will avoid transmission of vibration to slab and occupied floors. Floor mounted air handling units (AHU) shall be double skin (for noise control) construction, comprising centrifugal fans, cooling coil section, stainless steel double sloping drain pan (for zero water retention) and filter section shall be provided for the first floor. These shall be floor-standing type with ducted arrangement for supply air. All ducts shall be fabricated out of galvanized sheet steel (GSS) for long life and as per fire norms. Motorized smoke dampers shall be installed within supply air ducts at AHU room wall crossings, to prevent spread of smoke / fire to the adjoining areas. Smoke & Fire dampers shall be motorized and shall be actuated by smoke sensor as per fire regulations. Air handling units shall also be tripped in case of emergency.

Floor drain channels and dedicated drain pipes in slope shall be provided for effective disposal of waste water wherever required. The HVAC contractor shall also carry out the civil work including trench work as required for doing underground piping/cabling.

SCREW TYPE WATER CHILLING UNITS

1 **SCOPE**

1.1 The scope of this section comprises the supply erection, testing and commissioning of the water chilling units conforming to this specification and in accordance with the requirements of the "Schedule of Quantities".

2 **CODES & STANDARDS**

The water-cooled liquid chilling packages shall conform to the latest edition of following standard:-

ASHRAE 15	Safety code for Mechanical refrigeration
ASHRAE 23	Methods of testing and rating positive displacement refrigerant compressors and condensing units
ASHRAE 30	Methods of testing liquid chilling packages
ASME SEC VIII DIV I	Boiler and pressure vessel code
ANSI B 31.5	Code for refrigeration piping
ARI 550/590 (1998)	Standard for reciprocating and rotary water chilling packages
ARI 575	Standard for method of measuring machinery sound within an equipment space
ISO 1940	Mechanical vibration – Balance quality requirements of rigid rotors
ISO 10816-1	Mechanical vibration – Evaluation of machine vibration of measurements on non-rotating parts. General guidelines

3 **TYPE**

The chilled should be of modular construction and should be with multiple inverter scroll compressors having multiple refrigerant circuit & automatic capacity controls and unit mounted VFD along with necessary controls. Chiller shall be ISEER certified and minimum 3 star rated.

The chiller should be factory assembled and tested and should be complete with evaporator, Air-cooled Condenser, Compressor, Microprocessor based control panel mounted on common base frame / skid. The chiller should be with factory charged refrigerant R-410A/R407C and compressor oil.

The chiller is to be designed for tropicalized condition with higher air over coil temperature not less than 35 Deg C.

The chiller should be capable of automatic loading and unloading based on multiple compressor options by sensing the chilled water in temperature.

4 **CHILLER:**

Chiller shall be multi pass, DX and designed for the duty specified in the schedule of equipment. The shell shall be of welded steel construction fitted with steel sheets on either side. The cooler shall have copper tubes with micro grooves. The tubes shall be internally reinforced seamless copper type rolled into tube sheets. The tubes shall be designed to incorporate a minimum of 1 or 2 independent refrigerant circuits. The tube
ends shall be properly expanded in the tube sheet to prevent leakage of refrigerant.

Tubes shall be individually replaceable from either end of the heat exchangers without affecting the strength and durability of the tube sheet. The baffles on the waterside in the shell are to be arranged to ensure adequate water velocity over the tubes and proper direction of flow. The refrigerant heads shall be made of cast iron and the faces ground to a close tolerance to prevent leakage of refrigerant between passes and between the circuits in case of a multi circuit cooler. Chiller (Evaporator): Chiller shall be designed so as to prevent liquid refrigerant entering the compressor. The chiller shall be provided with liquid level sight glass and a relief service to prevent excess pressure in the heat exchanger.

The chiller shall be provided with following connections and accessories.

- Refrigerant inlet and outlet pressure gauges.
- Drain and vent connections with stop valves.
- De-scaling valves
- Water flow switches at the outlet
- Ribbed rubber isolator or pads to eliminate transmission of vibration up to 90%.

Chiller shall be insulated with 19 mm closed-cell, polyvinyl - chloride foam with a Maximum K factor of 0.28. Insulation shall be applied to cooler shell, flow chamber, tube
Sheets, suction connection and all the necessary parts (wherever required). The insulation shall be set with compound recommended by the insulation manufacturer and shall be applied sealing the joints. The insulation shall be applied in such a manner that water boxes and covers shall be removable without damaging it.

Air-cooled Condenser:

The air-cooled condenser should be of adequate surface area to facilitate efficient cooling. The copper tube to be used should be with inner groove for higher surface area and thickness not less than 0.28mm. The type of fins should be aluminum and minimum 14 Fins per inch to be considered. The condenser fan motor should be of TEFC and speed less than 1000 RPM. The motor should be with Class F insulation.

Microprocessor Controller:

The chiller should be equipped with an intelligent Microprocessor based control panel. The Microprocessor should have following features;

1. Digital setting of temperature levels
2. Built in time delays
3. Auto distribution of load
4. Run time equalization for multiple compressors.
5. Protection mechanism
6. Remote control operation
7. Non-volatile memory
8. Self diagnostics
9. Auto restart.

5 Following accessories shall be considered to be part of equipment. These may be soured locally.

- Drain and vent connections with stop valves.
- De-scaling valves
- Water flow switches at the outlet
- Ribbed rubber isolator or pads to eliminate transmission of vibration upto 90%.

6 SELECTION OF WATER CHILLING UNIT

The water chilling unit should be selected for least power consumption at all operating points. The maximum IKW/TR of the chiller at Full load shall not be more than 1.3 KW/TR at site conditions. ARI certified print out shall be submitted alongwith the offer.

7 PAINTING

The Rotary Screw Chilling Machine shall be finished with durable enamel paint. The shop coats of paint that may become marred during shipment or erection, shall be cleared with mineral spirit, wire bushed and spot primed over the affected areas & then be coated with enamel paint.

8 **TESTING**

Equipment capacity in tons of refrigeration shall be computed from the temperature readings and water flow measurements. Computed results shall tally with the specified capacities. The power consumption should tally with the specified capacities according to the figures furnished in the tender. The contractor shall provide all instruments and personnel for tests.

9. **START UP**

The Chiller manufacturer shall provide a factory trained representative, employed by the chiller manufacturer, to perform the start-up procedures as outlined in the start-up, operation and maintenance manual provided by the chiller manufacturer.

After the above services have been performed, the same factory trained representative shall be available for classroom instruction not to exceed a period of 4 hours to instruct the owner's personnel proper operation and maintenance of the chiller
Manufacturer shall supply the following literature:
Start-up, operation and maintenance instructions & manual
Installation instruction
Field wiring diagrams

SPECIFICATIONS FOR PUMPS

1. **SCOPE**

1.1 This section of specification covers the supply, installation, testing, commissioning of water pumps along with accessories conforming to these specifications and in accordance with requirement of drawings, 'Technical Schedule of Equipment' and of the 'Schedule of Quantities'

2. **CODES AND STANDARDS**

2.1 The design, materials of construction, manufacture, inspection, performance and testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility. The equipment supplied shall comply with the latest applicable Indian, American, British or equivalent standards.

3. **TYPE**

3.1 All chilled, condensing water pumps shall be of capacity and size in accordance with the requirements indicated in the drawings and 'Schedule of Quantities' Pumps shall conform to relevant IS standards/codes.

4. **MATERIAL OF CONSTRUCTION**

The pumps shall be of centrifugal back pull out / monoblock type as specified in "Schedule of Quantities" with the following material of construction.

Type	Horizontal Split casing / End Suction Back Pull Out	Monoblock
Duty	Chilled / Condenser water	Chilled / Condenser water
Casing	Cast Iron	Cast Iron
Impeller	Bronze / Gunmetal machined to close tolerance	Bronze / Gunmetal machined to close tolerance
Shaft	High quality alloy steel EN8 grade	High quality alloy steel EN8 grade
Bearings	Heavy duty ball/roller	Heavy duty ball/roller
Base plate	Cast iron/fabricated MS channel in all welded construction	Cast iron/fabricated MS channel in all welded construction
Seal	Mechanical	Mechanical
Flanges	Standard companion As per IS standards IS -1536/1960	Standard companion As per IS standards
Speed (Max)	1450 RPM	2900 RPM
Drive	TEFC Motor upto 7.5 HP	TEFC Motor upto 7.5 HP
Starter	DOL below 7.5 HP ; Star Delta for 7.5 HP and above	DOL below 7.5 HP: Star Delta for 7.5 HP and above

Other Components	Wearing rings, sleeves and any other standard accessories	Wearing rings, sleeves and any other standard accessories

5 **ININE PUMPS:**

Pumps shall be single stage, in line pull out design to allow removal and service of the entire rotating assembly without disturbing the pump casing & piping. Pump volute shall be Class 30 cast iron with integrally cast pedestal support feet. The impeller shall be cast bronze enclosed type, balanced to ISO 1940-1:2003 / ANSI/HI 1.1-1.5-1994, section 1.4.6.1.3.1, balance grade G6.3 and keyed to the shaft and secured by a locking cap screw. Pump Shaft shall be integrated with coupling by means of friction welding and make up a completely stable and rigid mechanical unit. Unless otherwise specified, renewable wear ring shall be furnished at least on the casing. The liquid cavity shall be sealed off at the pump shaft by an internally-flushed mechanical seal with ceramic seal seat and carbon seal ring, suitable for continuous operation at 284 Deg F (140 Deg C). Antifriction bearings shall be of standard type and shall meet minimum L-10 rating life of 25000 hrs. Maximum allowable working pressure for all the pressure containing parts shall in no case be less than the maximum discharge pressure produced by the pump at shut off (including tolerances), at the max suction pressure, for the maximum impeller diameter and the maximum continuous speed. MAWP shall not be less than 10 kg/cm² for pumps with 125# flanges (i.e. with cast iron casing) & 16 kg/cm² for pumps with 150# flanges. Pump shall be rated for minimum of 175 psi (12bar) working pressure. Volute shall have gauge tapping at the suction and discharge nozzles and vent and drain tapping at the top and bottom. The pump vibration limits shall conform to Hydraulic Institute ANSI/HI 1.1-1.5-1994; section 1.4.6.1.1 or ISO 10816 for recommend acceptable unfiltered field vibration limits (as measured per HI 1.4.6.5.2) for pumps with rolling contact bearings. The maximum permissible sound pressure level of the pump driver train shall not exceed 75 dbA upto 120 HP & shall not exceed 82 dbA for ratings beyond 120 HP, measured at 1m from pump surface for the recommended range of operation. The pump should be of close-coupled type with stub shaft. Motor shall meet IEC / NEMA and EPACT '92 (where applicable) specifications and shall be of the size, voltage and enclosure called for on the plans. Pump and motor shall be factory aligned. The pump(s) selected shall conform to HI 9.6.3.1 standards for Preferred Operating Region (POR) unless otherwise approved by the engineer. The pump NPSH shall conform to the HI 9.6.1-1997 standards for Centrifugal and Vertical Pumps for NPSH Margin. Pump with constant speed drives shall be capable of at least 5 % head increase at rated condition and at rated speed by replacing with a new impeller. Offered impeller shall in no case be less than the minimum diameter impeller. Each pump shall be hydrostatically tested at factory as per Hydraulic Institute standards. Pumps with variable speed drives shall be capable of operating continuously up to 105% of rated speed as well as operating briefly up to driver trip speed. Casing vent and Drain as per manufacturer standard shall be provided. As an option casing drain with an isolation valve and flanged piping terminated at the skid edge shall be provided. Motor should be of variable frequency drive compatible. Motor protection should be IP 55 min. Insulation class should be class F with temperature rise limited to class B.

Actual pump capacity along with the power consumption at full and part load conditions shall be as shown in the form of performance curve in technical submittal.

6. **ACCESSORIES AND FITTINGS included in cost of pump**

Pump shall be complete with

Lubrication fittings

Test and air vent cocks.

Water seal piping connections

ACCESSORIES AND FITTINGS excluded from cost of pump

Gland drain (25mm min) piping upto nearest floor drain point.

Suction, discharge pressure gauge (not less than 150 mm diameter) of appropriate range, with globe valves.

Suction and discharge shut off valves.

Discharge check valve

Y type strainer at suction of each pump

Flexible couplings (at section & discharge) with control rods.

7 ACCESSORIES AND FITTINGS excluded from cost of pump

- Gland drain (25mm min) piping upto nearest floor drain point.
- Suction, discharge pressure gauge (not less than 150 mm diameter) of appropriate range, with globe/ball valves.
- Suction and discharge shut off valves.
- Discharge check valve
- Y type strainer at suction of each pump
- Flexible couplings (at section & discharge) with control rods.

8 **INSULATION**

The Pump casings for chilled water along with its accessories and fittings shall be insulated as specified in section on insulation. The cost of this insulation should be included in the cost of the pump. Pumps shall be insulated only after they have been tested and test results have been approved by the engineer.

9. **INSTALLATION & TESTS**

The pump sets shall be mounted on cement concrete foundation, which shall be provided by other agencies. However, grouting nuts, bolts, channels, shims etc shall be provided by the HVAC contractor. While loading/unloading the Contractor shall ensure no damage to equipment. The Contractor shall rectify any damage done. The decision of Engineer-in-charge is final. The Engineer-in-charge shall see that the equipment is properly installed and connected, if not, the Contractor shall redo the work without any extra cost. Any re shifting/relocating of equipment within the room shall not be paid extra. The equipment shall be located as per drawing and the Contractor shall counter-check with the Engineer-in-charge before installation. The Contractor should visually inspect the equipment along with the Engineer-in-charge and prepare a joint record of missing parts, or mountings or gauges or visual damages. The pump shall be carefully transported to the place of installation and installed on a foundation made for the equipment. The equipment shall be leveled with leveling bolts or shims to the tolerances set by the Engineer-in-charge and equipment manufacturing recommendations and all foundations bolts shall be grouted. The Contractor shall supply necessary foundation bolts and Nuts or isolation pads, isolation mounts. The Contractor's scope shall also include mounting of gauges, and instruments. The installation, testing and commissioning of equipment shall be carried out in accordance with

manufacturer's installation manual and/or the instructions of the Engineer-in-charge. All drive motors shall be meggared with a meggar and readings recorded without load and with load.

Note: - All the hardware required for the installation and equipments required for testing & commissioning shall be supplied by the Contractor.

10. **MECHANICAL BALANCING**

The impeller shall be statically and dynamically balanced.

11. **VISUAL INSPECTION**

Pumps shall be offered for Visual inspection (if specifically asked for) before dispatch. The components of the pumps shall not be painted before inspection.

12. **MATERIAL TEST CERTIFICATE**

Materials of the various pump components shall be tested in accordance with the relevant standard and Test Certificates shall be furnished along with the Pumps.

13. **FIELD TESTING**

After installation, the pumps shall be subjected to testing at site also. If the performance does not meet the requirements regarding capacity, power consumption, vibration and noise etc. as specified, then the equipment shall be rectified or replaced by the VENDOR, at no extra cost to the CUSTOMER

14. **PAINTING**

All ferrous surfaces shall be painted with one coat of red oxide primer paint followed by two coats of synthetic enamel paint (approved shade).

15. **INSULATION**

The Pump casings for chilled water along with its accessories and fittings shall be insulated as specified in section on insulation. The cost of this insulation should be included in the cost of the pump.

Pumps shall be insulated only after they have been tested and test results have been approved by the engineer.

SPECIFICATIONS FOR AIR HANDLING UNITS

1. **SCOPE**

This section of the specification covers the supply, installation, testing and commissioning of double skin construction air handling units along with its accessories, conforming to these specifications and in accordance with requirement of the 'Schedule of Quantities', Drawings and 'Technical Schedule of Equipment'.

2. **CAPACITY**

The air handling capacities, maximum motor HP, static pressure shall be as shown on Drawings and as indicated in 'Schedule of Quantities'.

3 HORIZONTAL FLOOR MOUNTED

The Horizontal floor mounted air handling units shall be double skin modular, draw through type comprising of various sections such as mixing chamber (wherever return air and fresh air are ducted.), pre filter section, chilled water coil section, fan section supply air plenum as per details given in Drawings and Schedule of Equipment.

3.1 AHU HOUSING / CASING:

The AHU housing shall be of double skin construction with main structure made of extruded aluminum hollow sections. The panels shall be double skin sandwich type with 0.6 mm pre painted GSS/ pre-plasticised on the outside and 0.6 mm galvanized sheet inside with 40 mm thick PUF insulation material injected in between. These panels shall be screwed with soft rubber gasket fixed in built in groove of aluminum frame in between to make the joints airtight. Framework for each section shall be joined together with soft Neoprene rubber gasket in between to make the joints airtight. Suitable airtight access doors /panels with nylon hinges and locks shall be provided for access to various sections for maintenance. The entire housing shall be mounted on roller-formed GSS channel framework having pressure die cast aluminum jointers.

3.2 Drain Pan

The drain pan shall be of 18 G aluminum/stainless steel with necessary slope to facilitate fast removal of condensate. It shall be provided with drain connection of suitable size complete with 25 mm rigid insulation. Necessary arrangement will be provided to slide the coil in the drain pan. The drain pan shall be insulated with 12 mm thick close cell Nitrile insulation (self adhesive) or equivalent.

3.3 Cooling / Heating Coil

The chilled /hot water coil shall be of seamless copper tubes not less than 27 G thick and 12mm OD. Coil face areas shall be such as to ensure rated capacity from each unit and such that air velocity across each coil shall not exceed 150 meters per minute. The coil shall be pitched in the unit casing for proper drainage. The fins shall be spaced by collars forming integral part of the fins. The tubes shall be staggered in the direction of airflow.

The fins shall be uniformly bonded to the tubes by mechanical expansion of the tube for minimum thermal contact resistance with fins. Fin spacing shall be 11to 13 FPI. The coils shall be tested against leaks at a hydraulic pressure of 21-kg/sq. cm. This pressure shall be maintained for a period of at least 2 hours. No drop should be observed indicating any leaks. The water headers shall be complete with water in /out connections, vent plug on top and drain at bottom and designed to provide water velocity between 2 to 6 FPS.

3.4 Fan Section with Fan

The fan shall be Forward / Backward curved, double inlet double width type. The wheel & housing shall be fabricated from heavy gauge galvanised steel. The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame & pillow block heavy-duty ball

bearings. The fan shall be selected for a speed not exceeding 1000 RPM. The impeller & fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall not be more than 600 MPM. Fan housing with motor shall be mounted on a common extruded aluminum base mounted inside the air handling housing on anti vibration spring mounts or cushy foot mounts of at least 90% vibration isolation efficiency. The fan outlet shall be connected to casing with the help of fire-retardant double canvas or Neoprene rubber of imported Origin. The fan shall be selected for a noise level of less than 75 DB (A) at one meter distance.

3.5 Filter Section

Each unit shall be provided with a factory assembled filter section containing synthetic media washable air filters with efficiency of 90% down to 10-micron particle size. Filters shall have aluminum frame. Filter face velocity shall not exceed 150 meters per minute. Filter shall fit so as to prevent by pass. Holding frames shall be provided for installing number of filter cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels.

4. FRESH AIR INTAKES

Extruded aluminum construction duly anodized fresh air louvers with bird screen and extruded construction dampers shall be provided in the clear opening in masonry walls of the air handling unit room having at least one external wall. Fresh air louver, damper, pre filters, ducts and fresh air fan with speed regulator (wherever specified in 'Schedule of Quantities') shall be provided. Fresh air dampers shall be of the interlocking, opposed blade louver type. Blades shall be free from rattle. Damper shall be similar to those specified in 'air distribution'. Fresh air fans and fresh air intakes shall be as per the requirements of 'Schedule of Quantities'.

5. ACCESSORIES

Each air handling unit shall be provided with manual air vent at highest point in the cooling / heating coil. In addition, the following accessories may be required at air handling units. Their detailed specifications are indicated in individual sections and quantities separately identified (for items a to i) in 'Schedule of Quantities'.

a. Stem type thermometer at each AHU coil inlet and outlet with tubing and gauge cocks and specification as per the section, 'Automatic Controls and Instruments'
b. Pressure gauge with globe valves at inlet and outlet of each AHU coil with tubing and specifications as per the section, 'Automatic Control and Instruments'.
c. Butterfly valves at inlet and outlet of the each coil.
d. Balancing valve at the outlet of each coil.
e. Y strainer at inlet of each coil.
f. Union and condensate drain piping from the unit up to the drain trap as described in section piping.
g. Motorized two way mixing valves located in chilled /hot water lines connected to the coil. This valve shall be operated by the cooling/heating thermostat and shall control the flow of chilled/hot water as per section 'automatic controls and instruments'.
h. Cooling /heating thermostat as per section 'Automatic Controls and Instruments' shall be located in return air stream.
i. Flexible connection between the fan outlet and duct.
j. Manual Air Vent – 20 mm dia at coil and drain plug at pipe header.
k. Vibration isolators of at least 90% efficiency.

6 SAFETY FEATURES

Each handling unit must have safety features as under:-

a. The fan access door must have micro switch interlocked with fan motor to enable switching off the fan motor automatically in the event of door opening. The access door shall further have wire mesh screen as an added feature, bolted on to the unit frame.
b. Fan and motor base shall be properly earthed from the factory.
c. All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

7. DRIVE

Fan drive shall be 3phase-squirrel cage totally enclosed fan cooled motor suitable for 415 ± 10%V, 50 HZ AC supply. Motor shall be specially designed for quiet operation and motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt drive arrangement with required no. of belts for power transmission without slippage. Belts shall be of oil resistant type of approved make only.

8 DESIGN DATA FOR AIR HANDLING UNITS

- Fan outlet velocity shall not exceed 600 MPM.
- The air velocity across coil shall not exceed 150 MPM.
- The air velocity across air pre filter shall not exceed 150 MPM.

Motor ratings are only tentative and shall be suitable for the duty but not less than the specified HP. The motor shall be selected with a safety factor of at least 15% over and above the brake power. The AHU fan shall be selected for static pressure as indicated in 'Schedule of Quantities'.

9. INSTALLATION

Air Handling Unit shall be installed to permit the removal of all the parts of AHU for any maintenance work without dismantling other equipment such as plenum, pipes, ducts etc. Air handling unit installation shall be carried out as per manufacturer's recommendation and mounted on serrated rubber pads with proper hanging arrangement. The serrated rubber pads shall be in two layers with 16G GI sheet sandwiched in between.

10. PERFORMANCE DATA

Air handling unit shall be selected for the lowest operating noise level of the equipment. Fan performance rating and power consumption data with operating points clearly indicated shall be submitted and verified at the time of testing, commissioning of the installation.

11. TESTING

Cooling/Heating capacity of various air-handling unit models shall be computed from the measurements of airflow and dry and wet bulb temperatures of air entering and leaving the coil.

Flow measurements shall be by anemometer and temperature measurements by accurately calibrated mercury in glass thermometer. Computed result shall conform to the specified capacities and quoted ratings. Consumption shall be computed from measurements of incoming voltage and input current.

SPECIFICATIONS FOR AUTOMATIC CONTROLS AND INSTRUMENTS

1. SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of automatic controls and instruments conforming to these specifications and in accordance with requirement of drawings and 'Schedule of Quantities'

2. PRODUCTS

2.1 **2 WAY VALVE**

2 way motorized / modulating valve for each air handling units shall be provided in chilled water line at each air handling units as shown on the Drawings and included in Schedule of Quantities. Each valve shall be actuated by a space or duct mounted sensor. Constant space condition shall be maintained by continuous proportional modulation of the chilled water through the coil. Motor shall be proportional modulating motor. Motor shall be suitable for 24 volts supply and shall have a cover mounted 220/24 volts transformer factory- installed. The unit shall be suitable for outdoor installation in the open space.

2 way motorized valve for each fan coil unit shall be provided in chilled water lines at each fan coil unit as shown on Drawings and included in Schedule of Quantities. The valve shall be actuated by space thermostat. Constant space conditions shall be maintained by allowing all of chilled water to either pass through the coil.

Valve shall be motorized two-position diverting valves 20 (3/4 inch) diameter with flare connection. Valve shall be selected for water flow rate of 5-6 USGPM. Pressure drop across the valve shall not exceed 2 psi. Valve shall have the facility to replace motor & actuator without removing the valve body.

2.2 **Flow switches** shall be provided in the condensing water line (outlet) and chiller water line (outlet) only near the chilling machine. The control supply of chilling units shall be interlocked with these flow switches.

2.3 **Thermostats** shall be electrical mode, fixed differential type with sensing element located in the return air stream.

2.4 **Electronic Modulating Temperature Controller** An electronic temperature controller with 0-10 output, working on 24V AC, shall be used to modulate the motor of 2/3 way mixing/diverting valves of AHU. The sensing element of electronic temperature controller shall be a precalibrated NTC thermistor sensor mounted either within the controller or in the return air duct. The range of the electronic temperature controller shall be 15°-35° C with a differential of 1°C.

2.5 **SNAP acting fixed differential thermostat** The thermostat for fan coil unit shall be electronic type with integrated ON/OFF, 3 FAN SPEED and HEAT/FAN/COOL switches. The thermostat shall operate on 230 V mains voltage and shall be suitable for operating 2 position motorized 3/2 way mixing/diverting valve. The thermostat shall have a precalibrated NTC thermistor and shall be suitable for operation in the range of 15°-35° C with a switching differential of 1° C.

3. **INSTRUMENTS**

3.1 **Thermometer**: Thermometers shall be dial type 100 mm dia or V form industrial type. Body shall be aluminum alloy, anodized gold colored surface. The casing shall be adjustable side ways for reading from the front. The glass capillary shall be triangular in shape with blue mercury filled in glass for better visibility. Scale of reading shall be of the range 0 deg C TO 60 deg C & +32 deg F to 150 deg F. Graduation of scale shall be 1 deg in both readings. Ranges of scales shall be 30-90 degrees F (0-50 deg C) for all conditioning applications of cooling only.

Thermometer shall be suitable for 15mm connection. Thermometer for chilled water shall be with long stem so that thermometer is removable without damaging the insulation ms socket to be welded on pipes shall be provided with thermometer. Thermometer shall be installed of chilled water supply and return at each air handling unit, supply and return of each chiller, condenser.

3.2 **Pressure gauge**: shall be installed on suction header and at discharge side of each pump in the chilled water supply and return at each air handling unit, at inlet and outlet of each chiller. Suction side gauge at pump suction header shall be compound gauge with 150 MM dia, range 75 cm vacuum to 10 kg pressure. Discharge side gauge at pumps and at all other locations shall be 150mm range 0-10 kg per sq cm (0-150 PSI) Pressure

SPECIFICATION FOR FANS & BLOWERS

1. SCOPE

The scope of this section comprises the supply, installation, testing and commissioning of centrifugal fans, inline fans and axial flow fans conforming to these specifications and in accordance with the requirement of drawings and 'Schedule of Quantities'.

2. TYPE

The blowers / fans shall be of type as indicated in drawings and 'Schedule of Quantities'

3 GENERAL REQUIREMENTS.

Static, dynamic balancing and vibration: the individual fan impeller, blades, motor shall be statically and dynamically balanced independently. After assembly the entire fan motor unit shall not give rise to any vibrations. The balancing shall be as per ISO: 1940 GR 6.3.

4 **NOISE LEVEL**: The tendered shall indicate the noise level generated by the fan / motor unit in terms of decibel units to be measured at 3M from the unit. This shall fall in line with best engineering standard.

5. CENTRIFUGAL FAN

Centrifugal fan shall be double inlet double width type construction, arrangement III, complete with squirrel cage induction motor, V belt drive, belt guard, access door and vibration isolators.

The fan housing shall be fabricated from heavy gauge galvanized steel 14-gauge sheet and in welded construction. It shall be suitably reinforced and supported by structural angles. Split casing shall be provided for larger sizes of fans.

Fan impeller shall be forward / backward curved as per schedule of quantities. Fan wheel and housing shall be statically and dynamically balanced. For fans up to 450 mm dia the outlet velocity shall not exceed 600-meter/ minute and maximum fan speed shall not exceed 1450 RPM. For fans above 450 mm dia, the outlet velocity shall be with in 700 meters / minutes and maximum fan speed shall not exceed 1000 RPM. (For forward curved fans only).

The fan impeller shall be mounted on a solid shaft supported to housing with angle iron frame and pillow block heavy duty bearing shaft shall be constructed of steel, turned, ground and polished.

MOTOR

Fan motor shall be suitable for 415 ± 10% volts, 50 cycle, 3 phase AC supply totally enclosed fan cooled motor provided with class F insulation. Motor nameplate horsepower shall exceed brake horsepower by minimum 20%. Motor shall be designed for quiet operation and motor speed shall not exceed 1440 RPM

The fan shall be selected for a noise level of less than 78 DB (A) at a distance of one meter

Drive to fan shall be provided through belt with adjustable motor sheave and standard belt guard. Belts shall be of oil resistance type.

VIBRATION ISOLATORS

MS base shall be provided for fan and motor and shall be mounted on a concrete foundation through resistoflex vibration isolators. The concrete foundation shall be at least 15cm above the finished floor level.

6. INLINE FANS

Inline fan shall incorporate SISW direct driven centrifugal fan with TEFC (IP-44) motor. The fan assembly shall be enclosed in a sheet metal housing of 22 gauge GSS and with necessary inspection cover with proper gasket assembly. The fan material shall be galvanized sheet steel. Flanges shall be provided on both sides of inline fan to facilitate easy connection. Flexible anti-vibration joints shall be provided to arrest vibration being transferred to other equipment connected to inline fan. Motor shall be single phase/three phase as per duty conditions.

All single-phase fans shall be provided with speed regulators while all three phase fans shall be provided with opposed blade dampers in GSS construction at fan outlet for air balancing.

7. PROPELLER FANS

Propeller fans shall be direct driven, three or four blade type mounted on a steel mounting plate with orifice ring.

Mounting plate shall be of steel construction, square with streamlined venturi inlet coated with baked enamel paint. Mounting plate shall be of standard size, constructed of 12 to 16 gauge steel sheet depending upon the fan size. Orifice ring shall be correctly formed by spinning or stamping to provide easy passage of air without turbulence and to direct the air stream.

Fan blades shall be constructed of aluminum or glass reinforced polypropylene. Fan hub shall be of heavy welded steel construction with blades bolted to the hub fan blades and assembly shall be statically and dynamically balanced

Shaft shall be of steel accurately ground and shall not pass through first critical speed through entire range of specified fan speed.

Motor shall be standard permanent split capacitor of shaded pole for small sizes, totally enclosed with pre-lubricated sleeve or ball bearings, designed for a quiet operation with a maximum speed of 1000 RPM for fans 60 cm dia or larger and 1440 RPM for fans 45 cm dia and smaller. Motors for larger fans shall be suitable for 415 ± 6% volts. 50 cycle 3-phase power supply and for smaller fans shall be suitable for 220 ± 6% volts, 50 cycles single-phase power supply. Motors shall be suitable for horizontal or vertical service as indicated in drawings and Schedule of Quantities.

Propeller fans shall be provided with following accessories: -

Wire guard and bird-screen

Gravity louvers at outlet

Regulator for controlling fan speed for single-phase fan motor.

Single-phase preventions for 3 phase fans.

Wiring between regulator and fan motor including termination at both ends.

8 TECHNICAL SPECIFICATIONS

The firm shall submit the technical data and performance characteristics with operating points duly marked for approval prior to fabrication. The supplier shall supply the test certificates of all the fans.

9. PAINTING

All fans and their accessories shall be painted with two coats of suitable enamel paint after one coat of Red Oxide primer.

10. PACKING

The fans shall be dispatched in packed condition to avoid damage during transportation to site. Transit insurance for the fans shall be included in this offer.

11. INSPECTION & TESTING.

All fans shall be subjected to inspection and testing requirements as given below. The contactor shall be responsible for providing all inspection facilities and for conducting all tests at works and at site after erection. Test certificates for all fans shall be submitted, some fans at the discretion of Client may be tested at the factory in his presence.

The performance of the fan motor unit shall be tested by operating at design conditions. The following parameters will be tested vis-à-vis the approved performance curves

Airflow capacity.

Static head developed

BHP requirement

Vibration and noise level

12. PERFORMANCE DATA

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

13. TESTING

Capacity of all fans shall be measured by an anemometer. Measured airflow capacities shall conform to the specified capacities and quoted ratings, power consumption shall be computed from measurements of incoming voltage and incoming current.

SPECIFICATIONS FOR FACTORY FABRICATED SHEET METAL WORK

1 **DUCT MATERIAL:** The ducts shall be fabricated from galvanized steel sheets class VIII - Light coating of Zinc conforming to ISS: 277-1962 (REVISED) with accompanying Mill test Certificates. Galvanizing shall be of 120gms/sq.m. (Total coating on both sides). In addition, if deemed necessary, samples of raw material, selected at random by owner's site representative shall be subject to approval and tested for thickness and zinc coating. Only new, fresh, clean (unsoiled) and bright GI sheets shall be used. The Engineer in charge reserves the right to summarily reject the sheets not meeting these requirements. Fabrication of ducts shall be through Lock forming machines. The G.I. raw material should be used in coil-form (instead of sheets) so as to limit the longitudinal joints at the edges only irrespective of cross-section dimensions. This shall be done as per the general specifications of IS 655 read along with the latest modification.

2 **FACTORY FABRICATED DUCTING:** All duct work including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and other transformation pieces must be factory-fabricated. Equivalency will require fabrication by utilizing the following machines and processes to provide the requisite quality of ducts and speed of supply. Coil lines to ensure location of longitudinal seams at comes / folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct. All ducts, transformation pieces and fittings to be made on CNC profile cutlers for required accuracy of dimensions, location and dimensions of notches at the folding lines. All edges to be machine treated using lock formers, flanges and roller for fuming up edges. Sealant dispensing equipment for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified will be used. The fabricated duct dimensions should be as per approved drawings and all connecting sections are dimensionally matched to avoid any gaps. All fabricated dimensions will be within ± 1.0 mm of specified dimension. To obtain required perpendicularity, permissible diagonal tolerances shall be ± 1.0 mm per meter. All transverse duct connectors (flanges / cleats) and accessories/related hardware are such as support system shall be zinc-coated (galvanized). Each and every duct pieces should be identified by color coded sticker which shows specific part numbers, job name, drawing number, duct sizes and gauge. Ducts shall be straight and smooth on the inside Longitudinal seams shall be airtight and at comers only, which shall be either Pittsburgh or Snap Button Punch as per SMACNA practice, to ensure air tightness. Changes in dimensions and shape of ducts shall be gradual (between 1:4 and 1:7). Turning vanes or air splitters shall be installed in all bends and duct collars designed to permit the air to make the turn without appreciable turbulence. The gauges, joints and bracings for sheet metal duct work shall further conform to the provisions as shown on the drawings. Factory Fabricated ducts shall

have the thickness of the sheet shall be as follows. Bracing with GI tie rods of suitable diameter GI rod for each piece of duct shall be provided.

Sl.	Size of Duct	Sheet Thickness	Fastener Size	Type of Joints	Support Angle
	Up to 600 mm	0.5 mm	3/8”	Fabricated out of G.I. sheet of 24 gauge at every 1.2 m internal or The flanges shall be made out of the same duct sheet and all the four corner shall be fitted for fitting the bolt	25x25x3 mm
a	601- 900 mm	0.63 mm	3/8”	Fabricated out of G.I. sheet of 24 gauge at every 1.2 m internal or The flanges shall be made out of the same duct sheet and all the four corner shall be fitted for fitting the bolt	25x25x3 mm
b	900 mm to 1200 mm	0.63 mm	3/8”	E-24 type flange, shall be fabricated out of 24 G sheet at every 1.2 m internal or the flanges shall be made out of the same duct sheet and all the four corner shall be fitted for fitting the bolt	25x25x3 mm
c	1201 mm to 1500 mm	0.80 mm	5/8”	E-22 type flange shall be fabricated out of 22 G sheet at every 1.2 m internal. The flanges shall be made out of the same duct sheet and all the four corner shall be fitted for fitting the bolt	40x40x5 mm
d	1501 mm to 2250 mm	1.00 mm	5/8”	J-16 type flange, shall be fabricated out of 16G sheet at every 1.2 m internal. The flanges shall be made out of the same duct sheet and all the four corner shall be fitted for fitting the bolt	40x40x6 mm angle
e	2251 mm and above	1.25 mm	5/8”	J-16 type flange, shall be fabricated out of 16G sheet at every 1.2 m internal. The flanges shall be made out of the same duct sheet and all the four corner shall be fitted for fitting the bolt	50x50x6 mm with MS rods of 12 mm dia.

For each drawing, all supply of ductwork must be accompanied by computer-generated detailed bill of material indicating all relevant duct sizes, dimensions and quantities. In addition, summary sheets are also to be provided showing duct areas by gauge and duct size range as applicable. Measurement sheet covering each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise. All duct pieces to have a part number, which should correspond to the serial number, assigned to it in the measurement sheet. The above system will ensure speedy and proper site measurement, verification and approvals.

4. **DUCT INSTALLATION:** All ducts shall be fabricated and installed in workman like manner, generally conforming to relevant BIS codes. Ducts so identified on the drawing shall be acoustically lined and thermally insulated as described in the section 'Insulation' and as indicated in 'Schedule of Quantities. Duct dimensions shown in drawings are overall sheet metal dimensions inclusive of the acoustic lining where required and indicated in 'Schedule of Quantities'. Ducts shall be straight and smooth on the inside with neatly finished joints. All joints shall be made airtight. All exposed ducts upto 60 cm width within conditioned spaces shall have slip joints. The internal ends of the slip joints shall be in the direction of airflow. Ducts and accessories within ceiling spaces visible from air-conditioned areas shall be provided with two coats of matt black finish paint. Change in dimensions and shape of ducts shall be gradual. Air turns shall be installed in all vanes arranged to permit the air to make the turn without appreciable turbulence. Ducts shall be fabricated as per details shown on drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees of ample size to keep the ducts true to shape and to prevent buckling, vibration or breaking. Rubber gasket 3 mm thick shall be used between duct flanges and between duct and duct supports instead of felt in all ducting installation for complete sealing. During the construction, the Contractor shall temporarily close duct openings with sheet metal covers to prevent debris-entering ducts and to maintain opening straight and square, as per direction of The Engineer in charge. Great care should be taken to ensure that the ductwork does not extend outside and beyond height limits as noted on the drawings. All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be tight and shall be made in the direction of airflow. The ducts shall be reinforced where necessary, and must be secured in place so as to avoid vibration of the duct on its support. All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise or vibration. All ducts shall be fabricated and installed in accordance with modern design practice. The sheet metal gauges and fabrication procedures as given in I.S. specifications shall be adhered to and shall be considered as an integral part of these specifications. The ductwork shall be varied in shape and position to fit actual conditions at building. All changes shall be in accordance with accepted duct design and subject to the approval of the Engineer in charge. The Contractor shall verify all measurements at building and shall notify the Engineer in charge of any difficulty in carrying out his work before fabrication. Sponge rubber or approved equal gaskets shall be installed between all connections of sheet metal ducts to walls. Sheet metal connections shall be made to walls and floors by means of galvanized steel angles anchored to the building structure with anchor bolts and with the sheet bolted to the angles. Sheet metal connections shall be as shown in the drawings or as directed by Engineer in charge. All ductwork shall be independently supported from building construction. All horizontal ducts shall be rigidly and securely supported, in an approved manner, with trapeze hangers formed of galvanized steel rods and galvanized steel angel / channel under ducts. All vertical ductwork shall be supported by structural members on each floor slab. Duct supports may be through galvanized steel insert plates left in slab at the time of slab casting. Galvanized steel cleat with a hole for passing the hanger rods shall be welded to the plates. Trapeze hanger formed of galvanized steel rods and angles / channels shall be hung through these cleats. Wherever use of metal insert plates is not feasible, duct support shall be through dash / anchor fastener driven into the concrete slab by electrically operated gun. Hanger rods shall then hang through the cleats. Where ducts pass through brick or masonry openings, it shall be provided with 25 mm thick TF quality thermo Cole around the duct prior to sealing of the opening. All ducts shall be totally free from vibration under all conditions

of operation. Whenever ductwork is connected to fans, air handling units or blower coil units that may cause vibration in the ducts, ducts shall be provided with a flexible connection, located at the unit discharge. Flexible connections shall be constructed of fire retarding flexible heavy canvas sleeve at least 100 mm long but not more than 200 mm, securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting ductwork rigidly held by independent supports on both sides of the flexible connection. The flexible connection shall be suitable for pressure at the point of installation. Flanges and supports are to be black, mild steel and are to be primer coated on all surfaces before erection and painted with aluminum thereafter. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified. The ductwork should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies.

5 **DUCT TESTING:** After completion, all duct system shall be tested for air leakage. The entire air distribution system shall be balanced to supply the air quantity as required in various areas and the final balance of air quantity through each outlet shall be submitted to the Engineer in charge for approval. Measured air quantities at fan discharge and at various outlets shall be identical to or less than 5% in excess of those specified and quoted. Branch duct adjustments shall be permanently marked after air balancing is completed so that these can be restored to their correct position if disturbed at any time.

6 **DUCT DAMPERS:** At the junction of each branch duct with main duct and split of main duct, volume control dampers must be provided. Dampers shall be rigid in construction to the passage of air. The volume dampers shall be of an approved type, lever operated and complete with suitable level links & quadrants, locking devices, which will permit the dampers to be adjusted and locked in any position. The dampers shall be of opposed blade or louver type. The damper blade shall not be less than 1.25 mm (18) gauge and shall not be over 225 mm wide. Automatic and manual volume opposed blade dampers shall be complete with frames and bronze bearings as per drawings. Damper frames shall be constructed of 16 gauge steel. After completion of the ductwork, dampers are to be adjusted and set to deliver the required amount of air as specified in the drawings.

7 **ACCESS PANEL:** A hinged and gasket access panel shall be provided on ductwork before each control device that may be located inside the ductwork. Doors shall be provided with non toxic rubber / PVC gaskets. Angle joints shall be provided with non toxic rubber / PVC gaskets for leak tightness of the joints. Access door/panels shall be provided: -
Near each smoke sensor
Any other place specifically mentioned in the drawing or if asked by Engineer in charge during execution stage.

8. **SUPPLY AND RETURN AIR DIFFUSERS:** Supply and return air diffusers shall be made of extruded aluminum section as specified in BOQ. The diffusers shall be powder coated in finish. Supply air diffusers shall be provided with screw operated opposed blade volume control devices of extruded Aluminium construction in black mat finish. The diffusers shall be suitable for concealed fixing arrangement and as approved by Engineer in charge. The diffusers shall be provided with removable central core. All diffusers shall be selected as per selection curves and in consultation with Engineer in charge. All diffusers shall have soft continuous rubber / foam gasket between the periphery of the diffusers and the surface on which it has to be mounted.

9. **LINEAR GRILLES:** Linear continuous supply or return air grilles shall be extruded aluminum construction with fixed horizontal bars at 0 /15^0 inclination with flanges on both sides. The thickness of fixed bar louvers shall be 3mm in front and the flange shall be 20mm wide with round edges. The grille shall be suitable for concealed fixing and horizontal bars of the grille shall be mechanically crimped from the back to hold them. Volume control device of extruded Aluminium construction in black mat finish shall be provided in S.A. duct collars.

10. **DOUBLE ADJUSTABLE LOUVERED SUPPLY / RETURN AIR GRILLES WITH HORIZONTAL LOUVER ARRANGEMENT**:
The grille shall be adjustable as each louver shall be pivoted to provide pattern with 0^0 to plus or minus 15^0 ARC upto 30^0 deflection down towards. The louvers shall hold deflection settings under all conditions of velocity and pressure. The rear louver of the register shall be in black shade. Volume control device of extruded Aluminium construction with black mat finish shall be provided in S.A. grills.

11. **EXHAUST AIR REGISTER:** Exhaust air register shall be made of extruded aluminum with fixed horizontal louvers at 40 degree angle setting on a 20 mm louvers pitch. The register shall have 20 mm wide flange with round edges all around. The register shall be suitable for front screw fixing. Volume control device of extruded Aluminium construction with black mat finish shall be provided.

12. **FRESH AIR INTAKE LOUVERS:** Fresh air intake louvers 50 mm deep (minimum) wherever required as per shop drawing will be made of extruded aluminum construction duly anodized or powder coated. Bird / insect screen will be provided with the intake louvers. The blades are inclined at 45^0 on a 40 mm blade pitch to minimize water ingress. The lowest blade of the assembly shall extend out slightly to facilitate disposal of rainwater without falling in door / wall on which it is mounted. Wherever specified, the intake louvers shall be provided with factory fitted all aluminum construction volume control dampers in black anodized finish.

13. **MOTORIZED COMBINED SMOKE & FIRE DAMPERS – SPRING RETURN** All supply and return air ducts at AHU room crossings (or ducts as applicable) and at all floor crossings shall be provided with approved make fire and smoke dampers of at least 120 minutes fire rating certified by CBRI ROORKEE as per UL 555:1973. Fire damper blades & outer frame shall be formed of 1.6 mm galvanized sheet steel. The damper blade shall be provided on both ends using chrome-plated spindles in self-lubricated bronze bushes. Stop seals will be provided on top and bottom of the damper housing made of 16 g galvanized sheet steel. For preventing smoke leakage side seals will be provided. In normal position damper blade shall be held in open position with the help of a 24 V operated electric actuators thereby providing maximum air passage without creating any noise or chatter. The damper shall be actuated through electric actuator. The actuator shall be energized with the help of a signal from Fire Alarm Control Panel system with multi criteria smoke detector installed in AHU room/R.A. duct/damper. The fire damper shall also close due to Temperature rise in Supply air ducts thru the electric temperature sensor factory set at 165^{o}F micro switches with Bakelite base will be provided to stop fan motor and give open & close signal at remote panel in case of motorized actuator. Each dampers in case of motorized smoke-cum-fire damper shall have its own panel which will incorporate necessary circuit required to step down voltage available from power supply to shown status of the damper (open or close), to allow remote testing of damper & indication in event of damper closure due to signal from smoke sensor / temperature sensor & reset button. Additional terminal will be provided to have signal (sound beep or visual) in central control room. Damper actuator shall be spring return so as to close the damper in the event of power failure automatically and open the same in case of power being restored. Spring return action of the actuator shall be an in-built mechanism and shall not be mounted externally. The damper shall be installed in accordance with the installation method recommended by the manufacturer.

14 FRESH AIR INTAKES Extruded aluminum construction duly anodized fresh air louvers with bird screen and extruded construction dampers shall be provided in the clear opening in masonry walls of the air handling unit room having at least one external wall. Fresh air louver, damper, pre filters, ducts and fresh air fan with speed regulator (wherever specified in 'Schedule of Quantities') shall be provided. Fresh air dampers shall be of the interlocking, opposed blade louver type. Blades shall be free from rattle. Damper shall be similar to those specified in 'air distribution'. Fresh air fans and fresh air intakes shall be as per the requirements of 'Schedule of Quantities'.

15 MISCELLANEOUS

Non Toxic rubber / PVC gaskets also to be provided behind the flange of all grilles. Each shoot from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot. Inspection doors measuring at least 450 mm x 450 mm are to be provided in each system at an appropriate location, as directed by Engineer-in-Charge. Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck. Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations. Additional supports are to be provided where required for rigidity or as directed by Engineer-in-Charge. All duct work joints are to be true right angle and with all sharp edges removed. All grilles, and diffusers shall be powder coated in color as approved by Architect / Engineer in charge before installation. All ducts immediately behind the grilles / diffusers etc. are to be given two coats of black paint in Matt finish. The return air and dummy portion of all linear grilles shall be provided with a vision barrier. The vision barrier shall be fixed to the false ceiling frame with self tapping screws and shall be given two coats of black paint in matt finish. Care shall be taken to ensure that the return air path is not obstructed.

SPECIFICATIONS FOR THERMAL INSULATION

1 SCOPE:

The scope of this section comprises the supply and application of insulation conforming to these specifications.

2 **MATERIAL:**

iv) Insulation material shall be Chemically cross linked closed cell polyethylene foam (XPE) insulation material. Density of material shall be 30+_3 kg/m3 Thermal conductivity of XPE foam shall not exceed 0.035 W / (M.K) at an average temperature of 40°. Flammability, Smoke Density and non-dripping of material shall be as per DIN 5510 (Pt-2)-54837. Horizontal Flammability test should classify 94 HBF as per UL -94. The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class 'O.'. Insulation material shall have negligible water vapour permeability, water vapour resistance factor (μ) >12000 as per DIN EN ISO :12572. Insulation material shall have good ozone resistance non-fiber erosion and CFC / HCFC free. Insulation material shall have negligible effects of acids and alkalis as per IS 9845 – 1998. Insulation material shall have zero rating for fungal and bacterial growth as per ASTM G-21 and ASTM G-22

Thickness of the insulation shall be as specified for the individual application. Each lot of insulation material delivered at site shall be accompanied with manufacturer's test certificate.

3 **DUCT INSULATION**: External thermal insulation shall be provided as per the approved drawings and specifications. The thickness of microcellular closed cell nitrile rubber thermal insulation shall be as shown on drawing or identified in the schedule of quantity. Following procedure shall be adhered to:

- The duct surfaces shall be cleaned with suitable solvents and rendered free from all physical and chemical impurities.
- Measurement of surface dimensions shall be taken properly to cut XLPE thermal insulating sheets to size with sufficient allowance in dimension.
- Material shall be fitted under compression and no stretching of material should be allowed.
- Adhesive shall be applied on the back of the insulating material sheet and then on to the metal surface.
- When adhesive is tack dry, insulating material sheet shall be placed in position and pressed firmly to achieve a good bond.
- All longitudinal and transverse joints shall be sealed as per manufacturer's recommendations.
- The adhesive shall be strictly as recommended by the manufacturer.
- The detailed Application specifications are as per the manufacturer's recommendations.

4 **UNDERDECK THERMAL INSULATION:** Underdeck thermal insulation shall be provided with 50 mm thick TF thermocole of minimum density of 20kg /cum. for all the exposed roofs of the air conditioned space as per the approved drawings and specifications.

SPECIFICATIONS FOR PIPING AND FITTINGS

1. SCOPE

The scope of this section comprises the supply and laying of pipes required for chilled water; condenser water & drain water conforming to these specifications and in accordance with the requirement of the 'Technical Schedule of Equipment' and 'Schedule of Quantities'

2. WATER PIPING

Water piping fittings and valves shall be of the following makes or approved equal make and shall conform to IS standards as indicated below.

Pipes UPTO 150MM 200 mm and above	MS, Class B (Medium Class) as per IS 1239 (Part I & II) 1990/1992 Min 6.35 mm thick as per IS 3589
Condensate Water Pipes	Blue Threaded uPVC pipes in schedule 40 class as per ASTM D-1785.

All welding shall be done by qualified welders and shall strictly conform to Standard Code of practice for manual metal arc, welding of Mild Steel

First butt weld of each welder shall be fully radio graphed by HVAC contractor under guidance of Engineer in charge for testing purposes. Upon approval of welding joints the concerned welder shall be allowed to carry further welding of pipes. Rest of the welds shall have 100% visual inspection.

All welded joints (except pipe welded end-to-end) shall be made by use of forged one-piece welding flanges, caps, nozzles, elbows, branch outlets and tees of approved make. Cut samples shall be submitted for approval, if directed. All such fittings etc. shall be of a type which maintain full wall-thickness at all points, simple radius and fillets, and proper bevels or shoulders at ends. All welding shall be done by the electric arc welding process in accordance with the following:-

- All joints shall have 45-degree bevel type, pipe mill-beveled or machine-beveled by the contractor. All scale and oxides shall be removed with hammer, chisel or file and bevel left smooth and clean.

- Pipe lengths shall line up straight with abutting pipe ends concentric.

- Both conductors from the welding machine shall be extended to locations at which welding work is being done. The leads from welding machine to location of welding work shall be held together with tape or other approved means as to prevent induced current in structural steel, in piping or in other metals within the building. The ground lead shall be connected to length of pipe through joints in pipe, structural steel of building or steel pipe supports.

3. GATE & GLOBE VALVES

Make: As approved shall be heavy duty non rising spindles as per IS 780, 778 and flanges as per IS 1536 and factory tested for 10Kg/ sq cm test pressure

S.No	Size	Construction	Ends
A	15 TO 40 MM	Gun metal body	Screwed
B	50 MM and above	Cast Iron Body & spindle valve, seat wedge etc., of Brass or Gun Metal	Flanged

4. BALANCING VALVES

The balancing valves control and shut off valves with built in pressure drop and flow measuring facility shall be provided in the water outlet pipes of condensers and chillers, AHUs or wherever shown in tender drawings.

15-65 mm Size: Gunmetal ASTM B-6 2 Screwed ends

80mm and above: Cast iron, flanged ends with stainless steel trim.

The valves shall have PTFE/SS disc with special erosion/corrosion proof sealing. The valves shall have temper proof adjustable and lockage arrangement for required water quantity after commissioning. The valves shall be complete with pressure test cock and drain cocks.

To enable accurate and practical operation, measurement of flow and differential pressure shall be made with a computerized balancing instrument which shall enable the operator to read the flow directly without the use of diagrams or tables. In addition to measuring flow rate, differential pressure and temperature, computerized balancing instrument shall have a computer programs to provide the following functions:-

To balance the HVAC installation and calculate the necessary valve settings, based on system measurements.

The supply of flanges shall form part of piping (not separately identified in Schedule of Quantities) and shall also include supply of bolts, washers, nuts and suitable rubber insertion gaskets (minimum 3 mm thick).

5. BUTTERFLY VALVES

Body: Cast Iron

Seat: Resilient lining moulded black nitrile rubber

Disc: SG Iron conforming to IS: 1865 SG 400/12 & BS 2789 GR 420/12 Nylon Coated

The handle shall have arrangement for locking in any position. Valve shall be suitable for 10 Kg/Cm^2 working pressure.

6. NON RETURN VALVES

Non return valves shall be dual plate check valve provided as shown on the Drawings, and identified in Schedule of Quantities conforming to relevant Codes and in accordance with the following Specifications

Size	Construction	Ends
50 to 150 mm	Body cast iron, gun metal plate	v) langed

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.

8. STRAINERS

Strainers shall be 'Y' type as included in BOQ. 'Y' Strainer shall be fabricated out of MS 'C' class pipe two sizes higher than that of Strainer pipe size. Flanges as per IS 6392 shall be provided at inlet and outlet connectors. The body shall be pressure tested at 10 kg/cm^2 and shall be hot dip galvanized. Permanent magnet shall be provided in the body of the Strainer to arrest MS particles. Filter element shall be of non-magnetic 20 gauge SS sheet with 3 mm perforation. Filtration area of the strainer shall be 1:4. Strainers shall be provided at in let of each Air Handling Unit and Pump as shown in drawings and included in BOQ.

All chilled water piping and fittings shall be pressure tested, painted and then insulated as described under the section "Insulation".

9 AUTO AIR VENT VALVES

Air vent valves shall be provided at all higher points in piping system for venting and of 10 mm diameter. Air vent valves shall be Gun metal and tested up to pressure of Class I pressure rating.

10 FITTINGS

The dimensions of the fittings shall conform to IS 1239/69 Part II (as per latest amendment) unless otherwise specified in specification. All bends in sizes up to and including 150 mm dia shall be readymade of heavy-duty, wrought steel of appropriate class. All fittings such as branches, reducers etc in all sizes shall be fabricated from pipes of same dia and thickness and length at least twice the dia of pipe. The branches may be welded straight to main line. Blank ends are to be formed with flanged joints and 1 mm thick blank insertion of rubber gasket between flange pair for 150 mm and over in case where a future extension is to be made otherwise blank end discs of 6 mm thickness are to be welded on with additional cross stiffeners. The tender drawings show schematically the size and location of pipes but this is for contractor's guidance only. Pipe runs may be changed to meet the site conditions.

11. PIPING INSTALLATION

All piping work shall be carried out in workman like manner causing minimum disturbance to the existing services. Piping shall be of steel, primer coated with rust preventive paint and finished with approved shade. Pipe supports shall not exceed the following spacing: -

vi)

Pipe Size (MM)	Spacing (Mtr)	Rod Size
25	2	10 mm
30 to 75	2.5	10 mm
100 and above	3.0	12.5 mm

Pipe hangers shall be fixed on walls and ceiling by means of metallic Raw bolts or approved shear fasteners. Piping shall be properly supported on, or suspended from, stands, clamps, and hangers as specified and as required. The contractor shall adequately design all the brackets, saddle, anchors, clamps and hangers and be responsible for their structural sufficiency.

Vertical risers shall be parallel to walls and columns. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 10 mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall also have a duck foot elbow or steel support welded to the pipe at the lowest point. On risers drain valves shall be provided at heels.

Pipe sleeve of 50 mm larger than the pipe diameter shall be provided wherever pipes pass through walls and the annular space filled with felt and finished with retaining rings. In case of an insulated pipe the diameter shall be inclusive of insulation.

Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. Metal sheet shall be provided between the insulation and clamp, saddle or roller extending atleast 150 mm on both sides of clamp, saddle or roller.

13. TESTING

All water 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/sq cm for a period of 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.

Pipes repaired subsequent to above pressure shall be retested in same manner.

Piping may be tested in section and such sections shall be securely capped.

The Contractor shall ensure that proper noiseless circulation of fluid is achieved through all coils and other heat exchange equipment in the system concerned. 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 above rectifications involving tearing up and refinishing of floor walls etc as required.

The Contractor shall give sufficient notice to all other agencies at site, of his intention to test a section or sections of piping and all testing shall be witnessed and recorded by Engineer in- charge at site.

The contractor shall provide temporary pipe connections to initially by-pass condenser/chiller and circulate water through condenser / chilled water pipe lines for minimum 8 hours. Water should be

drained out from the lowest point. The temporary lines shall be removed and blanked with dead flanges. Pot strainers and Y strainers shall be cleaned and fresh water filled in the circuits.

After the piping has been installed, tested and run for at least three days of eight hours each, all un-insulated exposed piping in plant room shall be given two finish coats, 3 mills each of approved colour, conforming to relevant BIS Codes. The direction of flow of fluid in the pipes shall be visibly marked with identifying arrows. For painting of insulated and clad pipes refer to insulation section.

After testing, all systems shall be chemically cleaned. After cleaning, the pipe work should be rinsed multiples times until the system is neutral. The contractor shall make a report conforming the above to Engineer in charge for records.

The Contractor shall provide all materials tools equipment, services and labour required to perform the test and to remove water resulting from cleaning and testing.

14. BALANCING

After completion of the installation, all water systems shall be adjusted and balanced to deliver water quantities as specified. Instruments required for the water balancing shall be accurately calibrated in an approved manner before taking any measurements. Calibrated orifices and portable flow meters shall be used to balance the water flow. Orifices used for testing and balancing shall be installed with straight length up stream and down stream as recommended by the manufactures and shall be left permanently installed in the system.

Automatic control valve and two way valves shall be set for full flow conditions during balance by procedure. Water circuit shall be adjustable by balancing cocks provided for balancing. These shall be permanently marked after balancing is completed so that they can be restored to their correct positions of disturbed. The computerized balancing shall be carried out by the balancing valve manufacturer and the test report shall be submitted as part of handing over documents.

15. PAINTING

In case of pipes to be insulated after thorough anti grease and rust removal treatment, clean the pipe and then apply two coats of epoxy primer before applying in insulation treatment as specified elsewhere. All uninsulated pipes after de rusting will be provided with two coats of epoxy primer followed by epoxy paint of approved shade.

SPECIFICATIONS FOR PIPE INSULATION

1 SCOPE:

The scope of this section comprises the supply and application of insulation conforming to these specifications.

2 **PIPE INSULATION**

2.1. MATERIAL:

The materials to be used for insulation shall be as follows, unless some other material is specifically mentioned elsewhere. The detailed specifications of the materials are listed under respective sub heads.

Pipe Insulation	:	TF quality Expanded Polystyrene (TF Thermocole)
Drain Pipe Insulation	:	Polyethylene Foam (Kinney Foam)

The insulation for chilled / Hot water piping, chillers, pump etc. shall be carried out from TF quality Expanded Polystyrene having a density of 20 kg/cubm. The thickness of the insulation for chilled water pipes shall be as under

Temp. Range (degree C)	Pipe Dia (mm)	Thickness (PUF/EP) (mm)
1.1 - 3.9	12 - 75	50/75
	100 - 300	75/100
4.4 - 12.2	12 - 200	30/50
	Over 200	50/75
12.8- 15.6	All Sizes	25/40

2.2 APPLICATION PROCEDURE:

Insulation shall be applied only after the piping system has been satisfactorily tested for leaks at 2.5 times the working pressure or at minimum 10 kg/sq.cm. test pressure. All chilled water, refrigerant, and condensate drain piping shall be insulated in the manner specified herein.

- Before applying insulation, all pipe work and fittings shall be brushed and cleaned, and dust, dirt, mortar and oil removed.
- All MS pipes shall be provided with a coat of zinc chromate primer, followed by two coats of cold setting adhesive compound.
- Premoulded pipe sections shall be placed over the pipes, the longitudinal and transversal joints of these pipe sections shall be sealed with the adhesive compound. The insulation shall be continuous over the entire run of piping, fittings and valves.
- All insulated pipes shall be covered with two layers of 400 gage polythene sheet to act as vapour barrier. GI wire at 400 mm centre shall be used to hold insulation and vapour barrier together.
- GI wire mesh (19 mm x 24 G) shall be tied on the surface to hold the insulation.
- The insulation shall be covered with 24 Gauge aluminium sheet to give mechanical protection. The cladding shall be neatly finished with screws etc.

UNDER GROUND AND IN TRENCHES/ PIPES EXPOSED TO ATMOSPHERE:

- The pipe shall be thoroughly cleaned with a wire brush and rendered free from all rust and grease.
- The pipes shall be with a coat of bituminous paint (tank Mastic-by shalimar painted tar products).
- Two coats of hot bitumen shall be applied on the cleaned pipe surface (bitumen 85/40 or 80/25 in the ratio of 1.0 kg per sq. mtr. for each coat).
- The preformed sections of insulation shall be fixed tightly to the surface taking care to seal all joints.

- Insulation on pipes in areas exposed to weather or underground shall be covered with tar felt sheets manufactured by shalimar tar products(1935)Ltd. and fixed with G.I. Wires of 1.0 mm. The tar felt sheet shall be stuck with bitumen R 85/25.

All valves, fittings, strainers etc. in chilled water piping shall be insulated to the same thickness as specified for the main run of piping and applied generally in the manner specified above, valve bonnets, yokes and spindles shall be insulated in such a manner as not to cause damage to insulation when the valve is used or serviced.

Tanks, wherever required in chilled water piping system i.e. expansion tanks shall be insulated to same thickness as for the pipes to which they are connected. The mode of the insulation shall generally be as above.

Pipe supports shall be of polyurethane foam (molded sections) of 'K' value 0.04 KCAL/HR/M/Deg C at 10° C of mean temperature of density 160 Kg/M^3 and conforming to IS latest code.

Chilled water pumps shall be insulated to same thickness as pipe to which they are connected and applied generally in the manner specified above. Care shall be taken to apply the insulation in a manner as to allow the dismantling of pumps without damaging the insulation.

SPECIFICATIONS FOR ELECTRICAL WORK AND CABLING

1 SCOPE:

The scope of this section comprises of fabrication, supply, erection, testing and commissioning of Motor Control Centre (MCC), wiring and earthing of all air-conditioning equipment, components and accessories.

2 GENERAL:

Work shall be carried out in accordance with the accompanying specifications and shall comply with the latest relevant Indian Standards and Electricity Rules and Regulations. All motor control centres shall be CPRI approved and shall be suitable for operation on 3 phase/single phase 415/230 volts, 50 cycles power supply system.

3 CONSTRUCTIONAL FEATURES:

The Motor Control Centre (MCC) electrical panels shall be sheet steel cabinet for indoor installation, dead front, floor mounting / wall mounting type. The control panel shall be totally enclosed, completely dust and vermin proof and shall be with hinged doors with Neoprene gasket. Control panel shall be suitable for the climatic conditions as specified in Specifications. Steel sheets used in the construction of Control panel shall be 2 mm thick for floor mounted panels, 1.60mm thick for wall mounted panels and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all welding, slag shall be rounded off and welding pits wiped smooth with plumber metal. The general construction shall confirm to relevant BIS Codes.

All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with wing nuts. Self threading screws shall not be used in the construction of Control panels. A base channel of 75 mm x 40 mm x 5 mm thick shall be provided at the bottom for floor mounted panels. Minimum clearance of 200 mm shall be provided between the floor of control panel and the lowest unit.

The control panel shall be of adequate size with a provision of 25% spare space to accommodate possible future breakers. Breakers shall be arranged in multi-tier. Removable sheet steel plates shall be provided at the top/bottom to make holes for cable entry at site .

Every cabinet shall be provided with Trifoliate or engraved metal name plates. All panels shall be provided with circuit diagram mounted on inside of door shutter protected with Hylam sheet. All live accessible connections shall be shrouded and minimum clearance between phase and earth shall be 20 mm and phase to phase shall be 25 mm.

4 WIRING SYSTEM:

All L T power cabling between MCC and motors shall be carried out with 1100 volts grade PVC insulated, overall PVC sheathed aluminium conductor armoured cables, Cables shall be sized by applying proper derating factor. All control wiring shall be carried out by using PVC insulated copper conductor wires in conduits. Minimum size of control wiring shall be 1.5 sq mm. Minimum size of conductor for power wiring shall be 2.5 sq. mm 1100 volts grade PVC insulated copper conductor wires in conduit.

5 CIRCUIT COMPARTMENT:

Each circuit breaker, contactor and relay shall be housed in a separate compartment and shall have steel sheets on top and bottom of compartment. Sheet steel hinged lockable door shall be duly interlocked with the breaker in the "ON" position. Safety interlocks shall be provided to prevent the breaker from being drawn-out when the breaker is in 'ON' position. The door shall not form an integral part of the draw-out portion of the panel. Sheet steel barriers shall be provided between the tiers in a vertical section.

6 INSTRUMENT ACCOMODATION:

Adequate space shall be provided for accommodating instruments, indicating lamps, control contactors and control MCBs. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker and bus bar `ON' lamps shall be provided on all outgoing feeders.

7 BUS BAR:

Bus bar and interconnections shall be of high conductivity electrolytic conductor and of rectangular cross section suitable for carrying the rated full load current and short circuit current without overheating of phase and neutral bus bar and shall be extendable on either side. Bus bar and interconnections shall be insulated with heat shrinkable sleeve and shall be colour coded and shall be supported on glass fiber reinforced thermosetting plastic insulated supports at regular intervals to withstand the force arising from in case of short circuit in the system. All bus bar shall be provided in a separate chamber and all connections shall be done by bolting. Additional cross sectional area shall be added to the bus bar to compensate for the holes. All connections between bus bar and breaker shall be through solid copper/ aluminium strips of proper size to carry full rated current as per approved for construction shop drawing and insulated with insulating sleeves. Bus bar shall be rated for current density of 1.0amps/mm for aluminium and 1.28 amps/mm^2 for copper cross section area.

Unless otherwise specified, in the case of external surface of enclosures of bus bar trunking system which shall be accessible but do not need to be touched during normal operation, an increase in the temperature rise limits of 25° C above ambient temperature shall be permissible for metal surface and of 15° C above ambient temperature for insulating surfaces as per relevant BIS Codes.

8 CABLE COMPARTMENTS:

Cable compartment of adequate size shall be provided in the control panel for easy clamping of all incoming and outgoing cables entering from the top/bottom. Adequate supports shall be provided in cable compartment to support cables as per approved for construction shop drawing.

9 MOULDED CASE CIRCUIT BREAKER (MCCB):

All MCCB's shall be motor duty and Current Limiting type, and comprise of Quick Make - break switching mechanism, preferably Double Break Contact system, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCB's shall be capable of defined Variable overload adjustment. All MCCB's rated 200 Amps and above shall have adjustable Magnetic short circuit pick up. The trip command shall override all other commands. MCCB shall employ maintenance free double break contact system to minimise the let thru' energies and capable of achieving discrimination upto full short circuit capacity of downstream MCCB. The manufacturer shall provide both discrimination tables and let thru energy curves.

The breaking capacity of MCCB's shall be asked for in the schedule of quantities. The breaking capacities specified will be ICU=ICS i.e type-2 co-ordination as per relevant BIS and IEC Codes. The MCCB's shall be provided with rotary handle operating mechanism. The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to Disconnection as per the IS/IEC indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection.

10 MINIATURE CIRCUTE BREAKER (MCB)

Miniature Circuit Breaker shall comply with relevant BIS Codes and shall be quick make and break type for 230/415 VAC 50 Hz application with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting type (Class-3). MCBs shall be classified (B,C,D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values.

The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP and TPN miniature circuit breakers shall have a common trip bar independent to the external operating handle.

11 PAINTING:

All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphating, passivaiting (seven tank processing) and then painted with electrostatic paint (Powder coating). The shade of colour of panel inside/outside shall be as per relevant BIS code.

12 LABELS:

Engraved PVC labels shall be provided on all incoming and outgoing feeder. Circuit diagram showing the arrangements of the circuit inside the control panel shall be pasted on inside of the panel door and covered with transparent plastic sheet.

13 METERS

- All voltmeters and indicating lamps shall be through MCB's.
- Meters and indicating instruments shall be plug type.
- All CT's connection for meters shall be through Test Terminal Block (TTB).
- CT ratio and burdens shall be as specified on the Single line diagram.

14 CURRENT TRANSFORMERS:

Current transformers shall be provided for Control panels carrying current in excess of 60 amps. All phase shall be provided with current transformers of suitable VA burden with 5 amps secondary's for operation of associated metering. The CTs shall confirm to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to withstand thermal and dynamic stresses during short circuits. Secondary terminals of CTs shall be brought out suitable to a terminal block which shall be easily accessible for testing and terminal connections. The protection CTs shall be of accuracy class 5P10 and measurement CTs shall be of accuracy class I.

15 SELECTOR SWITCH

Where called for, selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

16 STARTERS:

Each motor shall be provided with a starter of suitable rating. Starters shall be in accordance with relevant IS Codes. All Star Delta Starters shall be fully automatic.

17 CONTRACTOR:

Contactor shall be built into a high strength thermoplastic body and shall be provided with an arc shield for quick arc extinguishing. Silver alloy tips shall be provided to ensure a high degree of reliability and endurance under continuous operation. The magnet system shall consist of laminated yoke and armature to ensure clean operation without hum or chatter.

Starters contactors shall have 3 main and 2 Nos. NO / NC auxiliary contacts and shall be air break type suitable for making and breaking contact at minimum power factor of 0.35. For design consideration of contactors the starting current of connected motor shall be assumed to be 6 times the full load current of the motor in case of direct-on-line starters and 3 times the full load current of the motor in case of Star Delta and Reduced Voltage Starters. The insulation for contactor coils shall be of Class "E". Coil shall be tape wound vacuum impregnated and shall be housed in a thermostatic bobbin, suitable for tropical conditions and shall withstand voltage fluctuations. Coil shall be suitable for 220/415±10% volts AC, 50 cycles AC supply.

18 THERMAL OVERLOAD RELAY:

Thermal over load relay shall have built in phase failure sensitive tripping mechanism to prevent against single phasing as well as on overloading. The relay shall operate on the differential system of protection to safeguard against three phase overload, single phasing and unbalanced voltage conditions. Auto-manual conversion facility shall be provided to convert from auto-reset mode to manual-reset mode and vice-versa at site. Ambient temperature compensation shall be provided for variation in ambient temperature from -5° C to +55°C. All overload relays shall be of three element, positive acting ambient temperature compensated time lagged thermal over load relays with adjustable setting. Relays shall be directly connected for motors upto 35 HP capacity. C.T. operated relays shall be provided for motors above 35 HP capacity. Heater circuit contactors may not be provided with overload relays.

19 TIME DELAY RELAY:

Time delay relays shall be adjustable type with time delay adjustment from 0-180 seconds and shall have one set of auxiliary contacts for indicating lamp connection.

20 INDICATING LAMP AND METERING:

All meters and indicating lamps shall be in accordance with BS 37 and BS 39. The meters shall be flush mounted type. The indicating lamp shall be of low wattage. Each MCC and control panel shall be provided with voltmeter 0-500 volts with three way and off selector switch, CT operated ammeter of suitable range with three nos. CTS of suitable ratio with three way and off selector switch, phase

indicating lamps and other indicating lamps as called for. Each phase indicating lamp shall be backed up with 5 amps fuse. Other indicating lamps shall be backed up with fuses.

21 TOGGLE SWITCH:
Toggle switches shall be in conformity with relevant IS Codes and shall be of 5 amps rating.

22 PUSH BUTTON STATIONS:
Push button stations shall be provided for manual starting and stopping of motors / equipment Green and Red colour push buttons shall be provided for 'Starting' and 'Stopping' operations. 'Start' or 'Stop' indicating flaps shall be provided for push buttons. Push Buttons shall be suitable for panel mounting and accessible from front without opening door, Lock lever shall be provided for 'Stop' push buttons. The push button contacts shall be suitable for 6 amps current capacity.

23 CONDUITS:
Conduits and Accessories shall conform to relevant Indian Standards. Wall thickness shall be 16 gauge upto 32 mm dia and 14 gauge above 32 mm dia conduit. Screwed MS conduits shall be used. Joints between conduits and accessories shall be securely made, to ensure earth continuity. All conduit accessories shall be threaded type only. All raw metal shall be painted with bitumastic paint. Only approved make of conduits and accessories shall be used. Conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer

24 CABLES: M.V.
Cables shall be PVC insulated aluminium / copper conductor and armoured cables conforming to IS Codes. Cables shall be armoured and suitable for laying in trenches, ducts, and on cable trays as required. M.V. Cables shall be termite resistant. Cable glands shall be double compression glands. Control cables and indicating panel cables shall be multi core PVC insulated copper conductor and armoured cables.

25 CABLE LAYING:
Cable shall be laid in accordance with IS code of Practice. Cables shall be laid on 14 gage factory fabricated perforated galvanized sheet steel cable trays, and cable drops / risers shall be fixed to ladder type cable trays factory fabricated out of galvanized steel angle. Access to all cables shall be provided to allow cable withdrawal / replacement in the future. Where more than one cable is running on a cable tray, one dia spacing shall be provided between cables to minimize the loss in current carrying capacity. Cables shall be suitably supported with Galvanized saddles when run on walls / trays. When buried, they shall be laid in 350 mm wide and 750 mm deep trench and shall be covered with 250 mm thick layer of soft sifted sand & protected with bricks/tiles. Special care shall be taken to ensure that the cables are not damaged at bends. The radius of bend of the cables when installed shall not be less than 12 times the diameter of cable.

26 WIRE AND WIRE SIZES:
For all single phase/ 3 phase wiring for equipment upto 15 HP shall be, 1100 volts grade PVC insulated copper conductor wire. For balance and bigger capacity motors 1100 volts grade PVC insulated aluminium conductor cables shall be used. The equipment inside plant room and AHU room shall be connected to the control panel by means of conductor wires of adequate size in GI cable trays. Final connections to the equipment shall be through wiring enclosed in galvanized flexible conduits rigidly clamped at both ends and at regular intervals. An isolator shall be provided near each motor / equipment wherever the motor/equipment is separated from the supply panel through a partition barrier or through ceiling construction. PVC insulated copper conductor wires shall be used inside the control panel for connecting different components and all the wires inside the control panel shall be neatly dressed and plastic beads shall be provided at both the ends for easy identification of control wiring. The minimum size of control wiring shall be 1.5 sq. mm PVC

insulated stranded soft drawn copper conductor wires drawn through conduit to be provided for connecting equipment and control panels.

All the switches, contactors, push button stations, indicating lamps shall be distinctly marked with a small description of the service installed. The capacity contactors and overload relays shall be provided for different capacity motors as per manufacturer's recommendation.
Two speed motors when specified, shall be provided with DOL starter irrespective of it rating.

27 EARTHING:

Earthing shall be provided in accordance with relevant BIS Codes and shall be of copper strips /wires .The main panel shall be connected to main earthing system of the power supply. All single phase metal clad switches and control panels be earthed with minimum 3 mm diameter copper conductor wire. All 3 phase motors and equipment shall be earthed with 2 numbers distinct and independent copper wires / tapes as follows:

i.	Motor upto and incl.10 HP rating	2 Nos. 3 mm dia copper wires
ii.	Motor 12.5 HP to 40 HP capacity	2 Nos. 4 mm dia copper wires
iii.	Motor 50 to 75 HP capacity.	2 Nos. 6 mm dia copper wires
iv.	Motor above 75 HP.	2 Nos. 25 mm x 3 mm copper tapes.

All switches shall be earthed with two numbers distinct and independent copper wires' tapes as follows:

i.	3 phase switches and control panels upto 60 amps rating.	2 nos. 3 mm dia copper wires
ii.	3 phase switches and control panels 63 amps to 100 Amps rating.	2 Nos. 4 mm dia copper wires.
iii.	3 phase switches and control panels 125 amps to 200 Amps rating.	2 Nos. 6 mm dia copper wires.
iv.	3 phase switches, and control bus ducts, above 200 amps rating.	2 Nos. 3 mm x 25 mm copper tapespanels,

The earthing connections shall be tapped off from the main earthing of electrical installation. The overlapping in earthing strips at joints where required shall be minimum 75 mm. These straight joints shall be rivetted with brass rivets & brazed in approved manner. Sweated lugs of adequate capacity and size shall be used for all termination of wires. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substance, and properly tinned.

28 DRAWINGS:

Shop drawings for control panels and for wiring of equipment showing the route of conduit & cable shall be submitted by the contractor for approval of Engineer in charge before starting the fabrication of panel and starting the work. On completion, four sets of complete "As-installed" drawings incorporating all details like, conduits routes, number of wires in conduit, location of panels, switches, junction/pull boxes and cables route etc. shall be furnished by the Contractor.

29 TESTING:

Before commissioning of the equipment, the entire electrical installation shall be tested in accordance with relevant BIS codes and test report furnished by a qualified and authorised person. The entire electrical installation shall be gotten approved by Electrical Inspector and a certificate from Electrical Inspector shall be submitted. All tests shall be carried out in the presence of Engineer in charge. Testing of the panels shall be as per relevant BIS Codes.

30 PAINTING:

All sheet steel work shall undergo a process of degreasing, thorough cleaning, and painting with a high corrosion resistant primer. All panels shall then be baked in an oven. The finishing treatment shall be by application of powder coating of approved shade.

31 RUBBER MAT:

Rubber mat shall be provided in front to cover the full length of all panels. Where back space is provided for working from the rear of the panel, rubber mat shall also be provided to cover the full length of panel.

TRAINING OF OWNER'S PERSONNEL

The Vendor /Contractor shall train the Owner/Purchaser's engineering personnel in the shops, where the equipment will be manufactured and or in their collaborator's works and where possible, in any other plant where equipment manufactured by the Vendor/Contractor or his collaborator is under installation or test to enable those personnel to become familiar with the equipment being furnished by the Vendor/Contractor, either at his works or at his Sub-Vendor's/Sub-Contractor's works or at site.

The period of training shall be adequate and mutually agreed upon by the Owner/Purchaser and the Vendor/Contractor.

The training shall be so oriented as to make the Owner's/Purchaser's personnel proficient in operating the equipment.

The Owner's/Purchaser's personnel shall also be trained for routine maintenance work and lubrication, overhauling, adjustments, testing and replacement procedures to be adopted for the equipment offered.

The Vendor/Contractor shall train the Owner's/Purchaser's personnel in carrying out minor repairs, if need arises, during the operation of the equipment.

The charges for training the Owner's/Purchaser's personnel, if any, be included in the price for supply of erection, testing and commissioning.

APPROVED MAKES OF EQUIPMENT & MATERIALS

S No	Equipment / Material	Approved Makes
1	Air cooled Scroll Chiller	Carrier / York / Trane / Blue Star / Voltas / Daikin
2	Pump and Condenser Pump (all capacities)	Grundfoss / Kirloskar/ Beacon

3	Secondary CHW Pump with variable Speed Pumping System Including Adjustable frequency Drive, Secondary pumps and pump controller.	XYLEM (ITT) / Grundfoss / Armstrong
4	Hot water Generator	Rapid Cool / Khokkar
5	Air Handling Unit all types	Zeco / Edgetech
6	Variable Frequency Drive for AHUs	Danfoss / Siemens
7	Cooling Coil for AHU's	Zeco / Edgetech
8	Fan Coil Unit	Zeco / Edgetech
9	Centrifugal fans for AHU/ Fresh Air / Exhaust Fan	Kruger / Nicotra
10	Axial Flow Fan	Systemair / Kanalflakt / Kruger
11	Propeller fan	Alstom/ khaitan/ Crompton
12	In-Line fan	Systemair / Kanalflakt / Kruger
13	GI pipe Medium Class	Jindal /TATA
14	MS Pipe (up to 200 mm Dia)	Jindal / TATA
15	MS Pipe (Above 200 mm Dia factory Rolled)	Jindal / TATA /SAIL
16	Flexible Pipe Connection	Resistoflex/ Kanwal
17	Butterfly Valves	Audco/ Advance
18	Non Return Valves/ Check Valves	Audco / Advance / Castle
19	Balancing Valves	Audco / advance
20	Motorized Butterfly valve with Actuators	Belimo / Beacon Rotork/ Nibco
21	Ball / Gate/ Globe Valves	CIM / Rapidcool /Leader
22	Ball valve with Y-Strainer (Fan Coil Units)	Rapid Cool / Leader
23	Pot / Y Strainer	Rapid Cool / Leader
24	Suction guide	Anergy / Emerald
25	Pressure Gauges	H.Guru/ Fiebig/ Dwyer
26	Thermometers (with brass encasing)	Taylor/ H Guru/ D S Engg
27	Flow Switch	Rapid cool /Siemens

28	Automatic Air Vent	Rapid Control/ Anergy
29	Filters	AAF/ Purolater/ Thermadyne
30	3 way Modulating valve for AHU	Honeywell / Siemens / Danfoss / Belimo
31	3 way valve (on/off) for FCU	Honeywell/Siemens/ Anergy/ Belimo
32	Room Thermostat/ AHU & FCU Thermostat	Honeywell/ Siemens/ Anergy
33	Humidistat	Honeywell/ Siemens
34	Safety Thermostat for heater	Anergy Controls
35	Dial Thermometer Capillary Type	Penn/ Tadington
36	Cooling and heating mode changer	Siemens
37	Pre-moulded TF Thermocole section for pipe insulation	Beardsell / India Packaging
38	PUF pipe supports	Malanpur/ Lloyd
39	Aluminium Tape	Johnson/ Birla 3M
40	Anchor fastners	Hilti /fishner
41	Vibration Isolator	Resistoflex/ Dunlop
42	V belt	Dunlop / fenner
43	Expansion tank (open type)	Syntax
44	Paints	ICI/ Asian/ Narolac/ Berger
45	Electrical Panels	Adlec /Tricolite /KEPL / RR Electricals / Kalyani, Chandigarh
46	Motor apart for Chiller, axial fan and jet fan	Siemens / Bharat Bijlee / CGL / Kirloskar /
47	Starter, Contactor, Push Button	Schneider Electric (MG) / Larsen & Toubro / GE Power Controls / Siemens
48	Moulded Case Circuit Breaker (MCCB)	Schneider Electric (MG) / Larsen & Toubro / GE Power Controls/ Legrand/ Siemens
49	Miniature Circuit Breaker (MCB)	Schneider Electric (MG) / GE Power Controls/Legrand / Siemens

50	Overload relays with built in Single Phase Preventer	Schneider Electric (Telemechanique) / Larsen & Toubro / Siemens/GE Power Control
51	Current Transformer (Epoxy Cast Resin)	Automatic Electric / Indcoil / pragati / Kappa
52	Protection Relay (numeric type)	Alstom /Asea Brown Boveri / Siemens / L&T
53	Switch Fuse Unit, HRC Fuse	Larsen & Toubro / GE Power Controls / Siemens
54	Rotary Switch/ Time Delay relay	Larsen & Toubro / GE Power Controls / Siemens
55	Timer	Schneider Electric (Telemechanique) / Larsen & Toubro / GE Power Control / Siemens
56	Selector Switch, Toggle switch	Larsen & Toubro / Kaycee/GE/CS
57	Change Over Switch	Larsen & Toubro / siemens /HPL/GE Power control
58	Ammeter and Voltmeter	Rishabh (L& T) / Automatic Electric / Conzerve
59	Indicating Lamps LED type , Push Button	Larsen & Toubro / GE Power Controls / Siemens / Vaishno Electricals / CS
60	Grilles/ Diffusers	Caryaire / Systemair / Pine aire / Trueair / Airflow
61	Fire Dampers UL listed	Ruskin / Systemair
62	Fire Damper motors	Belimo /Seimens
63	G.I. Sheet Metal Duct	SAIL/ Tata
64	Factory fabricated G.I. Sheet Metal Duct	Zeco / Ecoduct / Rolastar
65	Hessian (Fire treated)	Navair/ Pyroguard
66	VCD / Gravity louvers / Exhaust& fresh air louvers	Caryaire / Systemair / Pine aire / Trueair Airflow
67	Nitrile rubber Insulation Class O	K Flex / Arma Cell / Supreme.
68	TF Thermocole	Beardsell / India Packaging
69	M S Conduits	BEC /AKG
86	Water Level Switch	Veksler / Warree / Jumo

Note: For any other item required for successful completion, but not included in the above list the Contractor shall take prior written approval from the Consultant/ Engineer in charge.

FORMATS FOR TEST READINGS

AIR HANDLING EQUIPMENT TEST REPORT

PROJECT _____SYSTEM / UNIT _____					
LOCATION _____					
UNIT	**DATA**		**MOTOR**	**DATA**	
Make/Motor No.			Make / Frame		
Type/Size			H.P / RPM		
Serial Number			Volts/Phase/Cycles		
Arr./Class			F.Lamps.		
Discharge			Pulley Dia/Bore		
Pulley dia/ Bore			Pulley/ Distance		
No. Belts/make/Size					
No. Filters/type.Size (Pre.)					
No. Filters/type.Size (secondary)					
TEST DATA	DESIGN	ACTUAL	TEST DATA	DESIGN	ACTUAL
Total Cfm			Discharge S.P		
Total S.P					
Fan RPM			Cooling Coil S.P		
Motor Volts			Filters S.P		
Out air Cfm					
Return air Cfm					
REMARKS.					
TEST DATE _____					

READINGS BY _____

Note : Please Furnish above report for EACH AHU.

PREAMBLE TO MODE OF MEASUREMENT

1 All equipment described hereafter shall be in accordance with the specifications. All equipment shall be selected and installed for the lowest Operating noise level.

2 Supply of various equipment shall include all expenses for correspondence with manufacturers, submission of shop drawings, documents and their approval by the Consulting Engineer, procurement of equipment, transportation, shipping, payment of all taxes and levies, storage, supply of equipment at the point of installation, furnishing all technical literature required, replacement of defective components, and warranty obligations for the individual equipment.

3 Installation of various equipment shall include all material and labour associated with hoisting and lowering of equipment in position, insulation of the components and vibration isolation as required, grouting and anchoring or suspension arrangements and all incidentals associated with the installation as per the specifications and manufacturer's recommendation.

4 Vibration isolators as specified or as recommended by the manufacturer shall be installed with each component. Performance ratings, power consumption and power data for each component shall be verified at the time of testing and commissioning of the installation, against the data submitted with the tenders.

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

6. Testing and commissioning shall include furnishing all labour, materials, equipment, instruments, and incidentals necessary for complete testing of each component as per the specifications and manufacturer's recommendations, submission of test results to the Engineer in charge and obtaining their approval and submission of necessary documents and completion drawings.

7 All ducts shall be fabricated and installed conforming to the relevant Indian standards, approved shop drawings and the specifications.

8. Duct installation shall include fabricating and installing the ducts, splitter dampers, turning vanes, and distribution grids within the ducts in position, and providing, installing and making air tight all joints with slips, bonded felt insertions, nuts, bolts and screws as required. In addition multi-louvered manually adjustable dampers shall be provided in various branch ducts as required or shown on drawings for proper balancing of air flows.

9 All registers and diffusers shall be provided with a soft continuous rubber gasket between their periphery and the surface on which these have to be mounted.

10 Registers and diffusers shall be given, at the factory, a rust resistant primer coat and enamel paint finish of approved colour.

11 After completion of the installation, the entire air distribution system shall be tested for air leaks and balanced in accordance with the specifications.

MODES OF MEASUREMENTS

1. UNIT PRICES IN THE SCHEDULE OF QUANTITIES

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

THE UNIT PRICE OF THE VARIOUS ITEMS SHALL INCLUDE THE FOLLOWING:

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

- All the labour required supplying and installing the complete installation in accordance with the specifications.
- Use of any tools, equipment, machinery, lifting tackle, scaffolding, ladders etc. Required by the Contractor to carry out his work.
- All the necessary measures to prevent the transmission of vibration.
- The necessary material to isolate equipment foundations from the building structure, wherever necessary.
- Storage and insurance of all equipment apparatus and materials.
- The Contractor's unit price shall include all equipment, apparatus, material and labour indicated in the drawings and/or specifications in conjunction with the item in question, as well as all additional equipment, apparatus, material and labour usual and necessary to make in question on its own (and within the system as a whole) complete even though not specifically shown, described or otherwise referred to.

2. MEASUREMENTS OF SHEET METAL DUCTS, GRILLES/DIFFUSERS ETC.

Duct Work shall be measured on the basis of external surface area of ducts. Duct measurements shall be taken before application of the insulation. The external surface areas shall be calculated by measuring the perimeter comprising overall width and depth, including the corner joints, in the center of each duct section, multiplying with the overall length from flange face to flange face of each duct section and adding up areas of all duct sections. Plenums shall also be measured in similar manner. For tapered rectangular ducts, the average width and depth shall be considered for perimeter, whereas for tapered circular ducts, the diameter of the section midway large and small diameter shall be adopted, the length of tapered duct section shall be the center line distance between the flanges of the duct section. For special pieces like bends, tees, reducers, branches and collars, mode of measurement shall be identical to that described above using the length along the centerline. The quoted unit rate for external surface of ducts shall include all wastage allowances, flanges and gaskets for joints, nuts and bolts, hangers and angles with double nuts for supports, rubber strip 3 mm thick between duct and support, vibration isolator suspension where specified or required, inspection chamber / access panel. Splitter damper with quadrant and lever 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 nor paid for.

PREAMBLE TO SCHEDULE OF QUANTITIES

1 All items of work under this Contract shall be executed strictly to fulfill the requirement laid down under" Basis of Design" in the specifications. Type of equipment, material, specification, methods of installation and testing and type of control shall be In accordance with the specification, approved shop drawing and relevant Indian Standards, however capacity of each component and their quantities shall as fulfill the above mentioned requirement.

2 The rate for each item of work included in the Schedule of Quantities shall' unless expressly stated otherwise, include cost of:

- All materials. Fixing materials Accessories, appliances tools, plants, equipment transport, labour and incidentals required in preparation for and in the full and entire execution as per Specification and Drawings.
- Wastage on materials and labour.
- Loading, transporting, unloading, handling/double, hoisting to all levels. Setting, fitting, and fixing in position, protecting, disposal of debris and other labour necessary in and for the full and entire execution and for the job in accordance with the contract documents, good practice and recognize principals.
- Liabilities, obligations, and risks arising out of Conditions of Contract.

3 All requirements of Specification, whether such requirements are mentioned in the item or not. The Specification and Drawing where available, are to be read as complimentary to and part of the Schedule of Quantities and any work called for in one shall be taken as required for all.

4 In the event of conflict between Schedule of Quantities and other documents including the Specification, the most stringent shall apply. The interpretation of the Engineer in charge shall be final and binding.

5 All equipment, quantities, and technical data indicated in this Schedule are for Contractor's guidance only; these are based on the documents prepared by the Consultant. This schedule must be read in conjunction with other documents. The Contractor shall be paid for the actual quantity of work executed by him in accordance with the approved Shop Drawing at the contract rates.

6 This Schedule shall be fully priced and the extensions and totals duly checked. The rates for all items shall be filled in INK including NIL items.

7 No alteration whatsoever is to be made to the text or quantities of this schedule unless Engineer in charge authorizes such alteration in writing. Any such alterations, cuts or additions shall unless authorized in writing, be disregarded when tender documents are considered.

8 In the event of an error occurring in the amount of the Schedule, as a result of wrong extension of the unit rate and quantity, the unit rate quoted by the tenderer shall be regarded as firm and the extensions shall be amended on the basis of rates.

9 Any error totaling the amount column and in carrying forward total shall be corrected, any error, in description or in quantity, omission of items from this Schedule shall not vitiate this corrected but shall corrected and deemed to be variation required by the engineer in charge.

10 The Contractor shall procure and bring Materials/ Equipment to the site only on the basis of drawing approved for construction and shop drawings and not on the Contractor's requisition for Engineer in charge supplied materials.

ANNEXURE-"F"

UNDERTAKING

We do hereby undertake to engage a specialised agency after approval of **The Registrar Baba Farid University of Health Sciences, Faridkot**, for undertaking the execution of works of (_____*_____ Name of the project____ ___) whose minimum qualification shall be as under:

i) Experience of having successfully completed similar works during last 3 years ending last day of month previous to the one in which applications are invited should be either of the following :

Three similar completed works each costing not less than the amount equal to 40% of estimated price of ___*_____ works.

or

Two similar completed works each costing not less than the amount equal to 50% of estimated price of ___*_____ works.

or

One similar completed work costing not less than the amount equal to 80% of estimated price of ____*_____ works.

ii) We shall be solely responsible for successful execution of ____*_____ work.

iii) Sub agreement will be signed with Engineer of the specialized work.

Note : -

* The bidder has to write the specialised works which he intends to carry out through specialised agency.

Authorized Signature of Bidder with stamp

ANNEXURE-"G"

1. QUALIFICATION OF THE BIDDER

1.1 All bidders shall provide the following Qualifications information and documents with their technical bid.

A. <u>For Works upto Rs. 5.00 Crores</u> –

(a) Tenderer should be approved contractors of Punjab PWD (B&R)/Any other Govt. Department or specialized agency dealing with providing "HVAC work"..

(b) satisfactorily completed in the last five years and as a prime contractor, where the Contract involved execution of all main items of work described in the bid document, provided further that all other qualification criteria are satisfied)

one similar work of value not less than 80% of the estimated cost

or

two similar works each of value not less than 50% of the estimated cost of work

B <u>For Works costing above Rs. 5.00 Crores</u> –

(a) valid enlistment with Punjab PWD B&R Branch under the appropriate class and category (Class 1st building work);

(b) achieved a minimum annual financial turnover (in all classes of civil engineering construction works only) equal to **40% of** the estimated cost of work in any one of the last three years.

(c) satisfactorily completed in the last three years and as a prime contractor (0r as a nominated subcontractor, where the subcontract involved execution of all main items of work described in the bid document, provided further that all other qualification criteria are satisfied)

one similar work of value not less than 80% of the estimated cost

or

two s1imilar works each of value not less than 50% of the estimated cost of work

the works listed should be attached along with certificates duly signed by the Engineer-in Charge, not below the rank of an Executive Engineer or equivalent.

C. <u>In addition, each bidder shall submit the following information for his qualification :</u>

(a) Copy of Permanent Account Number (PAN) issued by Income Tax department;

(b) Affidavit/undertaking of not having been black-listed by any Govt. /Semi Govt. Organization/Corporation at any stage and/or debarred by the department of Punjab PWD (B&R).

(c) Affidavit/undertaking that information being submitted is correct and true, and that any false information shall lead to disqualification at any stage;

(d) VAT Registration Number (TIN) issued by concerned department;

(e) EPF registration certificate from Provident Commissioner;

(f) Any other qualification information specified in the Conditions of Particular Application.

(g) Details of his available bid capacity with an undertaking that his available bid capacity, calculated as per following clause 1.2 below, is more than the total value of his financial bid; **(Only for works above Rs. 1.00 Crore)**

1.2 The bid capacity of the prospective bidders will be calculated as under:

Assessed Available Bid Capacity = (A * N* 2 - B)

Where

A = Maximum value of Civil Engineering works executed in any one year during the last five years (updated to the price level of year indicated in Appendix to ITB) taking into account the completed as well as works in progress.

N = Number of years prescribed for completion of the Project/Works for which these bids are being invited. (e.g. 7 months = 7/12 year)

B = Value (updated to the price level of the year indicated in Appendix) of existing commitments (only allotted works) and on-going works to be completed during the period of completion of the Project/Works for which these bids are being invited.

Note: *The statement showing the value of existing commitments and on-going works as well as the stipulated period of completion remaining for each of the works listed should be attached along with certificates duly signed by the Engineer-in Charge, not below the rank of an Executive Engineer or equivalent*.

1.3 Even though the bidders meet the above qualifying criteria, they are subject to be disqualified if they have:

- made misleading or false representation in the forms, statements and attachments submitted in proof of the qualification requirements; and/or
- record for poor performance such as abandoning the works, not properly completing the contractor, inordinate delays in completion, litigation history, or financial failures etc; and/or
- participated in the previous bidding for the same work and had quoted unreasonably high bid prices and could not furnish rational justification to the employer.

FORMAT

AFFIDAVIT/UNDERTAKING*

1. I/we, the undersigned, do hereby certify that all the statements made in the required attachments are true and correct.

2. The undersigned also hereby certifies that neither our firm M/s _____ have abandoned any work under Government of India or Govt. of Punjab nor any contract awarded to us for such works have been rescinded, during last five years prior to the date of this bid.

3. The undersigned hereby authorize(s) and request(s) any bank, person, firm or corporation to furnish pertinent information deemed necessary and requested by the Department to verify this statement or regarding my (our) competence and general reputation.

4. The undersigned understand(s) and agree(s) that further qualifying information may be requested, and agrees to furnish any such information at the request of the Department / Project/Work implementing agency.

5. The undersigned binds himself with all the stipulations of the Bidding Document including period of completion, provision of adequate equipment, personnel and other resources required for completion within the stipulated completion period and agrees to augment them, if found necessary for timely completion of the Project/Work, as desired by the Engineer/Employer.

6. Affidavit/undertaking of not having been black-listed by any Govt. /Semi Govt. Organization/Corporation at any stage and/or debarred by the department of Punjab PWD (B&R).

7. The undersigned has never been convicted by any court of law for any of the offences under any Indian/ foreign laws.

_____(Signed by an Authorized Officer of the Firm)

Title of Office_____

Name of Firm _____

DATE_____

* To be executed on a non-judicial stamp paper .

Electrical work

Scope of work shall include control panels, power / control cabling/ wiring/ GI earthing from Control Panel to various equipment and their starters like package chillers, Pumps, Hot water generators, AHUs Distribution Panel, etc along with GI strip connections.

MAIN HVAC Panel: MCC-1 at plant room

Designing, fabricating, transporting to site, installing, testing and commissioning of floor mounted, self supported, compartmentalized LT cubical pattern (Extendable Type) metal clad switch board, fabricated from 2mm (14 G) thick CRCA sheet steel suitable for 31 MVA rupturing capacity at 415 V, 3 phase, 4 wire, 50 HZ AC supply and equipped with PVC sleeved aluminum bus bars of specified rating and following switch gears inter connected by PVC sleeved solid conductors, including 7-tank cleaning, degreasing, phosphating process and treatment of panel with anti-corrosive zinc based primer paint and finally powder coating the panel, complete with earthing terminals, cable and bus bar alleys and hoisting hooks as required. The LT panel will comprise ACBs and MCCBs as described below for incoming and outgoing power supplies.

Necessary cable alley, spare switches, internal wiring, control wiring/cabling and earthing of all equipment shall also be included.

All starters shall have the following accessories:

TPN MPCB/MCB as per the suitable rating, terminal block for power distribution, contactor, overload relay with built in single phasing protection, phase indication lights and indicating light for ON/OFF status, ammeter with CTs & selector switches, relay, auto manual selection & push buttons with SP MCB.

All internal wiring and GI earthing of air handling unit motors from the panel shall be included. The panel shall include the following accessories.

TPN MPCB for incoming power as per rating given below

Terminal block for power distribution.

Single phase preventer.

Phase indicating lights and indicating light for 'ON' status with toggle switches and back-up fuses.

96 mm x 96mm voltmeter with fuse of suitable range.

Ammeter of suitable range with CTs and selector switch.

Time delay relay for delayed automatic restart of air handling unit motor.

220/24 volts transformer.

24 volts wiring to the 2-way diverting valve and space thermostat.

Control wiring for thermostat.

Bimetallic lugs shall be used at copper to aluminium joints.

Auto/Manual start/stop selector switch shall be provided for each equipment in the panel to facilitate remote operation from Central Indication Light Panel. Panels shall have adequate space for mounting transformers and other accessories related to control system.

INCOMERS

1 No MCCB as per following details/ specification:

800 A, 35kA, TPN MCCB with in-built protection relays such as over load release, earth fault release, magnetic short circuit, auxiliary contacts, ROH, Spreaders & padlock facility shall contain the following:

Voltmeter of 0-500V with VSS & one set of (RYB) phase indicating lights with 6A SP MCB

Indicating lamps shall be protected by 6A MCB to indicate ON,OFF, TRIP for MCCB
0 - 100 amps 96 x 96 sq mm ammeter with 1000/5 amps resin cast CT's and selector switch. 1 set of under voltage relay

BUSBARS :

1000 A , 35 KA, TPN Aluminium busbar duly sleeved - 1 set
Maximum density of aluminimun bus bars for current carrying capacity shall be one amp per square mm.

OUTGOINGS :

3 Nos. MCCB as per following details/ specification:

3 Nos. 315 amps TPN MCCBs, 35 KA, motor duty with extended handle, over load relays with built in single phasing protection and outgoing feeders (2W +1S). Each of these compartments shall contain CT operated ammeter of 0-400 amps range with selector switch, auto manual switch along with an ON/OFF indicating lamps, Local/remote Control Stations with LED Indications, Local/Remote Control stations with LED Idications and push buttons with SP MCB.

3 Nos. MCCB as per following details/ specification:

3 No. 40A, 25KA, TPN MPCB, motor duty, with extended handle and outgoing feeder to Chilled water pumps (2W + 1 S) Including 7.5 HP DOL starter with all accessories, Local / Remote Contro station with LED Indications etc. complete in all respect as required. The compartment shall contain :
"ON/OFF" LED indicating lamp with 6A control SP MCB
0 - 50 amps 96 x 96 sq mm ammeter with 63/5 amps CT's and selector switch.

2 Nos. MCCB as per following details/ specification:

2 No. 40A, 25KA, TPN MPCB, motor duty, with extended handle and outgoing feeder to Hot water pumps (1W + 1 S) Including 5 HP DOL starter with all accessories, Local / Remote Contro station with LED Indications etc. complete in all respect as required. The compartment shall contain :
"ON/OFF" LED indicating lamp with 6A control SP MCB
0 - 50 amps 96 x 96 sq mm ammeter with 63/5 amps CT's and selector switch.

1Nos. MCCB as per following details/ specification:

1 Nos. 315 amps TPN MCCBs, 35 KA, motor duty with extended handle, over load relays with built in single phasing protection and outgoing feeders (1W). Each of these compartments shall contain CT operated ammeter of 0-400 amps range with selector switch, auto manual switch along with an ON/OFF indicating lamps, Local/remote Control Stations with LED Indications, Local/Remote Control stations with LED Idications and push buttons with SP MCB.