

**PRASAR BHARATI  
(BROADCASTING CORPORATION OF INDIA)  
OFFICE OF THE ADG(E)(SOUTH ZONE)  
ALL INDIA RADIO & DOORDARSHAN  
SWAMY SIVANANDA SALAI, CHENNAI - 600 005**

No. ADG(E)(SZ)/PUR/ NIT-16/ACP/2011-12/

Date: 17-10-2011

**SUB.:** ENQUIRY FOR THE NOTICE INVITING TENDER FOR THE  
SITC OF 6 X 8.5 TR DX AIR COOLED CONDENSING UNIT ON  
TRANSMITTING CENTRE OF DOORDARSHAN KENDRA, CHENNAI.

Sir,

Please find enclosed herewith the enquiry for the Supply, Installation, Testing and Commissioning (SITC) of 6 X 8.5 TR Dx Air Cooled Condensing Unit on Transmitting centre of Doordarshan Kendra, Chennai.

Tender documents can be collected from this office from 18.10.2011 to 16.11.2011 on all working days between 11.00Hrs to 16.00Hrs, on payment of required tender cost in the form of cash/demand draft or the tender documents can be down- loaded from the website mentioned below. Demand Draft for Rs. 530/- drawn in favour of the ADG(E) (South Zone) AIR & TV, Chennai-5, shall be enclosed in separate cover along with the tender otherwise the tender shall be rejected.

**Prebid meeting is arranged at DDK, Chennai on 08.11.2011 at 11.00 Hrs. Attending pre bid meeting is mandatory. Only the firm attending the pre-bid meeting can participate in the tender.**

[www.cesairdd.org.in/tenders.html](http://www.cesairdd.org.in/tenders.html),  
[www.allindiaradio.org/tender.html](http://www.allindiaradio.org/tender.html),  
[www.tenders.gov.in](http://www.tenders.gov.in)

The tenders will be received at the Office of The ADG(E) (SZ), AIR & TV, Swamy Sivananda Salai, Chennai-5, up to 12.30 Hrs on **17.11.2011**. The Technical bid and E.M.D. will be opened on the same day at 15.00 Hrs. The Commercial bid of technically qualified tenders will be opened at a later date that will be intimated to the qualified tenderers.

Yours faithfully,

(T.SHANMUGARAJU)  
DY. DIRECTOR (ENGG)(PURCHASE)  
for Addl. Director General (E)(SZ)

PRASAR BHARATI  
(BROADCASTING CORPORATION OF INDIA)  
OFFICE OF THE ADG(E)(SOUTH ZONE)  
ALL INDIA RADIO & DOORDARSHAN  
SWAMI SIVANANDA SALAI  
CHENNAI 600 005

TENDER No. ADG(E)(SZ)/PUR/ NIT-16/ACP/2011-12/

Date:-17.10.2011.

**Supply, Installation, Testing and  
Commissioning (SITC) of 6 X 8.5 TR Dx Air  
Cooled Condensing Unit on Transmitting  
centre of Doordarshan Kendra, Chennai.**



PRASAR BHARATI  
(BROADCASTING CORPORATION OF INDIA)  
OFFICE OF THE ADDL.DIRECTOR GENERAL (E)(SZ)  
ALL INDIA RADIO & DOORDARSHAN  
SWAMI SIVANANDA SALAI  
CHENNAI 600 005

File No. ADG(E)(SZ)/PUR/ NIT-16/ACP/2011-12/

Dated:- 17.10.2011

To:

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**INVITATION TO BID**

On behalf of the Prasar Bharti (B.C.I.), sealed tenders are invited by this Organisation in the prescribed Bid Forms at Appendices, 2 to 7 of "Instructions to Bidders" enclosed at Annexure-I. The details of tender are given in the schedule below:

1. Tender No. : **ADG(E)(SZ)/PUR/ NIT-16/ACP/2011-12/**
2. Description and quantity of stores : NOTICE INVITING TENDER FOR Supply, Installation, Testing and Commissioning (SITC) of 6 X 8.5 TR Dx Air Cooled Condensing Unit on Transmitting centre of Doordarshan Kendra, Chennai.
3. Delivery Period: : **TWO Months** after the placement of Order.
4. Tender Fee: : **Rs. 530/-**
5. Earnest Money: : **Rs.80,000 /-**
6. Bid Validity up to: : **120 (One Hundred and twenty) days from the date of opening of Technical Bid.**

**NOTE:** Tender documents may be downloaded from the following websites:

[www.cesairdd.org.in/tenders.html](http://www.cesairdd.org.in/tenders.html)

[www.allindiaradio.org/tender.html](http://www.allindiaradio.org/tender.html)

[www.tenders.gov.in](http://www.tenders.gov.in)

7. Warranty : Required as per clause 8 of Annexure-II, General Terms & Conditions & as per Specs.
8. Performance Security Deposit : Required as per Annexure-II, (General Terms & Conditions).
- (i) Amount : 10% of the order value in form of Demand Draft / Bank Guarantee /FDR
- (ii) Validity : 60 (sixty) days beyond the date of expiry of Warranty / Guarantee
9. Correspondence Address: Dy .Director (Purchase) O/o  
Addl. Director General (E)(SZ)  
All India Radio &  
Doordarshan  
Chennai-600005
10. Paying Authority : Addl. Director General (E)(SZ)  
All India Radio & Doordarshan  
Chennai-600005.
11. Tender Opening Date: **17.11-2011 Time 15:00 hr**
12. Terms of Delivery : Delivery at Consignees' place.

**DDG(E)/ Installation Officer,  
Doordarshankendra,  
Chennai-600005.**

**13. Prebid meeting is arranged at DDK, Chennai on 08.11.2011 at 11.00Hrs. Attending pre bid meeting is mandatory. Only the firm attending the pre-bid meeting can participate in the tender.**

**14. Important Instructions:**

The tender will be governed by the "Instructions to the Bidder" as per Annexure-I; "General Terms & Conditions" placed at Annexure-II, and "Technical Specifications" placed at Annexure-IV.

Deviations/Exceptions to the clause, if any, should be explicitly recorded seriatim as a separate Annexure (Appendix 4 of Annexure-I), in your offer, failing which, all the clauses shall be deemed to have been accepted by you.

**Two Bid System** shall be followed for this tender. Tenderers should take due care to submit tenders in accordance with requirement in sealed covers as specified in clause 2 of **“Instructions to Bidders” (Annexure-I)**. Bid evaluation criteria at Annexure-III shall be the basis for evaluation of tenders.

**The Technical & Commercial Bid should be submitted in Separate Sealed Cover.**

**The EMD should be enclosed with the Technical Bid. (see annexure-I SI.No-15)**

The tenderer while submitting their bid, must adhere to the following instructions of Central Vigilance Commission, otherwise their offer is likely to be ignored.

1. One Agent / Dealer / Supplier shall not represent two manufacturers of quote on their behalf in a particular tender i.e. one bidder shall quote one type of equipment in a particular tender.

2. Tender documents submitted by the tenderer shall be neatly tied and each page numbered and signed and stamped by them.

**NOTE: The following documents must be submitted along with the tender failing which the offer may be liable to rejection and no further correspondence will be entertained in this regard.**

- (a) **Original Equipment Manufacturer’s Authorisation for equipment quoted.**
- (b) **Past Performance along with the user certificate in respect of timely and good quality supply of equipment / execution SITC / SETC ( Especially, the equipments should be supplied and installed at RF fields like AIR/DD Transmitter sites. ).**

Kindly refer item No.8 under Annexure-I.

[ ..... ]  
**Dy Director(Purchase)**  
**for Addl. Director General (E) (SZ)**

<b>LIST OF ANNEXURES</b>	<b>DETAILS</b>	<b>PAGES</b>
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**\* THIS TENDER DOCUMENT PART- I CONSISTS OF -38- PAGES.**

**TECHNICAL DOCUMENT PART- II CONSISTS OF -87- PAGES.**

**INSTRUCTIONS TO BIDDERS**

(Please sign each page of these conditions and send it with your offer)

**1. PREPARATION OF TENDER:**

i) The bid shall be submitted in the prescribed proforma as per Appendices 2 to 6. The bid document duly filled in and signed should be returned whether you are quoting for any item or not. When items are not being tendered for, the corresponding space should be defaced by some such words as "Not quoting".

ii) In the event of the space on the bid document being insufficient for the required purpose, additional pages may be added. Each such additional page must be numbered consecutively showing the Tender Number and duly signed. In such cases, reference to the additional page must be made in the tender form.

iii) The bid document referred to above, if not returned or if returned but not duly filled-in, will be liable to result in rejection of the tender.

iv) Bidders are advised in their own interest to ensure that all the points brought out in the checklist enclosed at Appendix 3 are complied with in their offer, failing which, the offer is liable to be rejected.

v) The Bids can only be submitted in the name of the bidder in whose name the bid documents were issued. The tender papers filled-in and completed in all respects shall be submitted together with requisite information and Annexures. It shall be complete and free from ambiguity, change or interlineations.

The tender submitted by bidders and any annotations or accompanying documentation submitted along with the tender, shall be in English language.

Bidders should indicate at the time of quoting against this tender their full postal/ fax / E-mail addresses.

Bidders shall sign their proposal with the exact name of the firm to whom the contract is to be issued. The tender shall be duly signed and sealed by an executive officer of the bidder's organisation.

Each page of the tender shall be signed by a duly authorised officer and in the case of a Corporation the same shall be sealed with the Corporation seal or otherwise appropriately executed under seal.

Bidders shall clearly indicate their legal constitution and the person signing the tender shall state his capacity and source of his ability to bind the bidder.

The Power of Attorney or authorisation, or any other document consisting of adequate proof of the ability of the signatory to bind the bidder, shall be annexed to the tender. This organisation may reject outright any tender unsupported by the adequate proof of the signatory's authority.

vi) It must be ensured that each page of the tender including terms and conditions, Bid Evaluation Criteria and specification (Annexures I, II, III and IV) are signed by bidder and returned to this office along with offer.

## 2. DELIVERY OF TENDER

2.1 The tender will be on the basis of **“Two Bid System”** and offers are to be submitted in separate sealed covers.

The first inner sealed cover will contain **“Technical Bid”** having all details including the list of equipment to be supplied / SITC / SETC to be executed, but with price column blanked out. There will be no mention of price anywhere in the **“Technical Bid”** and **EMD** will also be sent in the above first inner cover. This cover will clearly be super- scripted with **“Technical Bid”** along with tender number and item description.

The second inner-cover will contain the price schedule duly filled-in and signed and contain all the commercial details of the bid and will be clearly super-scripted with **“Commercial Bid”** along with tender number. These two covers shall be put into an outer cover and sealed. The outer cover should duly bear the tender number and date of closing / opening prominently underlined along with the address of this office.

All General Terms and Conditions (GTC) attached with the invitation to tender are sacrosanct for considering any offer as a complete offer. It is therefore, important that all documents duly completed and signed are returned with your offer.

2.2 The right to ignore any offer, which, fails to comply with the above instructions is reserved. Only one tender should be included in one cover.

2.3 Your offer must reach this office not later than 12:30 hr. on the notified date of closing of the tender. Offers sent by hand delivery should be put in the Tender Box in this office before 12:30 hr. on the specified date. All outstation tenders , if sent by post, should be sent under registered cover.

2.4 **Any change in quotation after opening of tender will not be considered.**

2.5 This organisation will not be responsible for the loss of tender form or for the delay in postal transit.

2.6 Tenderer is advised in his own interest to ensure that his offer reaches this office well before the closing date and time of the tender as **the offers received after the closing date and time of the tender, will not be considered.**

2.7 TELEGRAPHIC/TELEFAX/E-MAIL offers, received directly by this organisation, will not be considered.

## 3. VAGUE AND INDEFINITE EXPRESSION

Tenders qualified by vague and indefinite expressions such as **“subject to immediate acceptance”** or **“Subject to prior sale”** etc. will not be considered.

## 4. VALIDITY PERIOD OF OFFER

4.1 The tender shall be valid for acceptance for the period as indicated in the **“Invitation to Bid”** (hereinafter referred to as validity period) and shall not be withdrawn on or after the opening of tenders till the expiration of the validity period or any extension thereof.

The offers of those tenderers who have not kept the validity open till the period stipulated in the tender will be treated as un-responsive and will be ignored without making any reference to the tenderer.

4.2 The tenderer will undertake not to vary/modify the tender during the validity period or any extension thereof.

## **5. OPENING OF TENDERS**

5.1 The tenders will be opened at **15.00 hours** on the date of opening indicated in the "Invitation to Bid". The tenderer or his authorised representative may be present at the time of opening of tender on the specified date, but a letter in the form annexed as Appendix-7 hereto must be forwarded to this office along with tender document and a copy of this letter must be produced in the office by the person attending the opening of tender. Unless this letter is presented by him, he may not be allowed to attend the opening of tender.

5.2 In case of unscheduled holiday on the closing / opening day of tender, the next working day will be treated as scheduled prescribed day of closing / opening of tender, the time notified remaining the same.

## **6. PRICE:**

6.1 The price quoted must be net for per unit and must include packing and delivery charges.

6.2 The tenderers are requested to quote their firm prices. Any change or modification to the offer after opening of the tender will not be considered at all.

6.3 The bidder/tenderer is advised to quote rates keeping in mind that repeat order can also be placed upto 50% of the original quantity of any item(s) on the same terms and conditions as stipulated in the original purchase order during the validity of the order, or within six months of original supply order, whichever, is later. It will be obligatory on the part of the supplier / contractor to execute such repeat order (s) also.

6.4 Spares, Annual Maintenance Contract and Optional Items shall be quoted separately in the price bid, wherever asked for. Spares, AMC, and optional items will not form the part of commercial bid and will not count for deciding the lowest bidder.

### **6.5 Payment of excise duty and sales tax / VAT (on ultimate products)**

Payment of excise duty and sales tax/VAT (on ultimate products), as applicable on the closing date of tender will be to the supplier's / contractor's account. Any statutory variation (both plus and minus) in the rate of excise duty/sales tax/VAT after closing date of tender/revised price bid but before the expiry of the contractual delivery / completion period will be to the account of the office.

The bidder(s) will indicate, in their bid, the amount with exact rate of the Excise and Sales tax/VAT on ultimate finished product, as applicable at tendering stage, separately in the bid. In case the above information subsequently proves wrong, incorrect or misleading (a) this Organisation will have no liability to reimburse the excess in the difference in rates of the item under which the duty/tax assessed finally (b) this Organisation will have the right to recover the difference in case the rate of duty / tax finally assessed is on the lower side.

Any increase in excise duty, sales tax / VAT during extended period of the contract / supply order will be to supplier's / contractor's account where such extension in delivery of the materials/completion of the project was on the request of supplier / contractor. However, any decrease in excise duty/sales tax/ VAT during extended period of the contract / supply order, will be to the account of this Organisation.

6.6 As the material, which is to be transported to the consignee, belongs to the Government of India / Prasar Bharati and therefore is exempted from entry tax / octroi duty / toll tax. However, if the State Governments / Statutory Local Bodies are bound to levy such taxes, the taxes will be paid by supplier / contractor. Supplier/Contractor may raise its claim, for reimbursement of such duties / taxes paid, with Organisation, along with original receipt of the payment.

6.7 In case of SITC of / SETC tenders, prorata breakup details of cost of all the identifiable store items of supply and ITC / ETC charges shall be given along with a price bid.

6.8 The taxes like excise duty, sale tax / VAT, service tax etc. as applicable on the goods / services shall be quoted separately in the price bids.

## **7. Trade/Volume Discount**

Bidders will not indicate separate discount. Discount, if any, should be merged in the rates against the quoted item(s). Discount of any type indicated separately will not be taken into account for evaluation purposes.

## **8. Eligibility:**

Bids should be from actual manufacturers. Bid from sole selling agents / authorised distributors / Authorised dealers/ Authorised contractors can also be considered provided such bids are accompanied with necessary supporting documents / authority letter from concerned actual manufacturers who authorised them to market their products, provided further, such an authority letter is valid at the time of bidding. The supplier / contractor shall ensure that the required warranty cover is provided by the original manufacturer of the product. In case of SITC / SETC and specialised work, the contractor should also have sufficient experience and shall submit the experience certificate of satisfactory completion of atleast three similar works, each of value not less than 40% of the estimated cost put to tender, or two similar works, each of value not less than 60% of the estimated cost, or one similar work of value not less than 80% of the estimated cost, all amounts rounded off to the convenient full figure, in the last seven years ending on the last day of the month previous to the one in which the tenders are invited.

## **9. Purchase Preference for Product of Public Enterprises:**

The Organisation reserves the right to allow to the public enterprises, purchase preference facilities as admissible under the existing policy of the Government of India and not to accept the lowest rate quoted by the tenderer.

## **10. Scope of Supply of Equipments / SITC / SETC:**

The delivery of stores / execution of SITC / SETC is required as stated in Invitation to Bid on terms specified in clause 2 of General Terms & Conditions at Annexure-II. Any deviation must be clearly mentioned.

## **11. Samples**

11.1 Samples are not required unless specifically called for.

11.2 The samples when called for should be sent to the purchasing authority along with the offer. The cost and freight of sending the samples shall be borne by the tenderer and there will be no obligation on the part of receiving officer for their safe custody.

Samples received late are liable to be ignored. If the samples are sent by Railway Parcel, The Railway Receipt (RR) should be posted separately to the addressee to which the samples are sent (under covering letter giving the particulars of tender number and due date) well in advance to enable the addressee to get the parcel released before the date of opening of tender. The RR should not be sent along with the offer. Samples submitted with the tenders, which have not been accepted; will, if it has not been destroyed during testing, be delivered at your cost provided the application for return is made to the officer to whom the samples are sent, within one month of the date fixed for the opening of tender or after modification / cancellation of demand. This organisation will not be liable for loss, damage, or breakage in respect of samples. If no application is received within the due date, samples will be disposed of by public auction and the sale proceeds credited to this Organisation.

#### **12. Consideration of offer in full or in part:**

This Organisation may reject / accept or prefer any tender without having to assign any reason whatsoever. This Organisation also reserves to itself the right to accept any tender in part or split the order between two or more bidders. Tenderers are at liberty to quote separate rates for the whole quantity as well as reduced quantity.

#### **13. Acceptance of Offer by Telegram / Fax/E-mail**

Acceptance by the purchaser will be normally communicated by Telegram/Fax/E-mail. In case where acceptance is communicated by Telegram/Fax/E-mail, the regular order will be forwarded as soon as possible but the instructions contained in the Telegram/Fax/E-mail should be acted upon immediately. With the issue of Telegram/Fax/E-mail of acceptance, the contract shall be deemed to have concluded. Contract shall mean and include the invitation to tender / instructions to tenderers, acceptance of tender, supply of stores / SITC / SETC particulars and the general and special conditions specified in the acceptance of tender.

#### **14. Specifications:**

i) Unless otherwise asked for, the offers of "Makers design or for alternative specifications, the tenderer must note that his offer, will be rejected in case the tender stipulations are not complied with strictly or the goods offered do not conform to the required specifications indicated therein. The lowest tender will be determined from among those tenders, which are in full conformity with the required specifications.

ii) In case the offers have been asked for "Makers design" or for alternative specifications, the tender will clearly indicate as to how the materials being offered will serve this Organisation's purpose and in what respect the offer differs from the required specifications.

iii) If this Organisation finds that materials supplied / works carried out are not of correct quality and are not according to required specifications or otherwise not satisfactory owing to any reason of which the Organisation will be the sole judge, The Organisation will be entitled to cancel the contract for supply of stores / SITC / SETC and meets its requirements of stores / SITC / SETC from the open market at the risk and cost of the supplier / contractor, reserving always to itself the right to forfeit the security deposit placed by the supplier / contractor for fulfilment of the contract.

## 15. Earnest Money Deposit / Performance Security Deposit

### 15.1 Earnest Money Deposit :

The bidders must enclose with their technical bid along with EMD in the form of Demand Draft in favour of Addl. Director General (E)(SZ), All India Radio & Doordarshan, Chennai-600 005, from a Commercial Bank . EMD by means of Bank guarantee or any other mode of payment other than DD shall not be accepted.

15.2 Offers without EMD will be ignored.

15.3 The Earnest Money deposited by the tenderer shall be forfeited by this Organisation in the following events:

(a) If tender is withdrawn during the validity period or any extension thereof.

(b) If tender is varied or modified in a manner not acceptable to this Organisation during the validity period or any extension of the validity duly agreed by the bidder.

(c) If a tenderer, whose tender has been accepted, fails to furnish Security Deposit within 2 weeks from the issue of the acceptance offer of the tender, the offer is likely to be cancelled.

15.4 The EMD of unsuccessful bidders will be returned on finalization of the tender. The EMD of successful bidder will be returned on receipt of security deposit or it may be adjusted in the security deposit if requested by the tenderer.

### 15.5 Performance Security Deposit:

The contractor shall furnish the security deposit within 2 weeks of placement of order at the rate of 10% of the total contract value at the time of signing the contract. The Security deposit shall be furnished in favour of The Addl. Director General (E) (South Zone), AIR & Doordarshan, Chennai-5 in any one of the forms: Fixed Deposit Receipt from a Commercial Bank/DD Payable at Chennai / Bank Guarantee from a Commercial Bank valid up to the end of warranty period as per contract.

16. **Transfer of Tender Documents:** The tender is non-transferable.

### 17. Correspondence:

i) Our Fax / Email address is:

Fax: 044-25381147 Email : 1. [ceszpurchz@gmail.com](mailto:ceszpurchz@gmail.com)  
2. [purchase@ceszairdd.org.in](mailto:purchase@ceszairdd.org.in)

ii) All correspondence from tenderer / contractor shall be made to the Purchase Authority (by name), who has issued this tender.

iii) All correspondence shall bear reference to Tender No. / Purchase Order.

### 18. Order on Higher Tenderer:

It should be noted that if an order is placed for supply of stores / SITC / SETC on a higher tenderer in preference to the lowest acceptable offer in consideration of an earlier delivery, the tenderer will be liable to pay to the Purchaser, the difference between the contract rate quoted by the lowest acceptable tenderer, in case he fails to complete the supply of stores / SITC / SETC in terms of such contract within the specified date of delivery. This is without prejudice to other rights under terms of contract.

## **19. Payment Terms:**

### **(i) For Supply Contracts:**

(a) The supplier will submit its bill for 90% of the material cost along with copy of Inspection Certificate to the consignees. On receipt of stores in good condition, consignee will complete necessary formalities at his end and verify the bill and submit to the paying authority along with measurement book for making payment.

(b) The bill for balance 10% of material cost will be submitted by the suppliers along with proof of the deposit of performance security money for guarantee/warranty period to the consignee. Consignee will verify the bill and submit the same to the paying authority for release of payment.

### **(ii) For SITC/SETC (Supply, Installation /Erection, Testing & Commissioning) Contracts:**

(a) 80 % of the contract price for the equipments/materials inclusive of excise duty and Sales tax shall be paid on initial inspection and delivery of equipments at site in good condition. The consignee will complete necessary formalities at his end and verify the bill and submit to the paying authority along with measurement book for making payment.

(b) 20 % of the contract price for equipments and 100 % of installation charges on satisfactory completion of installation, testing, commissioning and handing over. The consignee will complete necessary formalities at his end and verify the bill and submit to the paying authority along with measurement book for making payment.

## **20. Unsolicited Post Tender Modification:**

In case certain clarifications are sought by this Organisation after opening of tenders, then the reply of the Bidder should be restricted to the clarifications sought. Any Bidder who modifies his Bid (including a modification, which has the effect of altering the value of his offer) after the closing date without specific reference by this Organisation shall render the bid liable to be ignored and rejected without notice and without further reference to the Bidder. Canvassing in any form by the Bidders shall also render the bid liable to be ignored and rejected without notice and without further reference to the Bidder.

## **21. Clarification in respect of Incomplete offer:**

This Organisation has to finalize its purchase within a limited time schedule. Therefore, it may not be feasible in all cases for this Organisation to seek clarification in respect of incomplete offers. Prospective Bidders are advised to ensure that their bids are complete in all respects and conform to our terms and conditions and Bid Evaluation Criteria of the tender. Bids not complying with this Organisation's requirements may be rejected without seeking any clarifications.

## **22. Income Tax/Trade Tax / Work Contract Tax Liability:**

(i) The Bidder will have to bear all Income Tax liability both corporate and personal tax. Income tax on the contract value, as applicable, will be deducted at source by the paying authority.

(ii) Some State Governments levy work contract tax/trade tax. These taxes are to be borne by the supplier / contractor, wherever applicable. These taxes will be deducted by the paying authority.

(iii) Bidder must give the TIN / PAN, VAT / Sale Tax, Service Tax, Registration no. in Appendix – 5, failing which the offer will not be considered.

### **23. After Sales Service and Training:**

The tenderer must furnish complete details of after sales service arrangement including training to be provided in respect of the equipment. After sales service arrangements should include details of infrastructure facilities available in the country. The training should be made available free of cost at sites. Failure to give this information, will lead to automatic rejection of the offer, without any reference to the Bidder.

### **24. Replacement/Rectification:**

In the event the stores supplied or SITC / SETC carried out against the contract are found to be defective, the supplier / contractor will have to take back the defective materials at his own cost and replace / rectify the defects of the Stores / SITC / SETC free of charge without loss of time. The supplier / contractor will not be entitled to dispose of the Store / Equipment / Material given for replacement / rectification without the prior permission of this Organisation. All charges concerned with the rectification including freight charges will be borne by the supplier / contractor.

### **25. Tender Fee: ( If applicable)**

- (i) Tender to be paid by Bidders is as indicated in the Invitation to Bid.
- (ii) The offers will not be considered without Tender Fee.

### **26. Evaluation / Security of bids:**

Technical / Commercial evaluation of bids shall be undertaken in accordance with the prescribed procedure by a Committee of the Organisation duly constituted for this purpose. The technical evaluation would be based on:

- (i) assessment of technical capability of tenderer to manufacture tendered items of stores / carry out SITC / SETC;
- (ii) capability of tenderer to effect supply of stores / carry out SITC / SETC in stipulated time as assessed on the basis of installed capacity for manufacturing and turnover of tendered items in preceding three years; and
- (iii) past record of timely and good quality supply of tendered items of store / execution of SITC / SETC by tenderer in preceding three years.

### **27. Employment by firms to officials of this Organisation:**

Firms / Companies, who have or had business relations with this Organisation, are advised not to employ serving employees of this Organisation without its prior permission or within the initial two years period after the retirement / resignation / severance from the service without specific permission of this Organisation. This Organisation may decide not to deal with such firms who fail to comply with the above advice.

## **28. Arbitration :**

If any dispute, difference, question or disagreement shall at any time, hereafter arise, between the parties hereto or the respective representatives or assignees in connection with or arising out of the contract or in respect of meaning of specifications, design, drawings, estimates, schedules, annexure, orders, instructions the construction, interpretation of this agreement, application of provisions thereof or anything hereunder contained or arising hereunder or as to the rights, liabilities or duties of the said parties hereunder or any matter whatsoever incidental to his contract or otherwise concerning the works of execution or failure to execute the same, whether during the progress or work of stipulated/extended period or before or after the completion or abandonment thereof, it shall be referred to the sole arbitration of the person appointed by the Addl. Director General (E) (SZ), All India Radio & Doordarshan, Chennai. There will be no objection to any such appointment that the arbitrator so appointed is an employee of this Organisation or that he had to deal with the matters to which contract relates and that in the course of his duties as this Organisation's employees he had expressed views of all or any of the matters in dispute or difference. If an arbitrator to whom the matter is referred dies or refuse to act or resigns for any reason from the position of arbitrator, it shall be lawful for the Addl. Director General (E) (SZ), All India Radio & Doordarshan, Chennai to appoint another person to act as arbitrator in the manner aforesaid. Such person shall be entitled to proceed with the reference from the stage at which it was left by his predecessor if both the parties consent to Addl. Director General (E) (SZ), All India Radio & Doordarshan, Chennai to this effect failing which the arbitrator will be entitled to proceed de-novo.

It is a further term of this contract that no person other than the person appointed by the Addl. Director General (E) (SZ), All India Radio & Doordarshan, Chennai as aforesaid shall act as arbitrator and that, if for any reason that is not possible, the matter is not to be referred to the arbitration at all. The arbitrator(s) may from time to time, with the written consent of all the parties to the contract enlarge the time for making and Publishing the award. It is a term of the contract that the party invoking arbitration shall specify the disputes to be referred to arbitration under the clause.

It is also term of the contract that the contractor shall not stop the work under this contract and work shall continue as expected to continue whether the arbitration proceedings have commenced or not.

The arbitrator shall give reasoned award in respect or each dispute or difference referred to him. The award as aforesaid shall be final and binding on all the parties to the contract in accordance with the law.

The Venue of the arbitration shall be at New Delhi (India). Subject to as aforesaid, the provision of the Indian Arbitration Act, 1940 and any statutory modifications or re-enactments thereof and rules made there under and for the time being in force shall apply to the arbitration proceedings under this clause.

**PROFORMA FOR BIDDERS TO ACKNOWLEDGE THE BID DOCUMENT**

Dated:

Dear Sirs,

We hereby acknowledge receipt of a complete set of Bid Documents pertaining to Procurement / SITC/SETC of \_\_\_\_\_ Against \_\_\_\_\_

We have noted that the closing date for receipt of the tender by you is the time specified in the tender document and opening at specified time and date.

We guarantee that the contents of the above said Bid Package will be kept confidential within our company and text of the said package shall remain the property of your Organisation and that the said documents are to be used only for the purpose intended by your Organisation.

Our address for further correspondence on this tender will be as under:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Fax No :  
Telephone No :  
E-Mail No :  
Personal Attention of (If required):

Yours faithfully

**BID SUBMISSION FORM AND AGREEMENT**

Tender. No ADG(E)(SZ)/PUR/ NIT-16/ACP/2011-12/

**The Addl. Director General (E)(SZ),  
All India Radio & Doordarshan,  
Chennai - 600005.**

Dear Sirs,

1. I/We hereby offer to supply the stores detailed in schedule hereto or such portion thereof as you specify in the Acceptance of Tender at the price given in the said schedule and agree to hold this offer open till.....I/We shall be bound by the communications of acceptance dispatched within the prescribed time.
2. I/We have understood the "Instructions to Bidders", specifically the instructions to the tenderers in the booklet DGS&D-229 and accepted the "conditions of contract" and specifically the conditions of the contracts as contained in DGS&D-68 (R) for Supply/SITC/SETC and have thoroughly examined the specifications, drawings and/or pattern quoted in the schedule hereto and am/are fully aware of the nature of the stores required and my/our offer is to supply stores strictly in accordance with the requirements.
3. The following pages annexure-II-to-annexure-IV have been added to and form part of this tender.
4. Agreement at Appendix 2A on purchase of Tender documents and submission of Tender has been duly signed and returned herewith.

Yours faithfully,

Signature of witness

Address

Date

Signature of witness

Address

Date

**PRASAR BHARTI  
(BROADCASTING CORPORATION OF INDIA)  
OFFICE OF ADDL.DIRECTOR(E) (SZ),  
All India Radio & DOORDARSHAN  
CHENNAI – 600 005.**

**APPENDIX-2A**

**AGREEMENT**

Tender **No. ADG(E)(SZ)/PUR/ NIT-16/ACP/2011-12/**

To  
PRASAR BHARTI (B.C.I.)  
The Addl. Director General (E) (SZ), All India Radio &  
Doordarshan,  
Chennai – 600005.

Sub:- Purchase Of Tender Documents

Ref:- Tender No. ADG(E)(SZ)/

The Addl. Director General (E)(SZ), All India Radio & Doordarshan, Swami Sivananda Salai, Chennai – 600005, acting on behalf of Prasar Bharti (B.C.I.) and the Tenderer agree that the Tenders is an offer made on the condition that the Tender would be kept open in its original form without variation or modification for a period as the mention in the invitation bid ,the last date for the receipt of tenders stated in the SITC/SETC/NIT AND THE MAKING OF THE TENDER SHALL BE REGARDED AS AN UNCONDITIONAL AND ABSOLUTE ACCEPTANCE of this condition of the Tender. We further agree that the contract consisting of the above conditions of Tender as the offer and the submission of Tender as the Acceptance shall be separate and distinct from the contract which will come into existence when tender is finally accepted by this Organisation. The consideration for this separate initial contract proceeding the main contract is that this Organisation is not agreeable to sell the Tender to the Tenderer and to consider the tender to be made except on the condition that tender shall be kept open for ..... days after the last date fixed for the receipt of tenders and the Tenderer desires to make tender on this condition after entering into this separate initial contract with this Organisation. This Organisation promised to consider the tender on this condition and the tenderer agrees to keep the tender open for the required period. These reciprocal promises form the consideration for this separate initial contract between the parties.

If Tenderer fails to honour the above terms and conditions this Organisation shall have unqualified, absolute and unfettered right to en cash the earnest money submitted on this behalf.

Yours faithfully,

(BIDDER)

(PURCHASER)

on behalf of the Prasar Bharti Corporation of India

(One copy of this agreement duly signed must be returned along with the Technical Bid)

**EXCEPTION / DEVIATION PROFORMA**

This organisation expects the bidders to fully accept the terms and conditions of the tender document. However, should the bidder still envisage some exception/ deviations to the terms and conditions of the tender documents, the same should be indicated here and put in unpriced bid i.e. "Technical Bids". The price effect for withdrawal of such exception(s) to be indicated in the price bids only. If this proforma is left blank, then it would be presumed that bidder has not taken any exception / deviations to the terms and conditions of the tender documents.

Clause No. of Tender document	Full compliance not agreed	Exception/ deviation taken by Bidder	Confirmation if price effect for withdrawal of this exception has been specified in the Price Bid	Remarks

Signature of the Bidder /Tenderer

Name

Seal of the Company

**BIDDERS PAST SUPPLIES PROFORMA**

Sl. No.	Name & Address of client	Period from..... To.....	Description of stores / works in details	Total quantity supplied successfully	Remarks

**Note:** Certificate from clients to be enclosed along with this proforma.

**BIDDERS INFORMATION PROFORMA**

Tenderer must give specific answers against each of the following questions.

Tender No. **ADG(E)(SZ)/PUR/ NIT-16/ACP/2011-12/** Due for opening -----

1. Whether stores offered / SITC/SETC conform to specification at Annexure-IV, if not, details of deviations must be stated here.
2. Date by which delivery of stores / execution of work can be completed.
3. Business name and constitution of tendering firm. Is the firm registered under?
  - (i) Indian companies Act, 1913.
  - (ii) The Indian Companies Act, 1932/1956
  - (iii) Any other Act, if not who are owners?  
(Please give a full name).
4. VAT / Sales tax Registration No.
5. Central Sales Tax Registration No.
6. Service Tax Registration No.
7. PAN No / TIN No.
8. Annual turnover for last 3 years.
9. Present worth of tendering firm.
10. Fax No.:
11. E-mail :
12. Valid Electrical License number of contractor, Attested copy of the License to be submitted. **(For Electrical Works)**

Signature of Tenderer

Date \_\_\_\_\_

## PRICE BID

## Schedule of Rates

(To Be Filled In By Tenderers)

Tender No. **ADG(E)(SZ)/PUR/ NIT-16/ACP/2011-12/**

Tender's Name \_\_\_\_\_

Due Date \_\_\_\_\_

Delivery Period:

Tenderer's Quotation No. ----- Validity of Quotation-----

**Kindly refer Part-II Page No. 3 to 9 for bill of materials.**

Tenderer's Signature

Date

Seal

**Note**

1. Please indicate prorata break up details of all identifiable items of supply of stores and ITC / ETC cost in proforma Appendix - 6A enclosed.
2. The statutory charges like Excise Duty, VAT/Sale Tax, Service Tax etc which will not be borne by the bidder must be indicated with % rates as applicable in column 7 above, failing which this Organisation will not be liable for payment of any such charges.
3. State Entry Tax, Toll Tax and other taxes which are collected by statutory bodies on the way during transportation of materials **shall not be included in the price bid**. These taxes, if paid, may be reimbursed as per actual on claim with original receipt of payment.

**PRICE BID**  
**Prorata Break Up Details Of The Identifiable Items of Supply**  
**And ITC / ETC cost**

(To Be Filled In By Tenderers)

Supply, Installation, Testing and Commissioning (SITC) of 6 X 8.5 TR Dx Air Cooled Condensing Unit on Transmitting centre of Doordarshan Kendra, Chennai.

Tender No **ADG(E)(SZ)/PUR/ NIT-16/ACP/2011-12/**

Tender's Name -----

Due Date-----

Delivery Period:-----

Tenderer's Quotation No. \_

Validity of Quotation\_\_\_\_

Sl No.	Description of items/works	Quantity	Unit	Rate per unit (both in figures and words)	Total (both in figures and words)	Taxes if any (rate & amount)
1.						
2.						
3						
4						
5						

**Grand Total (1+2+3+4+5) in Rs.**  
 (Both in words & figures)

Tenderer's Signature

Date  
 Seal

No.

To,

PRASAR BHARATI (BCI),  
The Addl. Director(E)(SZ),  
All India Radio & Doordarshan,  
Chennai – 600005.

SUBJECT : Tender No. \_\_\_\_\_ due on  
\_\_\_\_\_

Sir,

Sri \_\_\_\_\_ has been  
authorised to be present at the time of opening of above tender due on  
\_\_\_\_\_ at Chennai-5 on my/our behalf.

Yours faithfully,

Signature of Tenderer

Copy to : Shri \_\_\_\_\_ for  
information and for production before the time of opening of tenders.

**General Terms And Conditions  
(GTC)**

(Each page must be signed and returned along with your offer)

**1. Definitions**

Unless inconsistent with or otherwise indicated by the context, following terms stipulated in this ORDER shall have the meaning as defined hereunder.

**1.1 Order**

Shall mean written purchase order issued by this organisation to the successful bidder including subsequent amendments to ORDER in writing thereof.

**1.2 The Organisation /Purchaser**

Shall mean PRASAR BHARATI (BCI), ADDL.DIRECTOR GENERAL(E) (SZ) All India Radio & DOORDARSHAN, CHENNAI -600005, acting on behalf of President of India shall include all their legal representatives, successors and assignees.

**1.3 Supplier/Contractor**

Shall mean any person or persons of firm or company in India whose bid has been accepted by this Organisation and the legal representation, representatives, successors and permitted assignee of such person, persons, firm or company.

**1.4 Sub-Contract**

Shall mean ORDER placed by the Supplier/Contractor for any portion, of the ORDER or work Sublette with necessary written consent of this Organisation on third party. Such sub-letting shall not relieve the contractor from any obligation, duty or responsibility under the Contract.

**1.5 Sub-Contractor**

Shall mean any person or persons or firm or their legal representatives, successors, assignees to whom part of ORDER has been sub-letter by the Supplier/Contractor after necessary consent of this Organisation.

**1.6 ORDER PRICE**

Shall mean the sum accepted or the sum calculated in accordance with the rates accepted by this Organisation and amendments thereof and shall include all fees, registration and other charges paid to statutory authorities without any liability on the Organisation for any of these charges unless specially agreed to, in writing by this Organisation.

**1.7 DELIVERY PERIOD**

Shall mean dispatch of the stores or receipt of the stores or installation and commissioning or erection and commissioning or fabrication and erection of the stores depending on the type of contract (Supply of Stores / SITC / SETC) by the date specified in the ORDER.

## **1.8 DESTINATION**

Shall mean the location of the consignees for which this ORDER has been issued.

## **1.9 EQUIPMENTS/MATERIALS**

Shall mean and include any equipment, instruments, stores and goods to be supplied for under the ORDER and amendments thereto.

## **1.10 DRAWINGS**

Shall mean and include all Engineering sketches, general arrangements, layout drawing, Sectional plans, all elevations etc., related to the ORDER together with modification and revision thereto.

## **1.11 SPECIFICATIONS**

Shall mean and include detailed description, statements to technical data, performance characteristic and standards (Indian as well as as applicable and as specified in the ORDER).

## **1.12 INSPECTION OFFICER**

Shall mean any person or outside Agency nominated by this Organisation to inspect equipment, materials and services, if any, in the contract stage-wise as well as final before dispatch at Suppliers Works and on receipt at destination as per the terms of the ORDER.

## **1.13 TESTS**

Shall mean such process or processes to be carried out by the Suppliers/Contractor as prescribed in the ORDER, are considered necessary by this Organisation or their representative in order to ascertain quality, workmanship, performance and efficiency of equipment or part thereof

## **1.14 APPROVAL**

Shall mean and include the written consent either manuscript, typewritten or printed statement under or over signature or seal as the case may be of this Organisation or the representative or documents or other particulars in relation to the ORDER.

## **2. SCOPE OF ORDER**

2.1 Scope of the order shall be as defined in the ORDER, specifications, drawings and annexure thereto.

2.2 Completeness of the EQUIPMENT/SITC/SETC shall be the responsibility of the Suppliers/Contractors. Any equipment fittings and accessories, which may be specifically mentioned in the specification or drawing (s) but which are usual or necessary for the satisfactory functioning of the EQUIPMENTS (successful operation and functioning of the equipment being Suppliers/Contractors responsibility shall be provided by the SUPPLIER without any extra cost).

2.3 The Suppliers/Contractors shall follow the best modern practice in the manufacture of high grade EQUIPMENT notwithstanding any omission in that, the Supplier/Contractor shall in all respect design, engineer, manufacture and supply the same within delivery period to the entire satisfaction of the Organisation.

2.4 WORK TO BE CARRIED OUT UNDER THE ORDER

All equipment to be supplied/SITC/SETC to be executed under the ORDER shall conform to and comply with the provision of relevant regulations/Acts (State Govt. or Central Govt.) as may be applicable to the type of equipment/work carried out and necessary certificate shall be furnished.

**3. SPECIFICATION, DRAWING, TECHNICAL MANUALS**

3.1 The Suppliers/Contractors shall furnish four copies and such additional no. of copies as required by this organisation of technical documents final drawing, preservation instructions, operation and maintenance manuals, test certificates, spare parts catalogue before dispatch of the equipment as under:

- (i) Inspection Officer
- (ii) Consignee (2 copies)
- (iii) Purchaser

3.2 The Suppliers/Contractors shall be responsible for any loss to this Organisation consequent to the furnishing of the incorrect data/drawings.

3.3 The Suppliers/Contractors shall provide Cross Sectional Drawing to identify the spare parts numbers and their location.

3.4 Specifications, design and drawings issued by this Organisation to the supplier/contractor along with tender specification and ORDER are not to be sold or given on loan. These documents continue to remain property of this Organisation. OR THEIR ASSIGNEE AND ARE SUBJECT TO RECALL BY this Organisation. The Suppliers/Contractors and its employees shall not make use of the drawings, specification and technical information for any purpose any time and shall not disclose the same to any person, firm or corporate authorities without written permission of the Organisation. All such details shall be kept confidential.

3.5 In order to facilitate quick disposal, copies of the drawing for approval shall be sent directly and simultaneously to the authorities specified in the order in addition to the sets submitted to authority issuing order.

**4. ACCEPTANCE OF ORDER**

4.1 Within fifteen (15) days from date of mailing of ORDER, SUPPLIER/CONTRACTOR shall confirm acceptance of the order in its entirety.

4.2 The ORDER is accepted unconditionally by Suppliers/Contractors by returning to this Organisation copy of the ORDER duly signed.

4.3 When Suppliers/Contractors has accepted the order with all its terms and conditions, tenderer's bid with general sales conditions and all his previous correspondences are considered superseded and void.

- 4.4 Should Suppliers/Contractors not respect the time limit for the Confirmation of the order or in case Suppliers/Contractors cannot accept the ORDER, this Organisation reserves the right to cancel in writing without prejudice to other terms, the entire ORDER or part of it, without notice. Under these circumstances the earnest money given by the supplier/contractor will be forfeited in full.

## **5. MODIFICATION IN ORDER**

- 5.1 All modifications leading to changes in the order with respect to technical and /or commercial aspects, including terms of delivery, shall be considered valid only when accepted in writing by this Organisation by issuing amendment to the ORDER.
- 5.2 This Organisation shall not be bound by any printed conditions, provision in the SUPPLIER BID, forms of acknowledgement of ORDER, invoice, packing list and other document, which purport to impose any condition at variance with or supplement to ORDER.

## **6. JOINT AND SEVERAL RESPONSIBILITY**

- 6.1 Where Suppliers'/Contractor's Equipment or any part thereof are to be used jointly with the equipment supplied by another manufacturer (the name of the manufacturer will be communicated separately to supplier) this Organisation will hold supplier and the manufacturer jointly and severally responsible for the perfect operation of the entire group or section of equipment as regard the technical and mechanical characteristics stipulated in the specification. Such responsibility shall include the mechanical coupling as well as dynamic and starting moment.
- 6.2 Consequently, Suppliers/Contractors shall establish and maintain all necessary contract with the manufacturer to be indicated by the organisation with a view to ensuring the exchange of all relevant data and information.

## **7. PERFORMANCE SECURITY DEPOSIT**

- 7.1 To ensure due performance of the contract, Performance Security is to be obtained from the successful bidder awarded the contract. The successful bidder, 2 weeks from the date of the issue of the letter of indent will be required to deposit Performance Security Deposit in the form of Fixed Deposit Receipt from a Commercial Bank/Demand Draft / Bank Guarantee from a Commercial Bank for an amount as indicated in the letter of indent. The Performance Security Deposit shall be 10 % of cost of the order / contract value.
- 7.2 The Security money may be deposited in the form of Fixed Deposit Receipt/Demand Draft/Bank Guarantee from a Commercial Bank. It should remain valid for a period of 60 days beyond the date of completion of all contractual obligations of the supplier, including warranty/guarantee obligations.
- 7.3 This Organisation shall not be liable to pay any Bank Charges, Commissions or interest on the amount of Performance security deposit.

- 7.4 Performance Security deposit shall be refunded to the supplier/contractor after completion of all contractual obligations of the supplier, including warranty/guarantee obligations. If the materials are supplied in the extended delivery period, the supplier/contractor will extend the validity of Demand Draft/Bank Guarantee/ FDR accordingly and the Security Deposit / Performance Guarantee will be released after extended validity expires.
- 7.5 For release of Performance security deposit, supplier/contractor shall submit a certificate from the consignee to the effect that the equipment has performed satisfactorily during the guarantee period as stipulated in the order and organisation has not suffered any loss or inconvenience on this account.

## **8. WARRANTIES AND GUARANTEES.**

### **8.1 MATERIALS AND WORKMANSHIP**

- 8.2 Unless some special warranty/Guarantee clause has been stipulated elsewhere in the invitation to the tender or any of its Annexure, the following warranty shall form part of the contract placed on successful tender:-
- 8.2.1 Suppliers/Contractors shall fully warrant that all the stores, Equipment and components supplied under the ORDER shall be new and of first quality according to the specifications and shall be free from defects (even concealed fault, deficiency in design, materials and workmanship).
- 8.2.2 Should any defects be noticed in design, material and/or workmanship within 15 months from the date of shipment/dispatch of last consignment or 12 months from the date of receipt/commissioning of the equipment, or the guarantee/warranty period as specified in specifications (Annexure IV) whichever is later, the organisation shall inform Supplier/Contractor and Supplier/contractor shall immediately on receipt of such intimation, depute their personnel within 14 days to investigate the causes of defects and arrange rectification /replacement/modification of the defective equipment at site without any cost to the Organisation within a reasonable period. If the supplier/contractor fails to take proper corrective action to repair/replace the defects satisfactorily within the reasonable period, this Organisation shall be free to take such corrective action as may be deemed necessary at contractor's risk and cost after giving notice to the Supplier/Contractor.
- 8.2.3 Damage to the machinery and/or equipment due to incomplete and erroneous instructions issued by Supplier/Contractor will be the responsibility of the supplier/contractor and will be treated according to the provisions of warranty clause. Normal wear & tear shall not come under purview of this clause.
- 8.2.4 In case defects are of such nature that equipment shall have to be taken to suppliers/Contractor's works for rectification etc. Supplier/Contractor shall take the equipment at his cost after giving necessary undertaking or security as may be required by the Organisation. This Organisation shall, if so required by the supplier/contractor, dispatch the equipment by quickest mode on "Freight-to pay" basis to the supplier's/contractor's works. After repairs suppliers/contractors shall deliver the equipment at site on freight pre-paid basis. All risks in transit to and fro shall be borne by the supplier/contractor.

- 8.2.5 Equipment or spare parts thereof replaced shall have further warranty for a period of 12 months from the date of acceptance.
- 8.2.6 The supplier/contractor shall guarantee that they will supply spare parts if and when required on agreed price. The agreed price should include but without any limitation to agreed discount on the published catalogue price or on agreed percentage of profit on the landed cost.
- 8.2.7 The supplier will warranty that before going out of production for any of spare parts, they will give adequate advance notice to the purchaser so that the latter may undertake to procure, if necessary, the balance of the life time requirements.
- 8.2.8 If the repairs, replacement or modification referred are of such nature as may affect the efficiency of the EQUIPMENT this Organisation shall have the right to give to the Supplier/Contractor within one month of such replacement / renewal notice in writing to carry out test as may be required for acceptance of the equipment.
- 8.2.9 If the supplier/contractor fails to honour his obligation to repair or replace defective goods within a reasonable period of time, or if supplier/contractor refuses to carry out work under the guarantee clause and implied guarantee condition, if danger is anticipated or in case of severe urgency, the Organisation shall be entitled to carry out, at Supplier's/Contractor's cost and risk, repair work or replacement deliveries or have it done by a third party. In case not all goods have been delivered by Supplier/Contractor, this Organisation is entitled to procure the remaining goods/services at Supplier's/Contractor's cost and risk. This does not relieve Supplier's/Contractor's of any of his guarantee obligations. Taxes and duties of any kind whatever imposed by the authorities of the country of the supplier or his sub contractors until delivery shall be borne by supplier//contractor.

## **9. PERFORMANCE GUARANTEE**

- 9.1 Supplier/Contractor shall guarantee that the performance of the Equipment /Material supplied under the order shall be strictly in conformity with specification and shall perform the duties specified under the ORDER.
- 9.2 The Supplier/Contractor shall guarantee that the materials / equipment that shall be purchased from the sub-contractor(s) shall be such as to fulfil the requirements laid down vide para 8.1 to 8.10 above and shall undertake to ensure fulfilment of these requirement.

## **10 REJECTION**

If the ORGANISATION finds that the goods supplied are not in accordance with the specification and other condition stated in the order or its sample (s) are received in damaged conditions (of which matters this Organisation will be the sole judge), this Organisation shall be entitled to reject the whole of the goods or the part, as the case may be and intimate to the Supplier/Contractor the rejection without prejudice to the Organisation other rights and remedies to recover from the Supplier/Contractor any loss which the ORGANISATION may be put to, also reserving the right to forfeit the performance security deposit if any made for the due fulfilment of the contract.

The goods shall be removed by the supplier/contractor and if not removed within 14 days of the date of communication of the rejection the Organisation will be entitled to dispose-off the same on account and at the risk of the Supplier/Contractor and after recovering the storage charges at the rate of 5% of the value of goods of each month or part of month and loss and expense if any caused to the Organisation pay balance to the Supplier/Contractor.

**11. FAILURE AND TERMINATION CLAUSE**

Time and date of delivery shall be essence of the contract. If the Contractor/Supplier fails to deliver the stores / execute SITC / SETC, or any instalment thereof within the period fixed for such delivery in the schedule or at any time repudiates the contract before the expiry of such periods, the purchaser may without prejudice to any other right or remedy, available to him to recover demurrages for breach of the contract:-

- a) Recover from the Supplier/Contractor as agreed, liquidated demurrages including Administrative expenses and not by way of penalty, a sum equivalent to 0.5% per week upto maximum limit of 10% of the contract value for such delay or part thereof (this is an agreed, genuine pre-estimate of demurrages duly agreed by the parties) which the supplier/contractor has failed to deliver thereof is accepted after expiry of the aforesaid period, provided that the total demurrages so claimed shall not exceed 10% of the contract price of the stores / SITC / SETC. After full period of extension, termination of the contract will be considered by the Organisation.
- b) Purchase or authorise the purchase elsewhere on the account and at the risk of the contractor/supplier, of the stores not so delivered / SITC / SETC not carried out or other of a similar description (where stores exactly complying with the particulars are not in the opinion of the purchaser, which shall be final, readily procurable) by serving prior notice to the contractor/supplier without cancelling the contract in respect of the instalment not yet due for delivery or,
- c) Cancel the contract or a portion thereof by serving prior notice to the Contractor/Supplier and if so desired purchase or authorise the purchase of the stores not so delivered / SITC / SETC not carried out, or others of a similar description (where stores not delivered / SITC / SETC not carried out, exactly complying with particulars are not in the opinion of the purchaser, which shall be final readily procurable) at the risk and cost of the Contractor/Supplier. If the Contractor/Supplier had defaulted in the performance of the original contract, the purchaser shall have the right to ignore his tender for risk purchase even though the lowest, where the contract is terminated at the risk and cost of the firm under the provisions of this clause, it shall be in the discretion of the purchaser to exercise his discretion to collect or not, the Security deposit from the firm on whom the contract is placed, at the risk and expense of the defaulted firm.
- (d) Where action is taken under sub-clause (b) or sub-clause (c) above, the contractor shall be liable for any loss which the purchaser may sustain on that account, provided the purchase or if there is an agreement, to purchase, such agreement is made in case of failure to deliver the Stores/Services, within 6 months from the date of such failure and in case of repudiation of contract the Contractor/Supplier shall not be entitled to any gain on such the entire discretion of the purchaser to serve a notice of such purchase on the Contractor/Supplier.

- (e) It may further be noted that clause (a) above provides for recovery of liquidated demurrages on the cost of contract price of delayed supplies (whole unit) at the rate of 0.5% per week up to maximum limit of 10% of the contract value for such delay or part thereof. Liquidated demurrages for delay in supplies thus accrued will be recovered by the paying authority on instruction as specified in the supply order, from the bill for payment of the cost of materials / works submitted by the supplier / contractor in accordance with terms of supply order on instruction from Purchaser regarding liquidated demurrages amount.
- (f) Notwithstanding anything stated above, equipment and materials will be deemed to have been delivered / SITC / SETC will be deemed to have been carried out only when all its components, parts are also delivered. If certain components of stores are not delivered in time / SITC / SETC not carried out in time, the stores / SITC / SETC will be considered as delayed until such time all the missing parts are also delivered.

## 12. **INSPECTING/TESTING OF MATERIAL**

The inspection of stores/services/works will be carried out by the authority specified in the purchase order. The stores/works will be accepted only after the same has been found satisfactory after inspection and duly marked and sealed by the inspection authority.

- 12.1 The Supplier/Contractor shall ensure that the stores/services/works to be supplied/executed against this order shall be individually inspected, tested and analysed in terms of the specifications attached to the tender and the relevant codes and practices specified therein by expression or implication. Necessary test reports shall be provided as required.
- 12.2 The Supplier/Contractor should make available to the Organisation and any other individual/agency authorised by the Organisation for the purpose of inspection all its records and results in respect of inspection, test and analysis conducted by it as part of their manufacturing and testing operation under the applicable codes and practices specified by expression or implication in the tender.
- 12.3 Inspection tests and analysis shall be carried out/conducted at the Supplier's/Contractor's works by the authorised representative of the Organisation and the cost of to and fro air fare, accommodation and cash allowances payable to the authorised representative of the Organisation shall be borne by the Organisation.
- 12.4 The Supplier/Contractor shall provide and deliver free of charge for tests/analysis by an independent authority at any such place or places as the Organisation or its authorised inspector may reasonably require such raw material (s) used or intended to be used for the contracted work by the Supplier/Contractor as the Organisation/Inspector shall consider necessary. The cost of such tests/analysis shall be borne by the Contractor.
- 12.5 This Organisation shall be entitled at all times, whether prior to, during or after the completion of inspection by itself and/or through inspectors appointed by the Organisation at the Organisation's cost, to inspect, test and/or analyses and/or to direct the Contractor in all respect of any store(s) or materials processes used or proposed to be used in the fabrication of the product of any of them.

The said inspection, tests and analysis as far as required, is to be conducted in the presence of the inspectors. The contractor shall ensure that the inspecting personnel referred to above are given free access to all the required places and information connected with their work, besides working facilities to carry out their function.

- 12.6 Should the supplier/contractor fail to comply with any of the provisions aforesaid relating to inspection, testing and /analysis the Organisation shall be entitled by itself and/or through inspectors to conduct or have conducted the inspection, test and/or analysis at the risk and expense of the supplier/contractor in all respects.
- 12.7 No rejected raw materials shall be used for the contracted work or re-tendered for inspection and/or test except with the prior permission of concerned Inspectors.
- 12.8 Unless otherwise specifically authorised by the Organisation in writing, the contractor shall not dispatch the stores under the contract entered into, any material which has not been properly inspected/tested marked and in respect of which a certificate of quality has not been issued or signed by the inspectors.
- 12.9 In addition to the general conditions of the inspection stated above, the supplier/contractor shall also satisfy all the specific conditions of inspection as enumerated in the specification attached.
- 12.10 In addition to inspector(s) the Organisation shall be entitled to nominate, depute or designate a representative to be stationed at the supplier's/contractor's factory in order to supervise and/or coordinate operations related to the contract. In the event of there being more than one factory involved in the work entrusted to the Supplier/Contractor, the Organisation shall be entitled to nominate/depute or appoint such representative(s) as necessary in respect of each such factory.
- 12.11 The Supplier/Contractor shall at his cost afford and ensure proper working facilities to the said representative(s) at the factory (i.e.) to enable him to perform his functions, and shall furnish him with all such information, data and assistance as he may require for the proper performance of his functions.
- 12.12 The posting of such a representative by the Organisation or his actions in any manner does not absolve the contractor of any liability, and/or responsibility under this contract. The representative's posting shall be treated as advisory to the Organisation.
- 12.13 For false calls for the cases where material is rejected on inspection the supplier will bear the actual cost of inspection incurred/suffered by the Organisation.
- 12.14 Place of inspections specified in supply order will not be changed without written confirmation from Purchase Authority.

13. **SUB-STANDARD MATERIAL/REPLACEMENT OF REJECTED GOODS**

13.1 If the Organisation finds that MATERIAL supplied / SITC/SETC executed are not of the correct quality or not according to specification required or otherwise not satisfactory owing to any reason of which the Organisation will be the sole judge, the Organisation will be entitled to reject materials, cancel the contract and buy its requirement in the open market at the risk and cost of supplier, reserving always to itself the right to forfeit the performance security deposit placed by the supplier for the due fulfilment of the contract.

13.2 Rejected goods should be removed and replaced within 14 days of the date of communication of rejection.

14. **SUBLETTING AND ASSIGNMENT**

The Supplier/Contractor shall not, save with the previous consent in writing of the purchase Authority, sublet, transfer or assign the contract or any part thereof or interest therein or benefit or advantage thereof in any manner whatsoever, provided nevertheless that any such consent shall not relieve the contractor from any obligation, duty or responsibility under the contract.

15. **BREAKAGE/SHORTAGE**

Claim in respect of breakage/shortages, if any, shall be preferred on the supplier within thirty days from the date of receipt of stores at destination by the consignee which shall be replaced/made good by the supplier at his own cost.

All risk or loss or damage to the material shall be upon the Supplier/Contractor till it is delivered in accordance with the terms and conditions of the supply order.

16. **DESIGNS, PATENTS AND ROYALTIES**

If any material used or methods or processes practiced or employed in the manufacture of items to conform with the requirement of the contract is/are covered by a patent(s) in respect of which contractor is not licensed, the supplier/contractor shall before using the material, method or process, as the case may be, obtain such license(s) and pay such royalty(ies) and license fee(s) as may be necessary. The supplier/contractor shall keep the Organisation indemnified from and against any and all claims, actions demand and proceedings whatsoever brought or made against the organisation on the basis of any patent or infringement thereof claimed or otherwise relating to and arising from any method or process employed or matter or thing done to or in connection with any work executed by the supplier/contractor shall at their own risk and defend any suit for infringement or patent or like suit brought against the Organisation (whether with or without the contractor being a party thereto and shall pay demurrages and costs awarded in such suit and keep the Organisation indemnified from and against all consequence thereof.

17. **FORCE MAJEURE**

In the event of either party being rendered unable by force majeure to perform any obligation required to be performed by them under the contract, if any concluded, the relative obligation of the party affected by such force majeure lasts.

The terms "Force Majeure" as implied herein shall mean acts of God, War, Civil riots, fire directly affecting the performance of the contract, floods and Acts and Regulations of respective Government of the two parties, namely the Organisation and the contractor. Both upon the occurrence of such cause and upon its termination, the party alleging that it has been rendered unable as aforesaid shall within seventy two hours of the alleged beginning and ending thereof giving full particulars and satisfactory evidence in support of its claim. If deliveries are suspended by force majeure conditions lasting for more than 2(two) months, the Organisation shall have the option of cancelling this contract in whole or part at its discretion without any liability on its part.

18 **LANGUAGE/TERMINOLOGY**

The Supplier/Contractor shall ensure the language/Terminology/description of goods/Services/Works used in the Supply Order/Bill/Invoice/any other documents dispatched by the Supplier/Contractor is **verbatim in English**.

19 **REPEAT ORDER**

Repeat order can also be placed with the supplier up to 50% of the quantity of this order on the same terms and conditions as stipulated in the original supply order, during the validity of the supply order or within six months from the date of this supply order, whichever is later. It is a condition of this order and it will be obligatory on the part of Supplier/Contractor to execute such repeat order(s) also as the consideration for this option on favour of the purchase forms part of the main consideration under this order.

20 **PACKING & MARKING**

20.1 The supplier shall consign / Ship the stores in Sea worthy / Airworthy / Roadworthy packing confirming to the prescribed standards in force to withstand air / Ocean / Land journey and ensuring the safety of cargo en-route and also arrival of material at ultimate destination in good condition. The consignment shall be comprehensively insured against all risks by the Suppliers / Contractors from Supplier's / Contractor's warehouse up to destination . Each packing case should have proper identification like name of suppliers, name of consignee, gross weight, TOP / do not turn over / handle with care.

20.2 Each package shall have a detailed packing list.

21. **INSURANCE**

The contractor shall insure entire equipment during Transit, Storage, Installation, Testing, Commissioning until handing over to the consignee against losses, damages due to fire, earthquake, war, flood/ thefts etc. No claim will be admissible on this account.

22. **SHORT / DAMAGED / DEFECTIVE / NON RECEIPT OF MATERIAL**

The Supplier / Contractor is responsible for safe arrival of the material up to destination. Should there be any shortage / breakage of material found, the consignee, within a period of 30 days of receipt of material at destination, will lodge claim with the Supplier / Contractor and carriers under intimation to the Purchaser. The purchaser in question will also take up the matter with the supplier to make good the deficiency.

23. **Extension of Delivery Period**

In case where only portion of the stores ordered is tendered for inspection at the fag end of the delivery period and also in case where inspection is not completed in respect of the portion of the stores tendered for inspection during the delivery period ,the purchaser reserves right to cancel the balance quantity not tendered for inspection within the delivery fixed in the A/T at the risk and expenses of the contractor without further reference to him. If these stores for inspection during the fag end of the delivery period are not found acceptable after carrying out the inspection the purchaser is entitled to cancel the contract in respect of the same at the risk and expenses of the contractor. If, however the stores tendered for inspection and found acceptable, the purchaser may grant an extension of the delivery period subject to the following conditions.

- (i) The purchaser has the right to recover from the contractor under provision of clause 11 Annexure-II of the general condition of the contract liquidated demurrages on the stores which the contractor has failed to deliver within the DP/ refixed delivery period.
- (ii) That no increase in price on account of any statutory increase in or fresh imposition of customs duty, excise duty sales tax or on account of any other tax or duty leviable in respect of the stores specified in the A/T which takes place after the date of the delivery period stipulated in the A/T shall be admissible on such of the said stores as or delivered after the date of the delivery stipulated in A/T.
- (iii) That not with standing any stipulation in the contract for increase in price on any other ground, no such increase which take place after the date of the delivery stipulated in the A/T shall be admissible on such of the said stores as are delivered after the expiry of the D/P stipulated in A/T.
- (iv) But nevertheless, the purchaser shall be entitled to the benefit of any decrease in price on account of reduction in of remission of custom duty, excise duty, sales tax or on account of any other tax or duty or on any other grounds as stipulated in the price variation clause which takes place after the expiry of the date of delivery stipulated in the acceptance of tender.
- (v) The contractor shall not dispatch the stores, till such time an extension in terms of para (i) to (ii) above is granted by the purchaser and accepted by the supplier. If the stores are dispatched by the supplier before obtaining an extension letter from the purchaser, he would be doing so at his risk and no claim for payment shall lie against the purchaser either in respect of the cost of the stores dispatched or any other expenses which the supplier may have incurred. The purchaser shall however have a right to cancel the contract in terms of clause 11 Annexure II General terms & conditions . It shall be no defence that the consignee has taken delivery of the stores dispatched by the supplier without getting an extension letter and therefore the contract has been kept alive.
- (vi) In case where the entire quantity has not been tendered for inspection within the Delivery period stipulated in the A/T and the purchaser agrees to grant extension in the period the same would be subject to the conditions (i) to (iv) as mentioned paragraph above.

**BID EVALUATION CRITERIA**

1.	SALIENT FEATURES	BIDDERS CONFIRMATION
1.1	Open Tender No.	<b>ADG(E)(SZ)/PUR/ NIT-16/ACP/2011-12/</b>
1.2	Two Bid System	Yes
1.3	Tender Fee	As per clause 4 of Invitation to Bid
1.4	Validity period of Bid	120 days from the date of opening i.e. up to and inclusive of date of opening
1.5	Earnest Money	As per clause 5 of Invitation to Bid
1.6	Performance Security Deposit	Would be required on placement of Letter of indent i.e. 10% of the ordered value and shall be valid for 60 days from the date of expiry of guarantee / warranty
1.7	Delivery Period	As specified in the "Invitation to Bid"
1.8	Closing date of tender	<b>12.30 Hrs. on 17.11.2011</b>
1.9	Opening date of Technical bid	<b>15.00 Hrs. on 17.11.2011</b>
1.10	Opening date of Price bid	Date as may be separately notified later.

**2. VITAL COMMERCIAL CRITERIA FOR ACCEPTANCE**

The following vital commercial conditions should be strictly complied with failing which the bid will not be considered.

2.1 **Eligibility:** Reputed manufacturers of Air Conditioning (AC) systems only are eligible to participate in the bidding. They may also authorize their approved dealer to participate in the bidding. This should be accompanied with a certificate of authorization.

2.2 **Energy Efficiency (EER)** of the System is to be clearly specified. A base minimum value of EER is fixed at 9.5 BTUH/W (COP = 2.77). In case of higher EER, savings in running costs for an appropriate time horizon will be factored into during the evaluation of price bid.

2.3 Year-wise AMC for five years after warranty period should also be provided in the Price (Financial) Bid.

#### 2.4 SUBMISSION OF EARNEST MONEY ALONGWITH BID

The bidders must enclose with their technical bid along with EMD in the form of Demand Draft in favour of Addl. Director General(E) (SZ), All India Radio & Doordarshan, Chennai-600 005, from a Commercial Bank . EMD by means of Bank guarantee or any other mode of payment other than DD shall not be accepted. The amount of Earnest Money Deposit should be as per Clause 5 of "Invitation to Bid".The offers without earnest money will not be considered and summarily rejected.

2.5 Submission of Performance Security Deposit for execution of contract as well as for satisfactory performance of equipment during warranty period by the successful bidders

2.6 Acceptance of "Failure and Termination Clause", No. 11 (GTC) of Tender documents.

2.7 Acceptance of "Arbitration Clause", No.28 (Annexure-I) of tender document.

2.8 Acceptance of "Warranty and Guarantee Clause", No.8 (GTC) of tender document.

### 3. CRITERIA FOR LOADING OF BIDS

The following criteria will be adopted for evaluation of bid :-

3.1 For delivery/completion periods quoted longer than that specified in the bid document, the quoted price shall be loaded ½% per extra week or part thereof. Offers with delivery/completion period longer than 3 months beyond the stipulated delivery completion period will be rejected.

3.2 Bidders will not indicate separate discount. Discount if any should be merged in the rates against the quoted items. Discount, if any, indicated separately will not be taken into account for evaluation purposes.

### 4. VITAL TECHNICAL CRITERIA FOR ACCEPTANCE OF BIDS

4.1 Quotation in original must be from the manufacturers/authorised supply house.

4.2 In case, the bidder is an authorised dealer/supply house/contractor with requisite work experience, he should name the original manufacturer. Bidder should furnish warranty from the original manufacturer and also furnish a certificate from the manufacturer that the bidder can quote items of the original manufacturer directly. Offers not complying with these requirements will be rejected, without any notice/back reference.

4.3 Past performance report of similar items earlier supplied / similar works earlier carried out for this Organisation will be taken into consideration while evaluating this bid. The bid shall be rejected, if the past performance of the similar item earlier supplied/similar work earlier carried out for the Organisation is found to be unsatisfactory.

**ANNEXURE-IV**

**DESCRIPTION OF STORES & TECHNICAL SPECIFICATIONS**

Tender No **ADG(E)(SZ)/PUR/ NIT-16/ACP/2011-12/**

Due Date \_\_\_\_\_

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<b>Sl.</b>	<b>Description of Stores/SITC/SETC Specification No. No.</b>	<b>Qty.</b>
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Kindly refer **Technical Specification Part-II (1-87)** pages enclosed.

# **AC of Transmitter Rooms, DDK, Chennai**

## **TECHNICAL PART OF TENDER DOCUMENT**

**PLANT AND DUCT LAYOUT DRAWING**

**BILL OF QUANTITIES**

**CODES, STANDARDS AND REGULATIONS**

**TENDER SPECIFICATIONS**

- **Basis of Design**
- **Air Distribution System**
- **Air Handling Units**
- **Accepted Makes**
- **Air-cooled Condensing Unit**
- **Energy Recovery Ventilator**
- **Refrigerant Piping**
- **Insulation**
- **Testing and Balancing**

**TECHNICAL DATA SHEETS**

**TEST READINGS**



**AC system at Transmitter Rooms, Doordarshan Kendra, Chennai**

**BILL OF QUANTITIES :**

S.N	Description	Qty	Unit	Unit Rate	Total Amount
1	<b>DX AIR COOLED CONDENSING UNITS :</b> Supply of 8.5 TR Nominal capacity DX Air-cooled Condensing Unit fixed with energy efficient scroll compressor along with grooved copper tube/ aluminium fins air cooled condenser coil with anticorrosion coatings, liquid accumulator, low noise aluminium propeller condensor fan with IP 55 motor etc all suitably assembled neatly in heavy duty GSS sheet metal cabinet and duly powder coated as per specification. The unit to include built-in safety controls like HP/LP switch, power quality protector, in-built thermal/temperature protection . The operating refrigerant should be R-407C or R-410A.	Nos	6		
2	Inland transportation to site, Lifting, Installation , Testing, Commissioning and Handing over of the above 8.5 TR DX Air-cooled Condensing Unit	Nos	6		
3	<b>FLOOR MOUNTED AIR HANDLING UNITS :</b> Supply, Installation, testing and commissioning of Factory assembled Double Skin AHU With 45 mm-45 kg/cum PUF Insulated detachable panels, extruded thermal break aluminium profiles filled with PUF, panel external skin with 0.6 mm pre-plasticised sheet, panel internal skin with 0.6 mm galvanised sheet, AMCA tested DIDW backward curved centrifugal fan with EFF1 rating motor, drive arrangement with taper lock pulleys for fan and motor, vibration isolators out of heavy duty rubberised mounts, prefilters with 3 ply HDPE 50 mm thick filters having an efficiency of 90% 10 Mic, 6 row/ 12 FPI deep DX copper cooling coil with copper header and Aluminium fins, GI mist arrestor , condensate coil trough with SS-304-20G insulated with 9 mm closed cell elastomeric foam, Limit Switch, Inspection sight glass, Emergency Light, Guard for Inspection Door, outlet damper of aerofoil blades & PVC gears, and flexible fire retardant canvass complete with galvanised hardware. Each of the cooling coil will have independent distributors, electronic expansion valve kit, catch all drier, independent DX coil circuit to connectivity to each ODU circuit.				
	Each AHU of 6800 CFM-40 mm st.pr to be connected to 3 nos.8.5 TR DX air-cooled condensing unit ( 2 Nos working and 1No. To act as standby ).	Nos	2		

4	<b>REFRIGERANT PIPING :</b> Installation and Testing of Refrigerant piping consisting of Suction/ Liquid line piping and fittings with 19 mm thick closed cell elastomeric / XLPE insulation and finished with polyshield coating with at-least two coats of resin and hardner . The piping shall be carried out with hard drawn copper pipes with soldered / brazed socket fittings. Complete piping workmanship to be carried out as per recommended practice. The piping to be vaccum tested and leak tested. Scope includes all refrigerant pipes shall be properly supported and anchored to the building structure using steel hangers, anchors, brackets and supports etc which shall be fixed to the building structure by means of inserts or expansion shields of adequate size and number .	Supply,				
4a		22.2 mm dia	Rmt	120		
4b		28.6 mm dia	Rmt	120		
5	<b>REFRIGERANT GAS :</b> Charging of R-407C / R-410A refrigerant gas	Supply and	Lot	1		
6	<b>DRAIN PIPING :</b> Installation and Testing of Hard PVC drain piping insulated out of Class O closed cell elastomeric nitrile rubber material of approved make as per specification complete with supports, consumables, fittings, pipe sleeves, U trap, leak arresting of following sizes.	Supply,				
6a	40mm dia (19 mm thick insulation)		Rmt	25		
6b	25mm dia (19 mm thick insulation)		Rmt	QRO		
7	Supply and Installation of MS channel frame work with rubber mountings for mounting the DX air cooled condensing unit. The channel frame work shall be neatly painted with two coats of primer and two coats of enamel paint of approved make and quality.		Kg	750		
8	<b>GSS FACTORY FABRICATED RECTANGULAR DUCTING :</b> Supply, Installation, Testing & Balancing of Factory Fabricated Rectangular Galvanised Steel Sheet Ducting made of Lock- forming quality GSS Class VIII ; complying with IS: 277 and having 120 GSM coating classification with GI full threaded rods and GI slotted channel support /hangers with bolts, nuts neoprene fire retardant gaskets and sealed with RTV / silicon sealant, elbows, turning vanes, slip on flanges, in accordance with the approved shop drawings and specifications , sizes and quantities as below :					

8a	24 G - 0.63 mm	SQM	235		
8b	22 G - 0.80 mm	SQM	115		
8c	20 G - 1.00 mm	SQM	50		
9	Supply, installation, testing and commissioning of synthetic canvass connection treated to fire quality and properly sized for AHU units mouth with necessary GI frame etc as required.	Unit	2		
10	<b>"LOW LEAKAGE VOLUME CONTROL / DUCT DAMPERS:</b> Supply, installation, testing and commissioning of Factory fabricated Aerofoil-blade Aluminium dampers with compressible jamb seals and extruded-vinyl blade edge seals, in opposed-blade arrangement with steel operating rods rotating in nylon bearings mounted in a single extruded aluminium frame, and with hard PVC/Nylon gear arrangement for common linkage between blades. Frames and blades to be constructed from high quality extruded aluminium sections. Frame with flat frontal face to suit flanged connections with the ducts. Frames to be screw fixed and sealed to eliminate casing leaks. Blades to be pivoted on PVC bushes and operated through PVC gear system to be fully enclosed within the damper frame.	SQM	3		
11	<b>SUPPLY AIR DIFFUSERS</b> Supply, Installation, Testing and Balancing of powder coated, extruded aluminium construction square diffusers , external frame with flat 33 mm frontal face and inclined in internal core,centre core assembly removable type to remove easily for cleaning purpose and for concealed fixing , removable center core type. The diffuser shall be 4-way with Aluminium volume control collar damper as per specification.				
11a	Neck Size 450 X 450 MM ,	NOS	QRO		
11b	Neck Size 375 X 375 MM ,	NOS	30		
10c	Neck Size 300 X 300 MM ,	NOS	QRO		
11	<b>RETURN AIR DIFFUSERS</b> Supply, Installation, Testing and Balancing of powder coated, extruded aluminium construction square diffusers , external frame with flat 33 mm frontal face and inclined in internal core, centre core assembly removable type to remove easily for cleaning purpose and for concealed fixing , removable center core type. The diffuser shall be 4-way without Neck Damper.				
11a	Neck Size 450 X 450 MM ,	NOS	QRO		
11b	Neck Size 375 X 375 MM ,	NOS	30		
11c	Neck Size 300 X 300 MM ,	NOS	QRO		

12	<b>FIRE AND SMOKE DAMPERS :</b> Supply, Installation, Testing and Commissioning of fire and smoke damper tested and approved for 120 minutes rated as per UL-555 S- 1995 and CBRI. Construction out of factory - made, 1.6 mm thick 800 mm long, 150 mm wide GSS sleeves and inner V grooved flat type multi blade assembly. Frames to be welded and inner blades to be connected to the frame by means of chrome plated spindle rods and bronze self lubricated bushes. All blades to be connected by a suitable flat link arrangement. The dampers are also to be provided with SS concealed jam seal (compression type) on the sides. The damper operation is by spring return actuator. It shall be complete with control panel, sensor and inter-locking/ wiring / connection for tripping of the AHU fan motor	Sqm	3		
13	<b>FIRE DAMPER ACTUATOR :</b> Supply, Installation, Testing and Commissioning of UL Listed Smoke rated Fire damper spring return type on/off actuator, mechanical fool proof and fail proof, open and close 2-position operation only, suitable for control voltages 24VAC/230VAC power supply, manual over ride and lock in switch, necessary control cabling (15m) to the nearest Fire Alarm module with mounting accessories. The minimum torque rating for the actuator shall be 10 NM.	Nos.	5		
14	<b>ACOUSTIC INSULATION OF DUCTS :</b> Supply and Application of Acoustic insulation for the initial portion of supply air ducting. Material of construction shall be fibre-free elastomeric nitrile rubber foam with open cell structure. The density of the same shall be within 140-180 Kg/m <sup>3</sup> . The material should have a thermal conductivity not exceeding 0.050 W/mK. The maximum surface temperature the material should withstand is 105° C and minimum temperature should be -20°C. The Thickness of the material shall be 15mm. The material should conform to Class 1 rating for surface spread of Flame as per BS 476 Part 7. The insulation material shall be stuck to the cleaned duct surface by cold adhesive. The material and installation methodology should be in accordance with the specifications.	Sqm	50		
15	<b>ACOUSTIC INSULATION AHU ROOM :</b> Supply and Application of Acoustic insulation for AHU room using fibre glass with 50 mm thick 24 kg / m <sup>3</sup> with covered with RP tissue & 26 g Al perforated sheet etc, with GI frame work using 50 x 50 GI channel	Sqm	40		
16	<b>THERMAL INSULATION OF DUCTS :</b> Supply and Application of External Thermal Insulation of Supply Air ducting. Material of construction shall be cross linked polyolefin/ polyethylene foam material with closed cell structure and with factory applied reinforced aluminium foil. The density of the same shall be within 25 Kg/m <sup>3</sup> . The material should have a thermal conductivity not exceeding 0.032 W/mK. The insulation material shall be stuck to the cleaned duct surface by cold adhesive. The material and installation methodology should be in accordance with the specifications.				
16a	9 MM THICK	Sqm	275		
16b	13 MM THICK	Sqm	75		

17	<b>UNDER DECK INSULATION :</b> Supply and Application of insulation for underdeck portion of the exposed roof. Material of construction shall be cross linked polyolefin /polyethelene foam material with closed cell structure and with factory applied reinforced aluminium foil. The density of the same shall be within 30 Kg/m <sup>3</sup> .The material should have a thermal conductivity not exceeding 0.032 W/mK. The Thickness of the material shall be 20 mm. The insulation material shall be stuck to the cleaned surface of below slab by cold adhesive and held in position by GI screw and plastic washers at 600 mm centres. The material and installation methodology should be in accordance with the specifications.	Sqm	50		
18	<b>ENERGY RECOVERY VENTILATOR SYSTEM</b>				
	Supply, Installation, Testing and Commissioning of Energy Recovery Ventilators (ERV) incorporating Heat Recovery Wheel complete with forward curved centrifugal fan with drive & motors, supply & exhaust filter section with synthetic pre filters, closed cell insulation, 3 Angstrom molecular sieve coated with HRW & suitable for sensible recovery at least 65% and latent recovery at least 65%. On site assembly of the unit is not acceptable.				
18a	300 cfm	Nos	1		
	<b>ELECTRICAL WORKS</b>				
19	Supply, Erection, Testing and Commissioning of MV panel of Indoor, free standing floor mounting type, 3 ph/415 V 4, wire duct and vermin proof by construction of 14 SWG CRCA sheets , treated with 7 tank process, painted with epoxy powder coating, compartmentalised, modular type with IP 42 Protection. Incomer: 1No - 200A TPN 25 kA MCCB with ROHM arrangement , 1 Set of Current transformer rated 200/5A, 10VA/CI 1.0 for metering , 1 No - Digital Multi data Meter with dual reading arrangement for volt, Amps, PF & Energy , 1 Set - LED type RYB indication lamps with control fuses , 6A Four Pole control MCB with neutral link. Outgoing - 1 ( AHU) : 3 ph star-delta starter (fuse less protection), suitable MCCB, power contactor, bi-relay, timer, under voltage trip, over voltage trip, single phase prevention, phase reversal unbalanced load trip relays, on/off push button, indicator lamps and auto manual operation. Outgoing - 2: 6 Nos - 63A TPN MCB , 200A TPN Aluminium Bus Bar ( TPN+E Electrolyte grade) and associated accessories as required. Outgoing - 3: 2 Nos - 16A S/P MCB for the ERV , 200A TPN Aluminium Bus Bar ( TPN+E Electrolyte grade) and associated accessories as required Required support Frame & Adequate size of Earth Bus. The MV panel shall have 2 spare cubicle one for the AHU and the other for condensing unit. Include potential free contacts as and when required.	Nos	1		
20	Supply, Installation and Testing of BIS certified FRLS copper armoured power cable interconnecting the distribution board, indoor and outdoor units.	Lot	1		
21	Supply, Installation and Testing of BIS certified FRLS copper control cable interconnecting the indoor and outdoor units.	Lot	1		
22	Supply, Installation and Testing of earthing out of 8 SWG GI wire.	RMT	200		
23	Supply, Installation and Testing of earthing out of 25 mmx 3 mm GI flats	RMT	100		

24	Supply, Installation and Testing of 63 Amps isolators with IP55 enclosure and proper mounting brackets for the air cooled condenser suitable for outdoor applications.	Nos	6		
25	Supply and erection of following sizes GI perforated type 14G thick cable tray made out of sheet steel folded to required shape with adequate number of supports for Insulated refrigerant pipe and cable conduits.				
25a	150 mm width	RMT	20		
25b	300 mm width	RMT	15		
25c	450 mm width	RMT	30		
26	SITC of cable glands	Lot	1		
	<b><u>Note : The client will terminate main power supply to the incoming of the MV panel along with main earthing. Thereafter all power cabling, control cabling, terminations, isolations and earthing as required will have to be carried out by the vendor.</u></b>				
	<b>OTHER RELATED WORKS :</b>				
	<b>NOTE : VENDORS ARE REQUESTED TO VISIT THE SITE, ASCERTAIN THE EXTENT OF THE FOLLOWING WORKS AND QUOTE ACCORDINGLY.</b>				
27	Dismantling of existing ducts,grills & diffusers etc. and storing them as instructed by the client.	Lot	1		
28	Removing, Alteration & Re-fixing of Existing False Ceiling	Lot	1		
29	Minor civil works like making and dressing of holes required to run refrigerant piping, cabling, unit installation. Note : No civil work required at site will be carried out by the client.	Lot	1		
30	<b>DIGITAL GROUP CONTROLLER WITH PC CONNECTIVITY :</b> Supply, Installation, Testing & Commissioning of Digital Group Controller ( DGC) with PC Connectivity to control all the air-conditioners from a centrally located PC ( PC to be provided by the client ). The DGC to be suitable for flexi- schedule operation and be capable of choosing between various temperature bandwidths for different times of the day and control the entire system. The system should incorporate features like secure operations, constant monitoring, Energy saving, Ease of control, Run record ,Real-time Display, Fault Diagnosis, Password Protection , Run Time Equalisation etc. The scope also includes data cabling between controllers, air-conditioners and PC.	Set	1		
31	<b>PRE-INSULATED GLASS WOOL DUCTWORK :</b> Supply, Installation, Testing & Balancing of 25 mm thick Pre-insulated duct board shall be made of high density of rigid resin bonded fire safe glass wool with outer side factory laminated aluminum foil, outer facing foil should have - Reinforced aluminum + Kraft+ glass veil and inner facing with glass textile with GI full threaded rods and GI slotted channel support /hangers with bolts, nuts neoprene fire retardant gaskets and sealed with RTV / silicon sealant, elbows, turning vanes, slip on flanges, in accordance with the approved shop drawings and specifications, quantities as below :	Sqm	QRO		
	<b>Total</b>				
	<b>VAT</b>				
	<b>SERVICE TAX</b>				
	<b>GRAND TOTAL</b>				

Warranty and AMC	
Comprehensive Warranty after handing over (Years)	
AMC for 1st year after Warranty period including tax (Rs.)	
AMC for 2nd year after Warranty period including tax (Rs.)	
AMC for 3rd year after Warranty period including tax (Rs.)	
AMC for 4th year after Warranty period including tax (Rs.)	
AMC for 5th year after Warranty period including tax (Rs.)	
Total AMC for 5 years after Warranty including tax (Rs.)	

# CODES, STANDARDS AND REGULATIONS

## CODES, STANDARDS AND REGULATIONS :

- Generally all works under this contract shall be complied with the following Indian Standards of latest version.
- The contractor shall make available copies (upon Award of Contract) of the above standards for reference of the Owner.

<b>AIR CONDITIONING EQUIPMENT :</b>	
IS 659	Safety Code for air conditioning
IS 660	Safety Code for mechanical refrigeration
IS 3615	Glossary of terms used in refrigeration & air conditioning
IS 5111	Testing of refrigeration compressors
IS 7896	Data for outside design conditions for air conditioning
IS 10617	Thermostats for use in refrigeration, air conditioners etc.,
IS 8148	Packaged air conditioners
IS 10594	Thermostatic Expansion Valve
SP 7	National Building Code (Group 4)
<b>NOISE AND VIBRATION:</b>	
IS 2264	Preferred frequencies for acoustical measurements.
IS 3483	Code of practice for noise reduction
IS 3932	Sound level meter for general purpose use.
IS 9736	Glossary of terms applicable to acoustics in buildings.
IS 9901	Measurement of sound insulation in buildings & building element
IS 9876	Guide to the measurement of air borne acoustical noise & evaluation of its effects on man
IS 10423	Personal sound exposure meter
IS 11446	Measurement of air borne noise emitted by compressors units intended for outdoor use.
IS 12710	Glossary of terms used in acoustic emission testing.
IS 4758	Methods of measurement of noise emitted by machines
IS 14280	Mechanical vibration – balancing – shaft and fitment key convention
IS 12065	Permissible limits of noise level for rotating electrical machines.
<b>PIPE AND FITTINGS :</b>	
IS 638	Gaskets
IS 1239	Mild steel tubes & fittings
IS 3589	Electrically welded steel pipes

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## CODES, STANDARDS AND REGULATIONS

IS 6392	Steel pipe flanges
IS 778	Gun metal gate, globe and check valves for general purpose
IS 5822	Code of practice laying of electrically welded steel pipes for water supply.
IS 3624	Bourden tube pressure and vacuum gauges
IS 2592	Recommendation for methods of measurement of fluid flow by means of orifice plates and nozzles

### PUMPS AND VALVES :

IS 1620	Horizontal centrifugal pumps for clear, cold, fresh water
IS 778	Copper alloy gate, globe & check valves for water works purposes.
IS 4854	Glossary of terms for valves and their parts.
IS 5312	Swing check type non-return valves.
IS 8092	Code for inspection of surface quality of steel castings for valves, fittings & other piping components.
IS 12969	Method of test for quality characteristic of valves.
IS 13095	Butterfly valves for general purposes.

### REFRIGERANT GAS AND OIL :

IS 4578	Lubricating oils for refrigeration machinery
IS 10609	Refrigerants - Number - Designation

### SHEET METAL WORKS :

IS 277	Galvanized Steel sheet
IS 513	Cold rolled low carbon steel sheets.
IS 655	Metal Air ducts

### THERMAL INSULATION :

IS 3069	Glossary of terms, symbols & units relating to thermal insulation materials
IS 3346	Method of determination of thermal conductivity of thermal insulation materials

### VENTILATION :

IS 3103	Code of practice for Industrial Ventilation
IS 4894	Centrifugal Fans

### ELECTRICAL :

IS 325	Three phase induction motors
IS 1822	Motor starters of voltage not exceeding 1000 V
IS 996	Single phase small AC and universal motors
IS 732	Code of practice for electrical wiring and fittings for buildings

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## CODES, STANDARDS AND REGULATIONS

IS 2516	AC circuit breakers for voltage not exceeding 1000 volts
IS 4047	Heavy duty air break switches and composite units of air break switches and fuses not exceeding 1000 volts
IS 2208	HRC cartridge fuse links up to 650 volts
IS 1554-Part I	PVC insulated ( heavy duty) electric cables for working voltage up to and including 1100 volts.

### SAFETY CODES :

IS 660	Safety code for mechanical refrigeration
IS 659	Safety code for air conditioning
IS 3016	Code of practice for fire precautions in welding and cutting operations
IS 818	Code of practice for safety and health requirements in electrical and gas welding and cutting operations
IS 5216	Code of safety procedures and practice in electrical works
IS 3696	Safety codes for scaffolds and ladders.

### INTERNATIONAL STANDARDS :

SMACNA	HVAC Systems – Duct Design
SMACNA	HVAC Air duct leakage test manual
SMACNA	HVAC duct construction standards – Metal & flexible
SMACNA	Rectangular duct construction
SMACNA	Round duct construction
SMACNA	Energy conservation guidelines.
SMACNA	Energy recovery equipment and systems, air to air
SMACNA	HVAC Systems – Testing, adjusting & balancing
ASHRAE / ISHRAE	Handbooks
ASHRAE	Gravimetric & Dust spot procedures for testing air cleaning devices used in general ventilation for removing particulate matter. – 52.1
ASHRAE	Methods of testing liquid chilling packages.
ASHRAE	Number designation & safety classification of refrigerants
ASHRAE	Practices for measurement, testing & balancing of building, heating, ventilation & air conditioning system.
ASHRAE	Ventilation for acceptance indoor air quality-62.1-2007
ASHRAE	Commissioning of HVAC Systems.
ASHRAE	Methods of testing liquid chilling packages as per ASHRAE 30 Latest Standard
ASHRAE	Thermal environmental conditions for human occupancy-55
ASHRAE	Energy Standard for Buildings except Low-rise Residential Buildings -90.1

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## CODES, STANDARDS AND REGULATIONS

UL-555	Fire Dampers
ANSI	Scheme for identification of piping system
ARI	Rotary Screw Chilling Package ARI 560 Latest
AMCA	Laboratory methods for testing fans for rating as per ANSI / AMCA 210
CARRIER	System Design Manual

All works performed and equipments and materials supplied under this contract shall comply in every respect with the Rules and Regulations of the Local Authorities including but not limited to :

- Energy Conservation Building Code – ECBC.
- Electrical supply and inspection regulation
- Fire Regulation & Machinery regulation.
- National Environmental Regulation (NER)
- National Fire Protection Association (NFPA)
- The Factory Act

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# TENDER SPECIFICATION – BASIS OF DESIGN

1.0	<b>BASIS OF DESIGN :</b>	
	<i>Scope: Scope of this section comprises of defining the Basis of Design parameters .</i>	
1.1	<b>GENERAL CONDITIONS :</b>	
1.1.1	Outside Design Conditions – DB	39.44 Deg C Dry Bulb
1.1.2	Outside Design Conditions - WB	27.77 Deg C Wet Bulb
1.1.3	Inside Design Conditions - DB	21.00 Deg C Dry Bulb
1.1.4	Inside Design Conditions - DB	21.00 Deg C Dry Bulb
1.1.5	Inside Design Conditions - RH	Around 60% Relative Humidity
1.1.6	Fresh Air	7.5 CFM / Person and 0.06 CFM per Sq.Ft.
1.1.7	Lighting Load	15 Watts per Sqm
1.2	<b>SPECIFIC CONDITIONS - DIGITAL TRANSMITTER ROOM</b>	
1.2.1	Area to be Airconditioned	160 Sqm
1.2.2	Equipment Load	24 KW
1.2.3	Occupancy	5 persons
1.3	<b>SPECIFIC CONDITIONS - ANALOG TRANSMITTER ROOM</b>	
1.3.1	Area to be Airconditioned	10 Sqm
1.3.2	Equipment Load	21 KW
1.3.3	Occupancy	5 persons

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**TENDER SPECIFICATION  
– AIR DISTRIBUTION  
SYSTEM**

<b>2.0</b>	<b>AIR DISTRIBUTION SYSTEM :</b>						
	<i>Scope: Scope of this section comprises of the supply, installation, testing and commissioning of Air Distribution System confirming to the specifications and in accordance with the requirement of drawings and of the Schedule of Quantities. This section covers the general requirements for sheet metal ductwork with associated items like air outlets and inlets, fresh air intake, dampers etc.</i>						
2.1	<b>SHEET METAL DUCT WORK:</b>						
2.1.1	Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA-1995 standards ("HVAC Duct Construction Standards-Metal and Flexible-Second Edition- 2005" SMACNA).						
2.1.2	<b>RECOMMENDED SPECIFICATIONS :</b>						
<b>DUCT SIZES-MM</b>	<b>GUAGE MM</b>	<b>GUAGE-SWG</b>	<b>CONNECTOR TYPE</b>	<b>THICKNESS OF FORMED CHANNEL-MM</b>	<b>GUAGE</b>	<b>ROD DIA-MM</b>	<b>ANCHOR FASTNER</b>
0-750	0.63	24	C&S	1.5	16	8	M 8
751-1000	0.08	22	TDF	1.5	16	8	M 8
1001-1300	0.80	22	TDF	2.0	14	10	M 10
1301-1500	0.80	22	Slip On	2.0	14	10	M 10
1501-1800	1.00	20	Slip On	2.4	12	12	M 12
1801-2100	1.00	20	Slip On	2.4	12	12	M 12
2101-2700	1.25	18	Slip On	2.4	12	12	M 12
2.1.3	Selection of G.I. Gauge and Transverse Connectors : Duct Construction shall be in compliance with 1" (250 Pa) wg Operating Pressure norms as per SMACNA.						
2.1.4	The specific class of transverse connector and duct gauge for a given duct						

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**TENDER SPECIFICATION  
– AIR DISTRIBUTION  
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	dimensions shall be 1"(250 Pa) pressure class. Transverse joint must be able to withstand 1.5 times maximum operating pressure without deformation or failure.
2.1.4	Non-toxic, AC-applications grade P.E. or PVC gasketing shall be provided between all mating flanged joints. Gasket sizes shall conform to flange manufacturer's specification.
2.1.5	The fabricated duct dimensions shall be as per approved drawings and all connecting sections shall be dimensionally matched to avoid any gaps.
2.1.6	Dimensional Tolerances : All fabricated dimensions shall be within $\pm 1.0$ mm of specified dimension. To obtain required perpendicularity , permissible diagonal tolerances shall be $\pm 1.0$ mm per metre.
2.1.7	Transverse Joints : Where a transverse joint acts as a reinforcing member its maximum allowable deflection will be 0.25" (6.25mm) for ducts upto 48" (1220 mm) width (W), and (W/200) for greater widths.
2.1.8	For the spacing for transverse joints and type of reinforcement refer 'SMACNA' tables for rectangular ducting covering pressure class from 2" (125 Pa) W.G. to 10" (2500Pa) W.G.
2.1.9	For duct sizes below 750 mm, Slip joints (S or standing S cleats) or alternating Slip and Drive ('C' cleats) may be used. Under no circumstances should Drive ('C') cleats be used on all four of the duct sides. All such joints to be spot sealed to avoid visible gaps at the cleat interfaces.
2.1.10	Beading : Duct Sizes of 19" (500 mm) wide and larger which have more than 10 sq.ft. of unbraced panel shall be beaded. This requirement is applicable to 20 g (1.00 mm) or less.
2.1.11	Sealing Ducts : Leakage norms as per SMACNA. Heavy mastic sealants are more suitable as fillets in grooves of longitudinal seams. Mastics having excellent adhesion and elasticity are preferred. It shall be applied as a thin bead at the the interface of ducts and corner piece only. GI metal clear 150 mm in length can be snap – fitted or slid over the mating flanges
2.1.12	Corners : It shall be inserted into the hollow web of the slip – on flanges. 4 corner pcs. Are required for each rectangular frame, 8 corners pcs, per joint.

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## TENDER SPECIFICATION – AIR DISTRIBUTION SYSTEM

2.1.13	Gasket – Neoprene / PVC : Self adhesive, micro-cellular, cross-linked, polyethylene foam/ UV resistant PVC foam/neoprene.
2.1.14	.Bolts, Nuts And Washer : Electro – galvanized, square neck carriage bolts, nuts an washers. Each joint requires 4 sets.
2.1.15	Fabrication Equipment and Processes : All cutting, folding, notching, beading, shearing operations must be done by machines (CAD/CAM equipment preferred) for accuracy of parts and speed of fabrication.
2.2	<b>MATERIAL :</b>
2.2.1	All ducting shall be factory fabricated out Galvanised Steel Sheet (GSS) Lock Forming Quality (LFO) conforming to the standards of ASTM A653 and A924 or conform to grade D of IS 1079:1988 or IS 513:1986 as specified in IS277:1992. The coating of zinc shall conform to class VIII.
2.2.2	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 at contractor's expense.
2.2.3	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.
2.2.4	Only new, clean and bright sheets without watermarks shall be used.
2.2.5	Flanges and stiffeners used in duct sections shall be rolled steel angles. All nuts, bolts and washers shall be of zinc plated steel and all rivets shall be galvanized or made of aluminium alloy. Gaskets shall be of 3mm-neoprene rubber and shall be leak proof.
2.2.6	SLIP ON FLANGES : Roll-formed GI section with embedded sealant. Should be available in different cross – sections to provide a range of rigidity and strength characteristics.
2.2.7	CORNERS : 4 corner pieces are required for each rectangular frame to be inserted into the hollow web of the slip-on flange.
2.2.8	SEALANT : To be applied as a thin bead at the interface of duct and corner piece only.

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## TENDER SPECIFICATION – AIR DISTRIBUTION SYSTEM

2.2.9	CLEATS : GI Metal Clear 150 mm in length can be snap-fitted or slid over the mating flanges.
2.2.10	GASKET-NEOPRENE / PVC : UV resistant, self-adhesive, 10 mm wide and 4.5 mm thick.
2.2.11	BOLTS, NUTS AND WASHER : Electro-galvanised, square-necked carriage bolts, nuts and washers. Each joint requires 4 sets.
<b>2.3</b>	<b>CONSTRUCTION AND INSTALLATION :</b>
2.3.1	Duct shall be fabricated as per details shown on approved shop drawings. All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or angles of sample size to keep the ducts true to shape and to prevent bulking, vibration and breathing.
2.3.2	The contractor shall provide and neatly erect all sheet metal work as may be required as per specifications and drawings. The work shall meet with the approval of Owner's site representative in all its parts and details.
2.3.3	The fabrication of the ducting including details of transverse joint connections etc shall be generally as per SMACNA-2005. The ducts should be rigid and should have very minimum leakages.
2.3.4	Longitudinal Joints (Seams) : Longitudinal joints shall be restricted to two diagonally opposite edges. These should be machine-formed either Pittsburgh lock type or Button Punch Snap lock type (duct size and gauge limitations as per SMACNA). Joints and seams should be able to withstand 1.5 time maximum operating pressure without deformation or failure.
2.3.5	Four bolt factory made Transverse duct connectors shall be used for all transverse joints.
2.3.6	Coil (Sheet metal in Roll Form/ cut sheet) lines to facilitate location of longitudinal seams at corners/folded edges only, for required duct rigidity and leakage free characteristics. No longitudinal seams permitted along any face side of the duct.
2.3.7	All ducts, transformation pieces and fittings to be made on CNC profile cutter for requisite accuracy of dimensions, location and dimensions of notches at the folding lines.

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**TENDER SPECIFICATION  
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2.3.8	All edges to be machine treated using lock formers, flanges and rollers for turning up edges.
2.3.9	All transverse duct connectors (flanges/cleats) and accessories/related hardware such as support system shall be zinc-coated (galvanized).
2.3.10	All edges shall be machine treated using lock-formers and roller for furning up edges.
2.3.11	Sealant dispensing equipment shall be used for applying built-in sealant in Pittsburgh lock where sealing of longitudinal joints are specified.
2.3.12	Each duct pieces shall be identified by color coded sticker which shall indicate specific part numbers, job name, drawing number, duct sizes and gauge.
2.3.13	Ducts shall be straight and smooth on the inside. Longitudinal seams shall be airtight and at corners only, which shall be either Pittsburgh or Snap Button Punch as per SMACNA practice, to ensure air tightness.
2.3.14	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.
2.3.15	Plenums shall be shop/factory fabricated panel type and assembled at site.
2.3.16	The gauges, joints and bracings for sheet metal duct work shall further conform to the provisions as shown on the drawings.
2.3.17	Changes in section of duct work shall be affected by tapering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 DEG. Angle from the axis of the main duct unless otherwise approved by the Engineer-In-Charge.
2.3.18	The contractor shall temporarily close duct openings with sheet metal covers to prevent debris entering ducts and to maintain opening straight and square, as per direction of Engineer-In-Charge.
2.3.19	Great care should be taken to ensure that the duct work does not extend outside and beyond height limits as noted on the drawings.

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**TENDER SPECIFICATION  
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2.3.20	All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be air tight and shall be made in the direction of air flow. The ducts shall be re-inforced with structured members where necessary, and must be secured in place so as to avoid vibration of the duct on its support.
2.3.21	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.
2.3.22	Joints, seams, sleeves, splitters, branches, takeoffs and supports are to be as per duct details as specified, or as decided by Engineer-In-Charge.
2.3.23	Joints requiring bolting or riveting may be fixed by Hexagon nuts and bolts, stove bolts or buck bolts, rivets or closed centre top rivets or spot welding. Self tapping screws must not be used.
2.3.24	On all circular spigots the flexible ducting are to be screwed or clip band with adjustable screws or toggle fitting. For rectangular ducts the material is to be flanged and bolted with a backing flat or bolted to mating flange with backing flat.
2.3.25	The flexible joints are to be not less than 75 MM and not more than 250 MM between faces.
2.3.26	The duct work should be carried out in a manner and at such time as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.
2.3.27	Channels for support shall be used for plenums and large ducts in the AHU room. The distance between supports shall not exceed 2 meter centers in case of ceiling suspended ducts. Anchor grip bolts shall be used to fasten the duct supports to the ceiling.
2.3.28	All duct work joints are to be true right angle and with all sharp edges removed.
2.3.29	Sponge rubber gaskets also to be provided behind the flange of all grilles.
2.3.30	Diverting vanes must be provided at the bends exceeding 600 MM and at branches connected into the main duct without a neck.

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## TENDER SPECIFICATION – AIR DISTRIBUTION SYSTEM

2.3.31	Proper hangers / framework 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.
2.3.32	The ducts should be routed directly with a minimum of directional change.
2.3.33	All angles, rods and other MS members, materials, components etc. used for supports shall be provided with a coat of zinc rich primer, and a coat of enamel paint. Alternatively hot dip galvanization can also be done.
2.3.34	Suitable volume control dampers shall be provided in the branch ducts for balancing air quantities.
2.3.35	All joints shall be made air tight with proper packing gaskets and all interior surfaces shall be smooth. Bends shall be made with radius not less than one half the width of the duct or with properly designed inside curved vanes. Turning vanes shall be provided at branch take-off and collars wherever possible. Sealants shall be used where ever found necessary to minimize leakage.
2.3.36	Where sheet metal ducts or sleeves terminate in woodwork, tight joints shall be made by means of closely fitting heavy flanged collars.
2.3.37	All ducts shall be totally free from vibration under all conditions of operation.
2.3.38	As far as possible long radius elbows and gradual changes in shape shall be used to maintain uniform velocity accompanied by decreased turbulence, lower resistance and minimum noise. The ratio of the size of the duct to the radius of the elbow shall be normally not less than 1:1.5.
2.3.39	The fabrication and installation shall be in a workmanlike manner. Ductwork shall be rigid and straight without kinks.
2.3.40	Self adhesive Neoprene rubber / UV resistant PVC foam lining 5 mm nominal thickness instead of felt, shall be used between duct flanges and between duct supports in all ducting installation.
2.3.41	Ducts shall be supported independently from the building structure and adequately to keep the ducts true to shape. The support spacing shall not be more than 2 m.

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2.3.42	Where ducts cannot be suspended from ceiling, wall brackets or other suitable arrangements as approved by the engineer-in-charge shall be adopted.
2.3.43	Neoprene or other vibration isolation packing of minimum 6 mm thickness shall be provided between ducts and the angle iron supports / brackets.
2.3.44	Vertical duct work shall be suitably supported at each floor by steel structural members.
2.3.44	Air turns shall be installed with vanes, arranged to permit the air to make the turn without appreciable turbulence. Suitable vanes shall be provided in duct collar to have uniform/ proper air distribution.
2.3.45	Necessary allowance and provision should be made by the contractor towards beam, pipe or any other obstruction in the building, irrespective of the same is shown on the drawings or not. Where necessary to avoid beams or other structural work, plumbing or other pipes, and /or conduits, the ducts shall be transformed, divided or curved to one side, provided the required area being maintained as per the design requirements.
2.3.46	If duct cannot be run as shown on the drawings, the contractor shall install the duct between the required points by any path available, in accordance with other services and as per approval of Owners site representatives.
2.3.47	All the vertical ductwork to be supported by structural members in every floor. Air-conditioning contractor shall supply and install 50mm cube MS boxes with 10mmdia steel rod passing through box, all given two coats of red oxide paint, the MS rod tied with reinforcement bar at point of suspension shall be nearly exposed and opening subsequently filled with plastic compound after duct hangers are installed.
2.3.48	If duct passes through such areas where space between ceiling slab to false ceiling is more than 1500mm then duct should be supported by wall mounted brackets of size 40mm x 40mm x 3mm thick MS angle frame.
2.3.49	Ducting over furred ceiling shall be supported from the slab above or from beams, after obtaining approval of Owner's site representative. In no case shall any duct be supported from false ceiling hangers or be permitted to rest on false ceiling.
2.3.50	All metal work in dead or furred down spaces shall be erected in time to avoid delay of work of other contractors working in the building.

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2.3.51	Where metal ducts or sleeves terminate in woodwork, tight joints shall be made by means of closely fitted heavy flanged collars. Where ducts pass through brick or masonry opening a wooden framework shall be provided within the opening and crossing ducts provided with heavy flanged collars on each side of wooden framework, so that duct crossing is made leak-proof.
2.3.52	All ducts shall be totally free from vibration under all conditions of operation. Whenever duct work is connected to fans, air handling units, fan coil units or ductable split units that may cause vibrations in the ducts shall be provided of synthetic fire resistant flexible connection.
2.3.53	Rat proofing consisting of 16 gauge galvanised weld mesh, with about 4 mesh per inch, shall be provided in supply air ducts at AHU / Fan outlets, in return air openings of AHU room wall, and above return air slits in conditioned spaces.
2.3.54	The flexible connections located close to the unit, in mutually perpendicular directions. The flexible sleeve at least 10cm long securely bonded and bolted on both sides. Sleeve shall be made smooth and the connecting ductwork rigidly held by independent supports on both ends. The flexible connection shall be suitable for pressures at the point of installation.
2.3.55	Ducting supports shall be provided at every 2000 mm distance. Ducting supports shall be provided on both sides of the wall / partition when it is passing through the wall / partition. Ducting shall not be supported on the wall or false ceiling.
2.3.56	Duct support shall not be sagging. Proper care should be taken to avoid duct leakages. Sealant shall be used if required. Vanes in elbows and collar take off shall be provided. The distance between two rivets shall not be more than 125 mm. The size of the rivet shall be 3 mm. The rivets shall be made of MS. The distance between two bolt & nuts shall not be more than 150 mm. Sealant shall be applied wherever it is required to prevent air leakage.
2.3.57	Hanger supports shall be fixed to the ceiling through expansion fasteners , 2 Nos. for each leg. The Anchor fasteners shall be of approved make.
2.3.58	All necessary allowances and provisions shall be made by the Contractor for beams,, Pipes or other obstruction in the building, whether or not the same are shown on the drawings. Where necessary to avoid beams or other structural work or plumbing or other pipes or conduits, the ducts shall be transformed, divided or curved to one side,

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## TENDER SPECIFICATION – AIR DISTRIBUTION SYSTEM

	the required area being maintained, all as approved or directed by the Engineer.
2.3.58	In all branch ducts and at salient locations, suitable splitters and control dampers shall be provided to facilitate air balancing. All dampers shall be provided with suitable links, levers and quadrants with position indicators and locking arrangement.
<b>2.4</b>	<b>MEASUREMENT :</b>
2.4.1	Measurements for the ducting shall be taken at centre line.
2.4.2	Duct measurements (for insulated ducts) shall be taken before application of insulation.
2.4.3	Duct work shall be measured section wise on the basis of external surface area by multiplying the axial length from flange face to flange face for each section by the corresponding duct perimeter in the centre of that section length.
2.4.4	Measurement sheet should cover each fabricated duct piece showing dimensions and external surface area along with summary of external surface area of duct gauge-wise.
2.4.5	Uniformly tapering straight sections shall also be measured as in above.
2.4.6	However, for special pieces like tees, bends etc. area computations for surface areas shall be done as per shape of such pieces.
2.4.7	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.
2.4.8	The quoted unit rate for external surfaces of ducts shall include all wastage allowances, flanges, gaskets for joints, vibration isolators, bracings, hangers and supports, inspection chambers/access panels, splitter dampers with quadrants and levers for position indication, turning vanes, straightening vanes, and all other accessories required to complete the duct installation as per the specifications. These accessories shall not be separately measured.
2.4.9	All duct pieces shall have a part number, corresponding to the serial number assigned to it in the measurement sheet. The above system shall ensure speedy and

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# TENDER SPECIFICATION – AIR DISTRIBUTION SYSTEM

	proper site measurement, verification and approvals.
2.5	<b>FLEXIBLE DUCTING :</b>
2.5.1	Scope: Scope of this section comprises of the supply, installation, testing and commissioning of Factory Fabricated Flexible Ducting confirming to the specifications and in accordance with the requirement of drawings and of the Schedule of Quantities.
2.6	<b>MATERIAL :</b>
2.6.1	The flexible ducts used to tap supply air shall be of high quality thermally insulated duct. The thickness of the insulation shall be 25 mm thick and the density shall be not less than of 16 kg / cum. The inner core of the flexible duct shall be of double lamination of metalized polyester film permanently bonded to a coated spring steel wire helix . The outer jacket is made out of very tough spirally reinforced multiple layer aluminium laminated construction.
2.7	<b>INSTALLATION PROCEDURE :</b>
2.7.1	Flexible ducts shall be cut to the required size to ensure a curved connection between the main duct and the air terminal plenum. The contractor shall not join any small flexible pieces by any foreign materials before installation. The minimum length of the flexile duct shall not be less than 750 mm in length & Max length not to exceed 1.8 m.
2.7.2	A groove of 2 mm shall be made on the round collars to ensure that the spiral wire inside the flexible duct shall be fitted ahead of the groove. Stainless steel metal clamps, which are made out of 8-mm wide band with lifted edges, shall be used to tighten the connection of the flexible ducts on the round collars of the plenums.
2.7.3	On the flexible ducts the clamp is fitted with a flip up and quick lock tightening ahead of ease of fixing. The contractor shall ensure that all the flexile ducts wherever installed shall follow the above procedure.
2.7.4	Care must be taken to install all the flexible duct in fully extended position and bends made with adequate radius as per manufacturer recommended practices.
2.8	<b>AIR TERMINAL DEVICES</b>
2.8	<b>GENERAL</b>

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2.8.1	Provide Air Terminal Devices of sizes & type as shown in the drawings. All the accessories like adapter box with an extended round collar to connect the flexible duct as shown in the drawings shall be within in the scope of contractor.
2.8.2	All supply and return air grilles and diffusers shall be as per the approved list furnished in the document. Consultants / Architect reserves right to choose the best. The grille shall be provided with powder-coated paint of approved color. Further, the contractor shall submit a sample of grilles & diffusers for the approval.
2.8.3	MATERIAL : All air terminal devices mentioned in the tender documents / drawings shall be made out of extruded aluminum sections with very high quality finish. Grilles & diffusers shall be of extruded aluminium from hard stock free from pits and spots joints shall be hairline. The color of powder-coated finish shall be as per Client/Architect approval.
2.8.4	SIZING : Grilles / Diffusers shall be sized within limits of sound pressure level NC-32 curve as a typical room having average room attenuation of 8 dB.
2.9	<b>LOW LEAKAGE VOLUME CONTROL / DUCT DAMPERS:</b>
2.9.1	The design, method of handling, and control shall be suitable for the location and service required.
2.9.2	At the junction of branch duct with main duct and split of main duct, Low leakage aluminium volume dampers must be provided whether or not indicated on the drawings, but shall be provided for the proper volume control and balancing the system.
2.9.3	All dampers shall be louver dampers of robust construction and tightly fitted. The design, method of handing and control shall be suitable for the location and service required.
2.9.4	Material Specifications : Factory fabricated Aerofoil-blade Aluminium dampers with compressible jamb seals and extruded-vinyl blade edge seals, in opposed-blade arrangement with steel operating rods rotating in nylon bearings mounted in a single extruded 2 mm thick aluminium frame, and with hard PVC / Nylon gear arrangement for common linkage between blades.
2.9.5	Frames and blades to be constructed from high quality extruded aluminium sections.

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	Frame with flat frontal face to suit flanged connections with the ducts. Frames to be screw fixed and sealed to eliminate casing leaks. Blades to be pivoted on PVC bushes and operated through PVC gear system to be fully enclosed within the damper frame.
2.9.6	The volume dampers shall be of an approved type, lever operated and complete with locking devices, which will permit the dampers to be adjusted and locked in any positions.
2.9.7	The dampers for fresh air inlet shall additionally be provided with fly mesh screen, on the outside of 0.8 MM thickness with fine mesh.
2.9.8	After completion of the ductwork, dampers are to be adjusted and set to deliver airflow as specified on the drawings.
2.9.9	Blades shall be pivoted to the frame with Nylon bushes, so as to provide smooth and accurate operation.
2.9.10	In shop drawings it should be clearly marked 300 x 300 access door in suspended ceiling wherever the damper installed, so that at the time of Air balancing, damper location above suspended ceiling should be clearly identify.
2.9.11	All dampers shall be louver dampers of robust construction and tightly fitted. The design, method of handing and control shall be suitable for the location and service required.
<b>2.10</b>	<b>FIRE AND SMOKE DAMPERS :</b>
2.10.1	Fire Dampers shall be provided at all supply and return air ducts at air handling unit room crossings and at all floor crossings and wherever shown in the drawings.
2.10.2	Material Specifications : Fire and smoke damper tested and approved for 120 minutes rated as per UL-555 S- 1995 and CBRI. Construction out of factory - made, 1.6 mm thick 800 mm long ,1 50 mm wide GSS sleeves and inner V grooved flat type multi blade assembly.
2.10.3	Frames to be welded and inner blades to be connected to the frame by means of chrome plated spindle rods and bronze self lubricated bushes. All blades to be connected by a suitable flat link arrangement.

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2.10.4	The dampers are also to be provided with SS concealed jam seal (compression type) on the sides. The damper operation is by spring return actuator. It shall be complete with control panel, sensor and inter-locking/ wiring / connection for tripping of the AHU fan motor
2.10.5	In normal positions these blades shall be gathered and tackled at the frame head, providing for unobtrusive air passage. No loosely hanging pieces shall be present so as to avoid chattering noise due to air passage.
2.10.6	For preventing smoke leakage suitable seals shall be provided.
2.10.7	In normal conditions, the damper blades shall be held in open position with the help of a spring and latch arrangement. An electric actuator shall be provided, which upon receiving a signal from smoke detectors installed in AHU Room / RA Duct / Damper, shall release the latch and make the damper to close. .
2.10.8	The sensor shall be factory set to send signals when the environmental temperatures reaches 75 deg C. Micro switches / limits switches shall be installed and wired to stop the AHU motor and give open close status indication signal at remote panel.
2.10.9	Each such motorised dampers shall have its own control panel which will incorporate the necessary circuitry required to feed power to the actuators.
2.10.10	The power supply to these actuators shall be derived from a separate UPS or an emergency power supply. The panel shall also indicate the status of operation of dampers should allow remote testing of dampers etc., Further, additional terminals should be provided to have signal (sound or visual) in central control room.
2.10.11	The power supply to these actuators shall be derived from a separate UPS or an emergency power supply. The panel shall also indicate the status of operation of dampers should allow remote testing of dampers etc., Further, additional terminals should be provided to have signal (sound or visual) in central control room.
2.10.12	Supply to shown status of the damper (open or close ), to allow remote testing of damper and indication in event of damper closure due to signal from smoke sensor/ Temp. sensor and reset button.
2.10.13	Additional terminal shall 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

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	event of power failure automatically and open the same when power is restored.
2.10.14	Bushes will be made of gunmetal and angle stops shall be provided to retain the blades in closed position.
2.10.15	The solenoid actuator of 700C shall hold the blade in open or closed positions as required against the spring force. All fire Dampers shall have provision of manual tripping which shall be obtained by putting a suitable lever. Whenever the damper is installed in the concealed location, the manual tripping mechanism shall be suitably extended to permit the tripping of damper from the nearest remote location.
2.10.16	All Dampers shall be provided with easily visible indicating device showing open or closed position of the damper.
2.10.17	All Dampers shall be provided with electrical limit switch of suitable design to facilitate remote indication of the position of Fire Dampers. The solenoid actuator shall be suitable to receive the DC signal from smoke detection system for actuation of solenoid coil which shall be 240+/- 5% V AC continuous rating with the polling force of 5.5 Kg or more as required.
2.10.18	A heat resistant paint of good quality shall be factory applied and should be ensured that the paint does not hamper smooth operation of the damper.
2.10.19	Each damper shall be provided with angle flanges for installation in ducts or partitions.
2.10.20	All control wiring with FRLS Copper wires / cables of minimum 1.5 sq. mm. shall be provided between fire damper and electric panel.
2.11	<b>LOUVERS:</b>
2.11.1	Fresh Air Intake Louvers shall be provided wherever indicated in the shop drawings. The Louvers shall be fabricated out of extruded aluminium sections and shall be powder coated.
211.2	Bird / Insects screen will be provided at the outer surface of the louvers. The lowest louver member shall extend out of the bottom frame work, so that rain water can drain off. Wherever specified all fresh air louvers shall be provided with volume control dampers.

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2.11.3	These dampers shall be fitted integrally on the inside surface of the louvers. The damper shall be fabricated out of extruded aluminium sections.
2.11.4	Weather proof Louvers shall be made out of extruded aluminium and colour should match with the building finish or as approved by the Owner / Consultant and these shall be of rain protection and metal bird screen to be fitted on the inner surface. The louvers shall have nylon mosquito net and pre filter.
2.11.5	The louvers shall additionally be provided with heavy duty expanded metal (aluminium-alloy) bird screen and also 20micron filter for fresh air intake.
<b>2.12</b>	<b>GRILLES / DIFFUSERS</b>
2.12.1	Grilles shall be linear type made out of heavy extruded aluminium sections. The grilles shall be rectangular linear type for supply and return air. Supply air grilles shall have opposed blade volume control dampers of aluminium construction. All the grilles shall be powder coated with approved colour shade.
2.12.2	Teak wood frames treated with anti termite solution shall be used wherever necessary. Grilles shall have concealed fixing screw. Ducting and all items at the back side of the grilles shall be painted with dull black paint.
2.12.3	Diffusers shall be square in shape and made out of heavy extruded aluminium sections with removable core and concealed fixing screw. Opposed blade volume control dampers made out of aluminium extruded sections shall be provided for supply air diffusers.
2.12.4	Supply and return air diffusers shall be shown on the drawings and indicated in schedule of quantities. The supply air diffuser shall be provided with removable key operative volume control dampers. Aluminium supply and return air diffusers shall be powder coated and to have colour of client's choice or shall be extruded aluminium.
2.12.5	Supply/return air linear diffuser shall be Extruded aluminium construction, square, rectangular, or round diffusers with flush fixed pattern or adjustable flow pattern.
2.12.6	Diffusers for different spaces shall be selected in consultation with the Architect/Consultant.
2.12.7	Supply air diffusers may be equipped with fixed air distribution grids, removable key-

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	operated volume control dampers, and anti smudge rings as per requirements of schedule of quantities.
2.12.8	Linear Supply air/Return Air Grilles: This shall be extruded aluminium construction with fixed horizontal bars at 0 / 15deg inclination and flanged on both side. The thickness of fixed bar louvers shall be at least 5.5mm and angle shall be 20mm/30mm inside. The grilles shall be suitable for concealed fixing volume control damper of extruded. Aluminium construction with black anodized finished shall be provided in SA duct collars.
2.12.9	The colour of powder coating shall be decided by the architect. All supply air grilles / diffusers shall have volume control dampers, factory fitted.
2.12.10	The return air grilles / diffusers shall be similar to the supply air grille/diffusers except that they shall not be having volume control dampers.
2.12.11	Before ordering out of grilles/diffusers, the contractor shall furnish samples of the same to the Owners / Architects / Consultants and upon their approval only the grilles shall be procured.
2.12.12	All ceiling diffusers and side wall grilles should be fixed on to the supply collars of the ducts, with proper GI sheet metal cleats, and not on to the False ceiling / boxing. Suitable removable core diffusers and grilles should be provided to facilitate this.
2.12.13	For ceiling diffusers, the drop collar duct size should be made equal to the diffuser neck size. After fixing the diffusers, the mating portion of the collar and diffuser should be sealed air tight with proper sealant.
2.12.14	When continuous grilles are used, and when the ducts are visible through the grilles, the ducts should be painted with black Matt finish paint.
2.12.15	All supply grilles and diffusers including slot diffusers shall be provided with volume control dampers, turning vanes, deflectors which can be adjusted and set through the grille/diffuser face.
2.12.15	When grilles/diffusers which are not allowed to rest on the false ceiling, the A.C. Contractor shall suspend them from the ceiling slab through adjustable suspension system. Cost of this suspension shall be included in the price of the grilles/diffusers.

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2.12.16	All Return/Exhaust grille/diffusers shall be supplied without volume control dampers unless otherwise specified or required.
2.12.17	All supply grilles & diffusers shall have box type dampers, having vanes, deflectors which can be adjusted through the grille/diffuser face.
<b>2.13</b>	<b>LINEAR SLOT DIFFUSER:</b>
2.13.1	Linear diffuser shall be extruded aluminium construction multi-slot type with air pattern controlled provided in each slot. Supply air diffusion shall be provided with volume damper in each slot of the supply air diffuser. Plenum shall be provided for each supply air diffuser.
2.13.2	All grilles shall be selected in consultation with the Client/Architect/Consultant. Different spaces shall require horizontal or vertical face bars, and different width of margin frame.
2.13.3	All grilles shall have a soft, continuous rubber gasket between the periphery of the registers and the surface on which it has to be mounted. The effective area of the registers shall not be less than 75%.
2.13.4	Grilles shall be adjustable pattern as each grilles bar be pivotable to provide pattern with 0 to 100 deg. horizontal are and upto 30deg deflection up or down. Bars shall hold deflection settings under all conditions of velocity and pressure. Extruded aluminium grilles shall have fixed bars.
2.13.5	Bars longer than 45cm shall be reinforced by set-back vertical members of approved thickness.
<b>2.14</b>	<b>CROSS TALK ATTENUATORS:</b>
2.14.1	Cross talk attenuators shall be installed for all the full height cabins / rooms to avoid cross talk. The cross talk attenuators shall be made of 25 mm thick pre-insulated ducts with excellent noise dampening features.
2.14.2	They shall be constructed as per the approved drawings. These shall be installed across the partition above the false ceiling supporting on both sides of partition.
2.14.3	Cross talk attenuator shall be wrapped with 9 mm thk. 8" width nitrile foam at the

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	partition. After installation of cross talk attenuator, the gaps around shall be sealed from both inside and outside for proper noise isolation.
2.15	<b>ROUND SPIGOT &amp; BUTTERFLY DAMPER:</b>
2.15.1	Round spigot and butterfly damper shall be fabricated with 20 G GI sheet . Butterfly damper shall have handle for opening and closing. Handle should have the locking arrangement.
2.15.2	Open and close positions shall be marking with stickers on the damper. Rubber lining shall fixed on the inner face of the damper at the blade to avoid any metal to metal contact. Blade shall have smooth edges.
2.15.3	Butterfly damper shall be fixed with gasket, bolt and nuts.
2.15.4	Duct thermal insulation and acoustic insulation shall finished neatly around the butterfly damper.
2.16	<b>AIR TRANSFER DOOR GRILLES :</b>
2.16.1	Air transfer door grilles shall be provided wherever indicated in the shop drawings. The grilles shall be fabricated out of extruded aluminium sections and shall be anodised or powder coated.
2.16.2	The grilles shall be complete with dual grille frame to be mounted on door panel from both sides. The central core shall be NO-SEE-THRU type. Further, the grilles shall be provided with insects screen to prevent moment of insects across the door.
2.17	<b>MEASUREMENTS :</b>
2.17.1	Grilles and diffusers (except linear diffusers) shall be measured by the cross sectional areas, perpendicular to the airflow, and excluding the flanges. Volume control dampers, where provided shall not be separately accounted for.
2.17.2	Linear slot type diffusers shall be measured by linear measurements only, and not by cross-sectional areas, and shall exclude flanges for mounting of the linear diffusers. The supply air plenum for linear diffusers shall be measured as described above for ducting.

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2.17.3	Fire dampers shall be measured by their cross sectional area perpendicular to the direction of the airflow. Quoted rates shall include the necessary collars and flanges for mounting, inspection pieces with access door and fusible link arrangement.
2.18.1	<b>PRE-INSULATED GLASS WOOL DUCTWORK :</b>
2.18.2	<b>RECOMMENDED SPECIFICATIONS FOR PRE-INSULATED GLASS WOOL DUCTWORK :</b>
2.18.	Pre-insulated duct board shall be made of high density of rigid resin bonded fire safe glass wool with outer side factory laminated aluminum foil, outer facing foil should have - Reinforced aluminum + Kraft+ glass veil and inner facing with glass textile.
2.18.1	The outer facing of reinforced aluminium should be fireproof and provide excellent vapour barrier and air tightness. It should be smooth and high resistance to tearing and punching.
2.18.2	The inside facing should assure high acoustic absorption and should constitute a smooth surface with high resistance to tearing and therefore cleanable by brushing.
2.18.3	The thermal conductivity should be less than 0.032 W/m deg K. at 10 Deg C
2.18.4	The thermal resistance should more than 0.075 Sqm.Deg K/W. at 10 Deg C.
2.18.5	Density of glass wool duct board shall be 75-80Kg/m <sup>3</sup> and at the edge of panels shall have density of 150Kg/m <sup>3</sup> .Size of panels for duct construction as below.
2.18.6	Glass wool duct panels shall be tested as per EN 13403. Vapour permeance of duct panels should be approximate value: 0.013 g/m <sup>2</sup> . day mm Hg (outer facing)
2.18.7	Mechanical stiffness: R5 rigidity, according to EN 13403 (European Standard for non metallic ducts) this rigidity is the maximum level of the ones established by this standard.
2.18.8	Duct board should withstand pressure under 800 Pa with no evidence of fissures or swelling (test according to EN 13403).
2.18.9	Fire test: Panels shall be tested as Euroclass: Euro class C-s1, d0 - s1: null smoke emission

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	- d0: non flaming droplets / particles.
2.18.10	<b>Tools and Accessories for Installation of Duct Boards shall be followed as per recommendation of manufacturer’s manual.</b>
2.18.11	<b>Duct Support:</b> Duct board shall be installed, using support as described for metal ducts. Maximum distance between hangers / support shall not exceed for horizontal ducts as <ul style="list-style-type: none"> <li>- 900 mm inner dimension maximum distance of hanger 2.4 m</li> <li>- 900-1500 mm inner dimension maximum distance of hanger 1.8mm</li> <li>- Above 1500 mm inner dimension maximum distance of hanger 1.2 m</li> </ul>
2.18.12	<b>INSPECTION AND TESTING</b> Duct dimensions shall be checked based on the duct dimension / layout drawings duly approved by the Architects/ Consultants.
2.18.13	The ducts, branches elbows etc. shall be inspected and the joints and connection shall be checked properly before these are assembled in position. After assembly the system shall be checked for tightness of male/ female joints to avoid the leakage .
2.18.14	Al. tape of 75mm width shall be applied on each male / female joint to avoid the leakage of air .
2.18.15	Full sized standard dimension sheet as specified are to be used and any patched or made-up pieces of duct work are liable to be rejected. Joints between male/ female connections shall be fitted properly and Al. tape of 75 mm width shall be applied on joints.
2.18.16	Test points shall be provide at the discharge of each air handling unit and at each individual zone of the duct work system. Test points shall consist of 25mm diameter sockets fitted with sealing plugs which can be removed for the fitting of measuring devices. Test points shall be insulated as for the duct work and shall be provided with identification labels.

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2.18.17	Rectangular risers should be free supported by angles or channels secured to the sides of the duct flanges with bolts or sheet metal screws or blind rivets. The supporting angle or channel should be freely resting over the slab cut-out. Riser support intervals should be limited to one storey height.
2.18.18	<b>To ensure the air tightness, all ducts shall be checked with Leak Test after completion of duct fabrication but before installation of duct system.</b>
2.18.19	<b>CERTIFICATES:</b>
2.18.20	The material should have CE mark and should fulfill EN-13403 for non-metallic ducts.

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<b>3.0</b>	<b>AIR HANDLING UNITS :</b>
	<i>Scope: Scope of this section comprises of the supply, installation, testing and commissioning of Air Handling Units confirming to the specifications and in accordance with the requirement of drawings and of the Schedule of Quantities.</i>
<b>3.1</b>	<b>GENERAL CONDITIONS :</b>
3.1.1	The air handling units shall be of double skin construction, draw through type in sectionalized construction consisting of blower section, coil section, filter section and insulated drain pan. Unless otherwise specified, the unit shall be horizontal type.
<b>3.2</b>	<b>CASING :</b>
3.2.1	Double skinned panels shall be made of galvanized steel with 25 / 50 mm PUF insulation and shall be fixed to 2.5 mm thick aluminium alloy normal / thermal break profiles frame work with stainless steel screws. Outer sheet of panels shall be made of galvanized 0.63 mm thick pre-painted / pre-plasticised sheet and inner of 0.63 mm GSS. Aluminium profiles shall be internal round corners to avoid accumulation of dust.
3.2.2	The housing shall be so made that it can be delivered at site in total / semi knocked down condition, depending upon the requirements. The main framework shall be extruded aluminium hollow structural sections. All the framework shall be assembled using mechanical joints to make a sturdy and strong framework for various sections. Is specified framework shall be made of thermal break hollow extruded aluminium profile.
3.2.3	Minimum 450 mm access door shall be provided for easy access to filters, coils, fans etc. Each access door shall be provided with easy release ½ turn nylon handles and GM Chrome plated locks. Hinges shall be heavy-duty die cast solid aluminium with SS pivots. A safety “trip-switch” shall be provided to automatically cut off the electrical supply to the fan when the access door is opened.
3.2.4	The casing shall consists of an independent structural steel frame, properly reinforced and braced for maximum rigidity, having individually removable, double skin construction insulated panels. The casing shall be sectionalised construction, consisting basically of individual fan section, coil section, access sections, filter section, mixing box section and drain pan.

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3.2.5	Sections shall be joined with continuous gasketing to form an air tight enclosure. Sections shall be so designed that the method of joining can be performed with relative ease and without damage to the insulation and vapour barrier. The frame work shall be constructed of AISC structural rolled shapes having minimum thickness of 3mm or die formed sheet steel.
3.2.6	Framework shall be designed with recess suitable to receive enclosure panels, providing neat appearance, air tight enclosure and ease of panel removal. Enclosure panels 1.1.sqm(12 sft) in area and larger shall be constructed of not less than 1.3mm(1/16") die formed sheet steel.
3.2.7	Should the sides or top of a casing shall exceed 1.85sqm(20sft) in area, the panels shall be fabricated of more than one piece, with the individual panels recessed into intermediate structural members. Protection for the insulation edges shall be provided around the perimeter of each panel.
3.2.8	Protection shall be in the form of a " U " shaped panel edge or in the form 15mm (1/2") channels welded to the inside surface of each panel. Enclosure panels shall be fastened to the frame work by means of thread cutting sheet metal screws and shall be sealed against air leakage by the use of continuous neoprene gasketing of 3mm(1/8") minimum thick.
3.2.9	Inspection and service access doors shall be provided for access to the unit's interior, for filter removal and for coil inspection. Doors shall be constructed as specified for enclosure panels. Doors provided in access and filter sections shall be full height and width of the sections.
3.2.10	The cooling coils, special and standard filters, etc., shall all be housed in a separate enclosure of suitable size and length. The inspection doors shall have neoprene rubber T-section, rubber seals, hinges and locking arrangements. The gaps between filter frames and housing shall have synthetic rubber packing, to eliminate any air leakage. All filter frames shall be epoxy painted. The flat filter section shall be suitable for mounting filters vertically.
<b>3.3</b>	<b>FAN SECTION :</b>
3.3.1	The fans shall be centrifugal The fan shall be forward curved, double inlet double width type W heavy-duty backward curved blades, outlet velocity of fan not exceeding 10 mps. The fan shall have pre-greased ball bearings sealed for life. The fan meets the external statics, which may be required for supply and return air distribution.

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3.3.2	Fan section shall comprise of centrifugal fan with backward curved fan for floor mounted AHUs and forward curved fans for ceiling suspended AHUs. Fans shall be imported. Fan casing shall be made of galvanized steel sheet. Fan wheels shall be made of galvanized steel sheet. Fan wheels and pulleys shall be individually tested and precision balance dynamically. Motors shall be mounted inside the AHU casing on slide rails for easy self tensioning.
3.3.3	Both fan and motors assemblies shall be mounted on a deep section aluminium alloy base frame. Isolation shall be provided from the unit casing by combination spring and rubber anti vibration mounts and flexible connections on the fan discharge.
3.3.4	Fans shall be double width double inlet centrifugal type with scroll type housing. Rotating assembly shall be certified as resulting from tests performed in accordance with the standard test codes adopted by AMCA. The fan bearings shall be mounted on the fan scroll and not on the AHUs casings. The fan and the motor shall be mounted on an integral base frame which shall be in turn erected on cushifoot / spring mounts and should be totally isolated from the casings.
3.3.5	For units supplying less than 17,000 CMH(10,000 CFM) design conditions, the fan wheel shall be of the forward curved blade type. Airfoil or backward inclined blade type wheels shall be provided on all the units supplying 17,000 CMH(10,000 CFM) or greater.
3.3.6	The wheel & housing shall be fabricated from heavy gauge galvanized steel. The fan impeller shall be mounted on a solid shaft supported on angle iron heavy duty ball bearing. The fan shall be selected for a speed not exceeding 1800 RPM. The impeller & fan shaft shall be statically and dynamically balanced. The fan outlet velocity shall not exceed 1800 FPM
3.3.7	Fan housing with motor shall be mounted on a common extruded aluminum base mounted inside the fan section on anti-vibration springs mounts or cushy foot mount. The fan outlet shall be connected to casing with the fire retardant double canvass. The fan shall be complete with multi 'V' belt drive and adjustable motor mounting base. The opening for the access of the fan section shall be provided with micro-switch and galvanized iron mesh.
3.4	<b>MOTOR AND DRIVE SET:</b>
3.4.1	Fan motors shall be suitable for 415V + 10%, 50 cycles, 3 phase, AC supply. It shall

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	be squirrel cage, totally enclosed fan cooled with Class F insulation and EFF1 rating. Motors shall be specially designed for quiet operation and motor speed shall not exceed 1450 RPM. Fan motors shall be mounted inside the AHU on spring mounts with belt drive facility with easy belt tensioning.
3.4.2	The motor shall conform to IS:325 - 'Three phase induction motors'.
3.4.3	Drive to fan shall be provided through belt-drive with a standard belt guard housing the bolt and adjustable motor sheave. Belts shall be of the oil-resistant type. The frame for mounting the fan and motor shall be isolated from the double skin casing with spring isolators.
3.4.4	Motors shall drive heavy duty anti static V-belt, constant pitch, drive selected at 110% of motor horsepower. Drive sheave dimensions and belt number shall be sufficient to transmit the required power to the driven equipment with an efficiency of not less than 95 %. Drives shall have a service rating of 140 % of the maximum estimated load. Reinforced tachometer access openings shall be provided
3.4.5	Shafts shall be properly sized, one piece, polished steel. Fan shafts shall not be operated at their critical speed. Fan shaft bearing shall be self aligning, pillow block regreasable ball or roller type, with grease fittings piped to and mounted on the exterior of the unit if the bearings are located within the enclosure. They shall have an average life of 200,000 hours at design operating conditions per ANSI code B3.15.
3.4.6	Motors shall be of 1500 rpm, having ball bearings with grease lubrication. Motors shall be mounted on an adjustable base within the AHU casing itself.
3.4.7	Motors shall run on VFD mode as well S/D connection (above 5 KW), and DOL up to 5 KW.
3.4.8	Motors shall be connected to an electrical panel consisting of starters, isolators, ELCB, etc.
3.5	<b>COOLING COILS SECTION :</b>
3.5.1	Cooling coils be constructed from 13 mm OD – 27 SWG round seamless copper tubes combined with mechanically bonded 37 SWG Aluminium mild rippled fins and die formed directional guide channels and assembled within a heavy gauge galvanized steel frame work. The fins shall be 12 FPI and mechanically bonded to the copper pipes. Coils shall be provided with air vent and drain plugs. Coil assembly shall be

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	supported on slide frames for easy withdrawal.
3.5.2	The bends shall be ready made with solder rings on both ends. The coil shall have continuous aluminium dual sine wave fins. The fins shall be spaced by collars forming integral part of the fins. The tubes shall be staggered in the direction of air flow. The fins shall be uniformly bonded to the tubes by mechanical expansion of the tubes.
3.5.3	The coils shall be tested against leaks at a hydraulic pressure of 10 kg/ cm <sup>2</sup> . This pressure shall be maintained for a period of 2 hours. No drop should be observed indicating any leaks.
3.5.4	Coils shall be suitably sized to provide the required cooling capacity as specified elsewhere in this tender. Chilled water coils shall have ARI certified ratings with supporting catalogue data published by the unit manufacturer. Coils shall be mounted on tracks of structural steel and shall be removable from either end of the unit without dismantling or unbolting any sections of the air handling units, other than the coil access panel.
3.5.5	Coil headers shall be completely enclosed within the insulated coil casing section. The inlet and outlet connections shall be extended a minimum of 150mm(6") beyond the exterior of the coil casing through pre-cut openings. Sealing collars shall be provided at the openings for the coil connections. Drain connections shall be furnished for each coil and shall be located on the pipe connections, external to the unit cabinet, for ease of access.
3.5.6	Coils shall be provided in the capacity, quantity and arrangement for each air handling unit as per manufacturers selection data to suit the particular specification for the cooling coils. Unless otherwise noted in the schedule, coils shall have aluminium fins on seamless copper tubes. Fins shall be mechanically bonded to the tubes. No soldering or tinning shall be used for bonding. Working pressure shall be 1033 Kpa (150 PSI) at 94 Deg.C (200 Deg.F). Coil surface area shall be such that the average cross sectional air velocity in the coil plenum is no more than 135 m/min.
3.5.7	Each coil shall have galvanised sheet casing of 1.6 mm (1/16") minimum thickness. Intermediate centre supports shall be provided for all coils exceeding 1.37 M(4' - 6") in length.
3.5.8	Cooling coil shall be complete with drain pan constructed from stainless steel sheet and shall be installed inside the double skin panel to avoid condensation. The drain pan shall be fitted with drainage coupling on both sides. Drain tray shall have the

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	three directional slope.
<b>3.6</b>	<b>FILTER SECTION:</b>
3.6.1	Cleanable, non-flammable synthetic fibre filters 50 mm thick Pre filter section suitable for flanged G4 filters shall be used. Velocity through the filters shall not exceed 1.8 m.p.s. and pressure drop through clean filters shall not exceed 4 mm WG. The efficiency of of filters will be as under. Clean filter : 4 mm pressure drop Dirty filter : 12 mm pressure drop Efficiency : 90% down to 10 microns
<b>3.7</b>	<b>DAMPERS:</b>
3.7.1	Dampers shall be opposed blade type. Blades shall be made of double skinned aerofoil aluminium extruded sections with integral gasket and assemble with rigid extruded aluminium alloy frame. Manual dampers shall be provided with a bakelite knob of locking the damper blades in positions.
3.7.2	Air leakage through dampers when in the closed position shall not exceed 1.5% of the maximum design air volume flow rate at the maximum design air total pressure.
<b>3.8</b>	<b>EXPANSION DEVICE</b>
3.8.1	Expansion device shall be only Electronic thermostatic expansion valve suitable for R-407C / R-410A refrigerant with inlet and outlet connections. The expansion device shall also be suitable for a maximum operating pressure 400 psig.
<b>3.9</b>	<b>CONDENSATE DRAIN PIPING:-</b>  40 mm dia hard FRLS Grade PVC Drain Pipe shall be used to remove condensate from Evaporator Unit to drain point. The joints shall be properly sealed so that there is no water leakage. U trap shall be provided at the end. Additional insulated Drain tray shall be provided below the Evaporator Unit, if required. All Drain Pipes shall be insulated, with 6 mm nitrile rubber or equal Insulation.
<b>3.10</b>	<b>DRAIN PAN :</b>
3.10.1	The drain pan shall be at least 500 mm wide sufficiently extended to collect all

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	condensate, internally mounted with sloping sides for quick drain out and fabricated out of 1.2 mm SS 304 stainless steel sheets.
3.10.2	The drain pan shall be fully insulated with minimum 30 mm PUF. The PUF insulation shall be sandwiched between 1.2 mm SS 304 stainless steel sheets facing the inner condensate side outer skin similar to the AHU outer skin. The drain pan shall have coil skid facility for easy installation / removal of coils.
<b>3.11</b>	<b>INSTALLATION:</b>
3.11.1	Floor mounted AHU's shall be installed on civil pedestals keeping rubber pads to avoid transmission of vibration to the floor. AHUs shall be air tight without any leaks and shall be shown before commissioning.
3.11.2	The unit be installed as per manufacturer's recommendations. Care should be taken that no panels are damaged or scratched. In case of damage or scratch, panel shall be replaced free of all cost to the Client.
3.11.3	The air handling unit shall be so installed as to transmit minimum amount of vibration to the building structure. Adequate vibration isolation shall be provided by use of rubber / neoprene pads.
3.11.4	The concrete foundations required for the AHUs shall be prepared by the Owner as per the drawings supplied by the Contractor. However, the Contractor shall supply all foundation bolts. base plate, wherever required, vibration eliminators, etc. and shall ensure that all the above accessories are placed security in proper position while the foundation is cast.
3.11.5	The contractor shall ensure that the complete installation is totally vibration free.
<b>3.12</b>	<b>CONTROLS :</b>
3.12.1	All controls shall be electric and complete with auxiliary relays, contractors, wiring, etc. All control wiring from the central control panel and in the AHU room shall be carried out by the HVAC Contractor. All power wiring from the starter / isolator within the AHU room shall be carried out by the HVAC Contractor.;
3.12.2	AHU unit controls shall be as follows: <ul style="list-style-type: none"> <li>• Control circuit energized when fan is started.</li> <li>• Dry bulb temperature shall be controlled by means of a modulating supply air</li> </ul>

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	<p>thermostat to actuate motorized 2-way valve chilled water valve.</p> <ul style="list-style-type: none"> <li>• Extra contractors shall be provided in the control circuit to automatically shut off the AHU on receipt of a signal from the fire alarm system and for remote control operation.</li> </ul>
<b>3.13</b>	<b>LIMITATIONS :</b>
3.13.1	<p>The air velocity across the cooling coil shall not exceed 500 FPM (2.5 m per sec.). The fan outlet velocity shall not exceed 1850 FPM. The air velocity across the filters shall not exceed 550 FPM.</p>
<b>3.14</b>	<b>SAFETY FEATURES :</b>
3.14.1	<p>Each air handling unit shall have safety features as under :</p> <ul style="list-style-type: none"> <li>• The fan access door shall be equipped with micro switch interlocked with fan motor to enable switching off the fan motor automatically in the event of door opening.</li> <li>• Fan and motor base shall have proper provision for earthing from the factory.</li> <li>• All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.</li> </ul>
<b>3.15</b>	<b>PRE COMMISSIONING CHECKS</b>
3.15.1	<ul style="list-style-type: none"> <li>• Check the AHU's / FCU's / Fans installed according to the specifications and design.</li> <li>• Check the duct work is completed.</li> <li>• Check the air filters are fixed and clean.</li> <li>• Check the air terminals are installed as per the design.</li> <li>• Check the dampers are installed and accessible.</li> <li>• Check the duct work is cleaned internally.</li> <li>• Check the test holes drilled for measurement.</li> <li>• Check the FD's / VCD's are opened.</li> <li>• Check the Grills and Diffusers are installed.</li> <li>• Check the Fan chamber / unit are cleaned.</li> <li>• Check the motor termination and control unit.</li> <li>• Check the fuse rating is correct.</li> <li>• Check the drain pipe and slope is correct.</li> <li>• Check the direction of fan rotation is correct.</li> </ul>

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	<ul style="list-style-type: none"> <li>• Check the fan and motor are lubricated.</li> <li>• Check the fan shaft and bearing are aligned properly.</li> <li>• Check the Veebelts, drive guards and tension is correct and fitted.</li> <li>• Check the static balance and adequate access to fan.</li> <li>• Doors and Windows are fixed.</li> <li>• Re circulation and air transfer opening size is correct.</li> </ul>
<b>3.16</b>	<b>COMMISSIONING CHECKS</b>
3.16.1	<ul style="list-style-type: none"> <li>• Set the fan rpm to provide design total air quantity within acceptable limits.</li> <li>• Fan speed shall not exceed the maximum allowable rpm as established by the fan manufacturer.</li> <li>• Set all the main duct &amp; branch duct dampers and outlet dampers at full open position.</li> <li>• Check the total flow of the fan by duct traverse method, flow will be set to 105 % of design flow</li> <li>• Check the flow in all branches and find out the index branch.</li> <li>• Balance the branches in proportion with the same percentage of total flow by adjusting the volume control dampers and keeping the index branch dampers at fully open condition.</li> <li>• Measure the index branch and proportionally balance the air terminals.</li> <li>• The final setting of fan rpm shall not result in overloading the fan motor in any mode of operation.</li> <li>• Dampers shall be modulated, and the ampere of the supply fan motor shall be measured to ensure that no motor overload can occur.</li> <li>• After Total System Balancing, the following values shall be recorded:             <ol style="list-style-type: none"> <li>1. Fan rpm</li> <li>2. Motor voltage and current</li> <li>3. Entering static pressure</li> <li>4. Leaving static pressure.</li> </ol> </li> </ul>
<b>3.17</b>	<b>TESTING &amp; PERFORMANCE:</b>
3.17.1	<p>Cooling capacity of various Air handling unit models shall be computed from the measurements of air flow and dry and wet bulb temperatures of air entering and leaving the coil. Flow measurements meters shall be accurately calibrated. Computed results shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input</p>

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	current
3.17.2	Air handling units shall be selected for the lowest noise level of the equipment as per the selection criteria. Fan performance rating and power consumption data with operating points clearly indicated shall be submitted with the tender and verified at the time of testing and commissioning.
3.17.3	The AHU, after completely assembled with the coil, will have to be run tested at site, to establish the following: a) Air Quantity. b) Power consumption. c) Static pressure. d) Noise and vibration.
<b>3.18</b>	<b>PERFORMANCE EVALUATION CHECKS :</b>
3.18.1	<ul style="list-style-type: none"> <li>• Measure the Supply Air / Return Air / Fresh Air Volume in CFM / CMH</li> <li>• Measure the External Static Pressure in KPa / Pa</li> <li>• Measure the Fan RPM / Motor RPM</li> <li>• Measure the Voltage / Amperage</li> <li>• Measure the On Coil / OFF Coil Temperature in °C / °F</li> </ul>

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**TENDER SPECIFICATION  
– LIST OF ACCEPTED  
MAKES**

<b>4.0 LIST OF ACCEPTED MAKES</b>		
<i>Scope: Scope of this section comprises of the List of Accepted makes for various items of supply and work confirming to the specifications and in accordance with the requirement of drawings and of the Schedule of Quantities.</i>		
NO.	ITEM	ACCEPTABLE MAKES
1	AIR COOLED CONDENSING UNITS	VOLTAS / BLUESTAR / CARRIER AIRCON / DAIKIN / YORK / ETA-ENGG / HITACHI
2	CROSS LINKED POLYOLEFIN / POLYTHELENE	SUPREME / THERMOBREAK
3	GRILLES AND DIFFUSERS	COSMIC / RAVISTAR / AIRMASTER / AIR BREEZE
4	DUCT/ COLLAR / FIRE DAMPERS	COSMIC / RAVISTAR / AIRMASTER/ AIR BREEZE
5	FACTORY FABRICATED DUCTING	SEVEN STAR/ WESTERN AIR DUCTS/ VENUS ENERGY
6	FIRE SEALENT	3M / HILTI
7	FLEXIBLE DUCTS	SEVEN STAR / ATCO / VENUS ENERGY
8	AIR HANDLING UNITS	BLUE STAR / VOLTAS / ZECO / EDGETECH / CARRYAIRE
9	OPEN CELL ELASTOMERIC	A-FLEX / K-FLEX / ARMAFLEX / ARMACELL
10	G S S	SAIL / TATA / JINDAL
11	COPPER PIPES	RAJCO / MANDEV / KWALITY / PALLAVI / SAI FORGE
12	MOTORS	ABB / KIRLOSKAR / SEIMEN
13	FANS	COMFRI / KRUGER / NICOTRA
14	ELECTRICAL COMPONENTS	ABB / L&T / SEIMEN / IMT /MERLIN GERIN/SCHNEIDER
15	ELECTRICAL CABLES(only ISI)	HAVELLS / FINNOLEX
16	PIPE INSULATIONS	VIDOFLEX / ARMAFLEX / AEROFLEX
17	REFRIGERANT	DUPONT / HONEYWELL

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**TENDER SPECIFICATION  
– DX AIR COOLED  
CONDENSING UNIT**

<b>5.0</b>	<b>AIR-COOLED CONDENSING UNIT</b>
	<i>Scope: Scope of this section comprises of the supply, installation, testing and commissioning of DX Air-cooled Condensing Unit confirming to the specifications and in accordance with the requirement of drawings and of the Schedule of Quantities.</i>
5.1	<b>GENERAL CONDITIONS :</b>
5.1.1	The DX Air-Cooled Condensing Unit shall be self contained factory tested and assembled unit .
5.1.2	The construction, production, type and testing of DX Air cooled Condensing Unit shall conform to latest IS standards. Units shall be industrial heavy duty type.
5.1.3	The units shall be made of Galvanised steel sheets and powder coated. All fasteners used in the outdoor units shall be of good quality.
5.1.4	The unit shall be complete with Scroll compressor, condenser coil, fans, charging points and controls.
5.1.5	The noise level of the unit shall not exceed 60 dB(A) at 1 meter distance from the unit. All precautions to reduce noise and vibration transmission to be taken care.
5.2	<b>CONSTRUCTION :</b>
5.2.1	The external panels shall be constructed of 1.2 mm zinc coated sheet steel. The cabinet shall powder coated .
5.2.2	The panels shall be removable and include captive ¼ turn fasteners. The cabinet shall be assembled with pop rivets providing ease of disassembly.
5.2.3	The unit shall require front access only for routine service and installation work.
5.3	<b>SCROLL COMPRESSOR</b>
5.3.1	The compressor shall be of the high efficiency complaint scroll design, with E.E.R (Energy Efficiency Ratio) of not less than 11.1 BTUH/Watt (C.O.P. not less than 3.25)

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**TENDER SPECIFICATION  
– DX AIR COOLED  
CONDENSING UNIT**

	at ARI rating conditions. The compressor shall be charged with mineral oil and designed for operation on R-407C or R-410A only. Each compressor shall have internal motor protection and be mounted on vibration isolators.
5.3.2	Compressor shall be hermetically sealed scroll compressor suitable for 3-phase operation with operating voltage between 380 – 420V and operating frequency of 50HZ. Compressor shall be mounted on to the base of the packaged unit on top of resilient rubber grommet mounting with steel sleeve bolts and nuts.
5.4	<b>REFRIGERATION CIRCUIT</b>
5.4.1	The refrigeration system shall be of the direct expansion type and incorporate one or more hermetic scroll compressors, complete with crankcase heaters.
5.4.2	A hot gas bypass solenoid valve shall be used on single compressor models. The system shall include a manual reset high pressure control, auto reset low pressure switch, externally equalized thermal expansion valve, high sensitivity refrigerant sight glass, large capacity filter drier and charging/access ports in each circuit.
5.4.3	Each refrigeration circuit shall include rigidly mounted isolation valves in the discharge and liquid lines to aid servicing and installation (air cooled units only).
5.5	<b>AIR COOLED CONDENSER</b>
5.5.1	Air-cooled condenser shall be with single or multiple coils of minimum 3 rows deep. The tube thickness 0.3mm and dia of not less than 0.7mm. The tube shall also be internally grooved. Fins shall be made of Aluminium of thickness 0.16mm having 13 fins per inch and the method of bonding of tubes & fins shall be mechanical expansion.
5.5.2	Air cooled condenser shall have maximum surface area to ensure a good heat transfer across the coil. The air cooled condenser fan shall be direct driven and motor mounted on fan guard and the motor shall be equipped with double ball bearing. The motor shall have class 'F' insulation. Fan shall be propeller type made of mild steel. The maximum imbalance of the fan shall be 0.35gram.
5.5.3	The Air-cooled condenser shall be the low profile, weatherproof type incorporating high efficiency, direct drive, external rotor motors with axial blade fans. The condenser shall balance the heat rejection of the compressor at 39 Deg C ambient.

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## TENDER SPECIFICATION – DX AIR COOLED CONDENSING UNIT

5.5.4	The condenser shall be constructed from heavy duty aluminum and corrosion resistant through special anti corrosive epoxy coatings for any specific polluted areas. Heavy duty mounting legs and all assembly hardware shall be included.
5.5.5	Condensers shall be suitable for 24 hours operation and be capable of providing vertical or horizontal discharge. The condenser shall be fully factory wired and require a 230 volt, single phase, 50 Hz electrical service.
5.5.6	The high performance heat exchanger shall include mechanically expanded cross-hatched copper tubes and louvered aluminum fins for maximum heat transfer.
<b>5.6</b>	<b>MICROPROCESSOR CONTROLLER</b>
5.6.1	The unit shall be supplied with micro-processor based control system. The system shall have digital display of the return air temperature and the set point temperature.
5.6.2	The following safety features shall be provided and the same shall have LED indications: <ul style="list-style-type: none"> <li>• Under voltage / Over voltage trip.</li> <li>• Phase Failure / Phase reversal trip.</li> <li>• High Pressure trip (comp1 &amp; comp2 for dual circuits)</li> <li>• Compressor O/L trip (comp1 &amp; comp2 for dual circuits)</li> <li>• Fan fails indication.</li> </ul>
5.6.3	The following mode selection shall be provided: <ul style="list-style-type: none"> <li>• Fan Mode,</li> <li>• Cool Mode.</li> </ul>
5.6.4	The panel shall allow temperature set point adjustment.
	The microcomputer controller should offer the following user-friendly features: <ul style="list-style-type: none"> <li>• Run time equalization: To calculate and ensures equal run time for all compressors.</li> <li>• Auto restart after power failure: to avoid inconvenience of manual</li> </ul>

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– DX AIR COOLED  
CONDENSING UNIT**

	<p>restart.</p> <ul style="list-style-type: none"> <li>• Memory back up: To keep settings intact during power failures and stoppages.</li> <li>• Built-in-time delay: To protect compressor from instant stops and starts.</li> <li>• Single phasing and reverse phase protection: To protect compressors from damage.</li> <li>• Fuzzy logic: To cool intelligently based on the heat load, and hence to increase efficiency.</li> <li>• Self-fault diagnostics: To display system trips which facilitates faster corrective action.</li> <li>• Easy hook-up with fire alarm system: Potential free contacts to be provided for hooking on to the fire alarm system, for stopping the units in the event of a fire.</li> </ul>
5.7	<b>CONTROLS</b>
5.7.1	HP/LP cutout shall be provided for compressor protection. A thermostat located in the return air path shall control cutting in/out of the compressor. A selector switch enabling the running of the fan alone with cooling shall be provided. Reset facility shall be provided. Interlocking of compressor with condenser, and air handling fan shall be provided.
5.8	<b>VIBRATION ISOLATION</b>
5.8.1	The entire unit shall be placed on neoprene ribbed pads of 6mm thickness and size 150 X 150 mm.
5.9	<b>ELECTRICAL</b>
5.9.1	The units shall be supplied with a control panel, which shall house the complete electrical switch gear. The panel shall be housed in the unit itself. All necessary contactors, over load relays, anti-recycle timer relays etc.. shall be housed within this panel. Main power supply, if not specified otherwise in the BOQ or elsewhere, shall be terminated by the client in this panel and feeder cables to feed power to the out door condensing units shall be carried out by the AC contractor only.
5.10	<b>TESTING</b>
5.10	The capacity of the units shall be acceptance tested in accordance with the latest IS standards. The tenderer shall run the plant for 12 hrs and every hour reading to be

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**TENDER SPECIFICATION  
– DX AIR COOLED  
CONDENSING UNIT**

taken and the same has to be computed and submitted with performance test reports. Performance guarantee tests shall be conducted at site after completing the installation in all respects to establish cooling, power consumption, vibration and noise. In case the guaranteed performance could not be achieved, the same shall be repeated after necessary repairs/modification.

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**TENDER SPECIFICATION  
– ENERGY RECOVERY  
VENTILATORS**

<b>6.0</b>	<b>ENERGY RECOVERY VENTILATORS :</b>
	<i>Scope: Scope of this section comprises of the supply, installation, testing and commissioning of Energy Recovery Ventilators confirming to the specifications and in accordance with the requirement of drawings and of the Schedule of Quantities.</i>
	<b>ENERGY RECOVERY VENTILATORS ABOVE 3000 CMH :</b>
6.1	<b>GENERAL CONDITIONS :</b>
6.1.1	The air handling units shall be of double skin construction, draw through type in sectionalized construction consisting of blower section, coil section, filter section and insulated drain pan. Unless otherwise specified, the unit shall be horizontal type.
6.2	<b>CASING :</b>
6.2.1	Double skinned panels shall be made of galvanized steel with 25 / 50 mm PUF insulation and shall be fixed to 2.5 mm thick aluminium alloy normal / thermal break profiles frame work with stainless steel screws. Outer sheet of panels shall be made of galvanized 0.63 mm thick pre-painted / pre-plasticised sheet and inner of 0.63 mm GSS. Aluminium profiles shall be internal round corners to avoid accumulation of dust.
6.2.2	The housing shall be so made that it can be delivered at site in total / semi knocked down condition, depending upon the requirements. The main framework shall be extruded aluminium hollow structural sections. All the framework shall be assembled using mechanical joints to make a sturdy and strong framework for various sections. Is specified framework shall be made of thermal break hollow extruded aluminium profile.
6.2.3	Minimum 450 mm access door shall be provided for easy access to filters, coils, fans etc. Each access door shall be provided with easy release ½ turn nylon handles and GM Chrome plated locks. Hinges shall be heavy-duty die cast solid aluminium with SS pivots. A safety "trip-switch" shall be provided to automatically cut off the electrical supply to the fan when the access door is opened.

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## TENDER SPECIFICATION – ENERGY RECOVERY VENTILATORS

6.2.4	The casing shall consists of an independent structural steel frame, properly reinforced and braced for maximum rigidity, having individually removable, double skin construction insulated panels. The casing shall be sectionalised construction, consisting basically of individual fan section, coil section, access sections, filter section, mixing box section and drain pan.
6.2.5	Energy Recovery Ventilator shall be listed per ANSI/UL 1995, Heating and Cooling Equipment. Energy transfer ratings of the energy recovery wheel shall be ARI Certified. Ventilators shall bear the AMCA Certified Rating Seals for Air Performance.
6.2.6	Performance shall be as scheduled on plans. Outdoor air shall not mix with exhaust air in a common plenum. Exhaust discharge and outside air intake shall not be located on the same side on roof top units.
6.2.7	Wheel shall be of the enthalpy type for both sensible and latent heat recovery and be designed to insure laminar flow. Energy transfer ratings must be ARI Certified to Standard 1060 and bear the ARI certification symbol for ARI Air-to-Air Energy Recovery Ventilation Equipment Certification Program based on ARI 1060. Ratings "in accordance with 1060" without certification are not acceptable. Desiccant shall be silica gel for maximum latent energy transfer.
6.2.8	Wheel shall be constructed of lightweight polymer media to minimize shaft and bearing loads. Polymer media shall be mounted in a stainless steel rotor for corrosion resistance. Wheel design shall consist of removable segments (for wheels greater than 26 inches in diameter) for ease of service and/or cleaning.
6.2.9	Silica gel desiccant shall be permanently bonded to wheel media to retain latent heat recovery after cleaning. Wheels with sprayed on desiccant coatings are not acceptable. Wheels with desiccant applied after wheel formation are not acceptable. Energy recovery device shall transfer moisture entirely in the vapor phase.
6.2.10	Energy recovery drive belt material shall be high strength urethane and shall be factory installed in a pre-stretched state, eliminating the need for field belt tension adjustment. Link style belts are not acceptable.

## TENDER SPECIFICATION – ENERGY RECOVERY VENTILATORS

6.2.11	Centrifugal fans to be double width, double inlet, single fan forward curved type. All blower wheels shall be statically and dynamically balanced. Ground and polished steel fan shafts shall be mounted in permanently lubricated, sealed ball bearing pillow blocks.
6.2.12	Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speeds. Separate motors for exhaust and supply blowers shall be provided.
6.2.13	Adjustable sheaves on belt-driven fans with motors less than 10 hp shall allow independent balancing of exhaust and supply airflows. Optional speed controllers on direct-drive fans shall allow independent balancing of exhaust and supply airflows.
6.2.14	Fan and motor assemblies are mounted to unit base with neoprene isolators as standard. Fans shall be located in draw-through position in reference to the energy recovery wheel.
6.2.15	Motors shall be EFF1 energy efficient rating , complying with EPACT standards, for single speed ODP and TE enclosures. Motors shall be permanently lubricated, heavy-duty type, matched to the fan load and furnished at the specified voltage, phase, and enclosure.
6.2.16	Belt-drive motors shall be factory mounted to an adjustable motor plate having two heavy-duty adjusting bolts for alignment and belt tension. Drives shall be sized for a minimum of 150% of driven horsepower.
6.2.17	Pulleys shall be of the fully machined cast type, keyed and securely attached to the fan wheel and motor shafts; 10 horsepower and less shall be supplied with an adjustable drive pulley.
6.2.18	Energy wheel motors and direct-drive motors shall have integral overload protection.
6.2.19	Filters :Supply and exhaust air filters shall be 2-inch thick pleated fiberglass, 30% efficient and tested to meet UL Class 2. Filter racks shall be die-formed galvanized steel.

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## TENDER SPECIFICATION – ENERGY RECOVERY VENTILATORS

6.2.20	Electrical :All internal electrical components shall be factory wired for single point power connection. All electrical components shall be UL Listed, Approved or Classified where applicable and wired in compliance with the National Code
6.2.21	Accessories The following accessories must be provided by the Manufacturer: 1) Motorized Damper for Outdoor Air 2) Hinged Access Door 3) Sensor to detect Dirty Filter 4) Remote Control Panel with a Light showing Dirty Filter
	<b>ENERGY RECOVERY VENTILATORS BELOW 3000 CMH :</b>
6.3	<b>GENERAL CONDITIONS :</b>
6.3.1	CASING : Casing shall be made of 18/20/22 gauge CNC manufactured powder coated steel . Casing shall be insulated with 13 mm high density insulation. Access panel to the components shall be provided. The access panel shall be easily openable and tightly sealed by means standard gaskets.
6.3.2	FANS : Compact radial blowers. The blades shall be designed for maximum efficiency & quiet operation. Impeller shall be statically & dynamically balanced.
6.3.3	TOTAL ENERGY RECOVERY WHEEL : The substrate : The substrate or wheel matrix is to be of pure aluminum foil so as to allow:  a) quick and efficient uptake of thermal energy.  b) sufficient mass for optimum heat transfer  c) maximum sensible heat recovery at a relatively low rotational speed of 20 to 35 rpm.

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## TENDER SPECIFICATION – ENERGY RECOVERY VENTILATORS

6.3.4	<p>The wheel matrix should not make use of any non metallic substrates made from paper, plastic, synthetic or glass fibre media.</p> <p>The substrate matrix is to be made from materials which are nether combustible nor support combustion.</p>
6.3.5	The Desiccant : The desiccant is water molecule selective and non-migratory.
6.3.6	The desiccant is coated/used on the aluminum substrates as it helps to limit the cross contamination to absolute minimum, and to ensure the exclusion of contaminants in the air stream, while transferring water vapour molecules. For higher diffusion rate and slightly improved latent recovery without substantially sacrificing cross contamination, desiccant coated/used.
6.3.7	The desiccant should have sufficient mass, and is to be coated with a non masking porous binder adhesive on the aluminum substrate and must allow quick and easy uptake and release of water vapour. The matrix should not have desiccants impregnated in a non metallic substrate, such as synthetic fibre, glass fibre, etc., as the substrate is to be made from aluminum foil.
6.3.8	The rotor/wheel matrix should have equal sensible and latent recovery.
6.3.9	The weight of desiccant coating and the mass of aluminum foil should be in a specific ratio so as to ensure equal recovery of both sensible and latent heat over the operating range. The rotor matrix must not have an etched or oxidised surface to make a desiccant on a metal foil as that would result in insufficient latent recovery and hence unequal recovery; also the rotor matrix is not made by imtregnating the desiccant in a synthetic fibre matrix as that would result in insufficient sensible recovery, high rotation speed, and unequal recovery, which is generally not acceptable.
6.3.10	Rotor : As optimum heat and mass transfer takes place via the matrix formed by desiccant, which has sufficient mass, being coated on an aluminum foil, the rotor typically rotates at lower than 20 to 35 rpm, thereby also ensuring long life of belts and reduced wear and tear of seals.

## TENDER SPECIFICATION – ENERGY RECOVERY VENTILATORS

6.3.11	The rotor should be made of alternate flat and corrugated aluminum foil of uniform width. The rotor honeycomb matrix foil is to be so wound and adhered that it makes a structurally very strong and rigid media which does not get cracked, deformed etc. due to change of temperature or humidity.
6.3.12	The surface of the wheel/rotor should be specially and highly polished and ensures that the vertical run out does not exceed + 1 mm, thereby ensuring, negligible leakage
6.3.13	The radial run out also should not exceed + 1 mm, thereby minimising the leakage/drag on the radial seals, and minimising the fluctuations in the tension of the drive belt.
6.3.14	The number of wraps (of alternative corrugated and flat foil) for every inch of rotor radii should be extremely consistent and this ensures uniform air flow and performance over the entire face in the air stream. Flute height and pitch should be consistent to a very tight tolerance and this ensures uniform pressure drop and uniform airflows across the rotor face.
6.3.15	The rotor should be non clogging aluminum media, having a multitude of narrow aluminum foil channels, thus ensuring a laminar flow, and will allow particles upto 600 microns to pass through it.
6.3.16	The media is cleanable with compressed air, or low pressure steam or light detergent, without degrading the latent recovery.
6.3.17	ROTOR/WHEEL CASSETTE : The rotor/wheel cassette is made of galvanised steel / powder coated sheet framework which limits the deflection of rotor/wheel due to air pressure loss.
6.3.18	FILTERS : Filter shall be 25mm thick washable type.
6.3.19	ELECTRICALS : Power connection requirement : 220 volt/1 ph/50 Hz.

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## TENDER SPECIFICATION – REFRIGERANT PIPING

<b>7.0</b>	<b>REFRIGERANT PIPING</b>
	<i>Scope: Scope of this section comprises of the supply, installation, testing and commissioning of Refrigerant Piping for the Air-cooled Packaged Air-conditioning System confirming to the specifications and in accordance with the requirement of drawings and of the Schedule of Quantities.</i>
<b>7.1</b>	<b>GENERAL CONDITIONS :</b>
7.1.1	The section comprises the general requirements for the design, workmanship, quality of materials and accessories to be used for refrigeration piping and the tests to be carried out on the same.
7.1.2	The scope of this section covers supply, laying, testing and commissioning of copper refrigerant piping. The tender drawings enclosed depict the schematic layout for the refrigerant piping routing. The contractor shall prepare his working drawings for approval by the consultant before execution at site.
7.1.3	The vendor shall design the piping and prepare installation drawings showing full details of piping arrangement, pipe sizes and thickness, methods of supporting pipes and connections in various components for approval of Engineer-in-charge. Work shall commence only after approval. Piping shall be able to withstand the thermal stresses and vibrations encountered during normal operations.
7.1.4	Refrigerant pipe sizes indicated in the tender is only tentative and the contractor shall confirm the same.
7.1.5	Refrigerant piping shall be designed as per the requirement of the system. Suction risers shall be designed as per the minimum load requirement of the system. The contractor shall submit the design calculations for the same for the consultant's approval and then execute the same at site.
<b>7.2</b>	<b>CONSTRUCTION :</b>
7.2.1	Hard drawn copper pipes shall be used for the refrigerant piping.
7.2.2	Fittings like bends, tees, and sockets shall be of copper or brass and shall be suitable for duty involved. Flare type compression fittings shall be allowed upto 15mm size for which annealed copper tubing is used. Tubes upto and including 15mm size may be bent to form 90deg. bends with inside radius not less than 3 tube diameters. For

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	bigger sizes, bend fittings as mentioned above shall be used. Valves shall be of packed, back seating type, and shall be forged or cast brass construction.
7.2.3	<p>Joints between pipes or pipes and fittings shall be of the socketed or flanged type. Brazing alloy of the silver-copper-Phosphorous type shall be used and joints shall be made by the flow of brazing alloy by capillary action along the annular space between the two mating surfaces. Ends of mating tubes shall be square cut and cleaned properly to remove burrs and dirt or oxide. For flare type fittings, tubes shall be fully annealed at the flare before and after flaring.</p>
7.3	<p><b>HOT GAS LINE:</b></p> <ul style="list-style-type: none"> <li>• Oil entrainment by hot gas shall be achieved under all load conditions likely to be encountered during normal operation.</li> <li>• Horizontal lines shall have a grading of at least 1:250 away from the compressor and towards condenser to permit gravity draining of oil to condenser.</li> <li>• Equalizer lines shall be provided if called for in tender schedule. These shall be horizontal and have the same size as the discharge line of the largest compressor for hot gas and oil equalizers.</li> <li>• Hot gas mufflers shall be installed in vertical position or in horizontal position graded away from the compressors. Mufflers shall be designed to prevent oil trapping.</li> </ul>
7.4	<p><b>LIQUID LINE:</b></p> <ul style="list-style-type: none"> <li>• Liquid lines shall be sized to ensure that flashing of liquid refrigerant does not occur.</li> <li>• Liquid line solenoid valves shall be provided with test switches to enable manual energizing.</li> <li>• A full flow brass liquid strainer with bronze screens and permanent magnet shall be provided in a readily accessible position with isolating valves and valved by pass line. Screens shall be easily removable.</li> <li>• Each liquid shall be provided with a permanently installed refrigerant drier or rechargeable type. Drier shall be installed in valve by pass line.</li> <li>• Liquid cum moisture indicator shall be installed on all liquid lines.</li> <li>• Wherever liquid receiver is provided, it shall be fabricated from electric welded steel and have a total capacity to hold not less than 1.25times the volume, in liquid state, of the refrigerant in the system. Liquid level indicator shall be provided with the receiver.</li> <li>• Suction trap of adequate capacity shall be provided before each compressor or grouped compressors connected in parallel to collect all oil and refrigerant slugs.</li> </ul>

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## TENDER SPECIFICATION – REFRIGERANT PIPING

7.5	<p><b>SUCTION LINE:</b></p> <ul style="list-style-type: none"> <li>Oil shall be entrained by the suction gas under all conditions of load likely to be encountered in normal operation.</li> <li>Horizontal suction lines having suction trap or suction line at separator shall be pitched at least 1:250 in the direction of flow of refrigerant.</li> <li>Piping should be so designed as to ensure that oil would not separate from gas and drain to compressor in slugs.</li> <li>Piping shall have loops and direction changes to absorb normally encountered vibrations.</li> <li>All suction line shall be insulated as specified in Section IX paragraph 5.0, 'Insulation'. Insulation shall be carried out only after pressure testing is completed.</li> </ul>
7.6	<p><b>ISOLATING VALVES:</b></p> <p>If required isolating valves shall be provided to isolate each compressor, liquid receivers if provided, evaporators, strainers, drier and any other component requiring proper operation and maintenance.</p>
7.7	<p><b>THERMOSTATIC EXPANSION VALVES:</b></p>
7.7.1	Each cooling coil shall be provided with its thermostatic expansion valve to ensure that specified accuracy of temperature control of the system can be achieved. No valve shall operate 35% below its rated capacity..
7.7.2	Adjustable superheat control and external equalizer port shall be provided for each valve. Each expansion valve be easily removable for cleaning and adjusting.
7.7.3	Expansion valve bulb shall be located immediately after the evaporator outlet on the suction line 45" above bottom of pipe. Valve should be set so that overfeeding does not occur at partial load conditions
7.8	<p><b>PIPING INSTALLATION:</b></p>
7.8.1	The entire refrigerant piping shall be installed in a workmanship like manner, true to alignment and grade as required. Tube ends shall be kept plugged or kept closed at all times before installation and where practical, during construction, to prevent ingress of moisture and foreign matter.
7.8.2	All dust and welding flux should be removed before installation. Piping supports shall be spaced not more than 2 meters apart and substantial enough to prevent bending

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## TENDER SPECIFICATION – REFRIGERANT PIPING

	stresses.
7.8.3	The supports, shall be rigid type, either ceiling hung/wall bracketed angle iron . Each support shall be isolated from pipe by providing anti-vibration springs or neoprene rubber liner.
7.8.4	Valves shall be supported separately to avoid transmission of stresses to connected pipes.
<b>7.8.</b>	<b>PRESSURE TEST:</b>
7.8.1	After completion of piping installation, entire piping installation shall be pressure tested with dry nitrogen or carbon dioxide at the following pressures.
7.8.2	The high pressure shall be not less than 21 kg/cm <sup>2</sup> and low side pressure not less than 11 kg/cm.
7.8.3	Testing shall be carried out as follows. <ul style="list-style-type: none"> <li>• Systems shall be charged with inert gas (nitrogen) to 1kg/cm<sup>2</sup> gauge pressure and all joints shall be checked for large leakages with soap solution. Leaks shall be marked, pressure released and repairs carried out. Brazed joints that leak shall be opened and redone. These shall not be required by addition of brazing alloy to the joint.</li> <li>• System shall be charged with nitrogen or carbon dioxide to the pressure specified as above. Leak detection and repairs to leaks shall be carried out till no leak exists.</li> <li>• After all leaks have been repaired, system shall be retested with test pressure maintained for not less than 8 hours. No measurable drop in pressure should be detected after pressure readings are adjusted for temperature changes. Pressure gauges and controls may be closed during pressure testing.</li> </ul>
<b>7.9</b>	<b>EVACUATION :</b>
7.9.1	<ul style="list-style-type: none"> <li>• After pressure testing is completed, evacuation shall be carried out as follows after releasing pressure.</li> <li>• A 2 stage rotary vane vacuum pump shall be connected to the refrigeration system. On no account should the compressor be used for purpose of creating vacuum.</li> <li>• Vacuum pump shall be operated to reduce the pressure to 250 microns absolute and allowed to hold for 6 hours.</li> </ul>

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## TENDER SPECIFICATION – REFRIGERANT PIPING

	<ul style="list-style-type: none"> <li>Vacuum shall be broken with a mixture of dry nitrogen and a small quantity of refrigerant to be used. System shall be evacuated to 100microns and allowed to stand for 24hrs. Leak detection with halide torch or electronic leak detector shall be carried out.</li> <li>If no leak exists correct quantity refrigerant and oil shall be charged into the system. Final leak detection should be carried out once again to ensure leak tightness.</li> <li>If ok proceed for refrigerant charging.</li> </ul>
<b>7.10</b>	<b>CHARGING :</b>
7.10.1	<ul style="list-style-type: none"> <li>Charge refrigerant in liquid form, through liquid line port.</li> <li>Use weighing machine to charge exact calculated amount.</li> <li>Weight the refrigerant cylinder before and after charging.</li> <li>After complete charging open both suction and liquid ball valve of outdoor unit.</li> <li>If full additional charge cannot be charge in liquid form, then charge balance amount in liquid form by using the suction service valve with system working in cooling mode.</li> <li>After charging refrigerant remove manifold and refrigerant cylinder and replace caps of service valves.</li> <li>Close (Front End) both suction and liquid service valves</li> <li>Check for leaks in service valve connections.</li> </ul>
<b>7.11</b>	<b>PRE-COMMISSIONING CHECK LIST</b>
7.11.1	<ul style="list-style-type: none"> <li>All required commissioning tools are available</li> <li>Correct amount of refrigerant is calculated as per installed liquid line</li> <li>Correct amount of refrigerant and weighing machine is available at site</li> <li>Pressure testing done as per standard</li> <li>Evacuation done as per standard</li> <li>Refrigerant charging done as per standard</li> <li>Communication wire connected to outdoor PCB</li> <li>Continuity of communication wire checked</li> <li>Permanent power supply of allowed range is available in all Indoor Units and ODU</li> <li>Correct size of MCB and cables are installed</li> <li>Dip switch setting of IDU and ODU done</li> <li>All filters and coils of Indoor Units are clean</li> <li>Proceed for commissioning if all above steps are ready</li> </ul>
<b>7.12</b>	<b>COMMISSIONING :</b>

## TENDER SPECIFICATION – REFRIGERANT PIPING

7.12.1	<ul style="list-style-type: none"><li>• After refrigerant charging, energise the power supply to outdoor unit so that crankcase heater is energised for minimum 4 hours.</li><li>• Set dip switch settings.</li><li>• Check continuity of communication wiring.</li><li>• Check all electrical connections are tight.</li><li>• Check incoming voltage at power terminals.</li><li>• Operate the indoor units by unit controller or group controller.</li><li>• Observe for any abnormal noise.</li><li>• Observe parameters and inside conditions for 12 hours.</li><li>• Handover the system to customer along with user manual.</li></ul>
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## TENDER SPECIFICATION – INSULATION WORK

<b>8.0</b>	<b>INSULATION WORK :</b>
	<i>Scope: Scope of this section comprises of the supply and fixing of insulation work confirming to the specifications and in accordance with the requirement of drawings and of the Schedule of Quantities.</i>
<b>8.1</b>	<b>GENERAL CONDITIONS :</b>
8.1.1	The Contractor shall ensure that samples of all forms of insulation material to be installed are submitted to the CLIENT/Project Managers for the approval within 30 days from the date of issue of letter of intent. The CLIENT/Project Managers shall have the right to reject all subsequent supplies that do not conform to the approved samples.
8.1.2	All insulating materials in the form, which it is used and under the condition anticipated, shall not ignite, burn, support combustion or release toxic gases when subject to fire or heat.
8.1.3	All adhesives used to stick insulation shall also be non-flammable.
8.1.4	Manufactures recommendation for application & safety shall be strictly adhered to.
<b>8.2</b>	<b>THERMAL INSULATION FOR DUCT :</b>
8.2.1	Ducts shall be Thermally insulated with 9 mm / 13 mm thick ( as specified ) flexible thermal insulation made out of Cross Linked closed cell polyolefin/ polyethelene foam, factory fused to a reinforced 9 micron aluminium foil and longitudinal and transverse joints sealed with self adhesive tape of same material.
8.2.2	<b>MATERIAL SPECIFICATIONS :</b> <ul style="list-style-type: none"> <li>Cross linked, closed cell polyolefin foam with factory applied, reinforced aluminum foil.</li> <li>Optional factory applied acrylic adhesive backing</li> <li>Density : 25kg / m<sup>3</sup></li> <li>Thermal conductivity: Maximum 0.032W/m.k @ 23°C.</li> <li>Moisture absorption : non hydroscopic</li> <li>Water vapor permeability : better than 0.8gm/m<sup>2</sup>/24hrs(90%RH, 38° C)</li> <li>Minimum service temperature : - 80° C</li> </ul>

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## TENDER SPECIFICATION – INSULATION WORK

	<ul style="list-style-type: none"> <li>• Maximum mean duct service temperature : 90° C</li> <li>• Maximum service temperature : 100° C</li> </ul>
8.2.3	The material should confirm to class 0, self extinguishing, does not drip due to reaction with fire, dust, CFC, HCFC and fibre free with zero ODB.
8.2.4	<b>FIRE RATING:</b> <ul style="list-style-type: none"> <li>• Minimum fire rating properties of the insulation material when tested to BS476 part 6&amp;7 - Class 0</li> </ul>
8.2.5	<b>INSTALLATION PRE-CHECKS :</b>
	<ul style="list-style-type: none"> <li>• All joint should be butted firmly against each other, seal all joint with 75mm reinforced aluminum foil tape. no gluing in joints is required</li> <li>• Insulated each duct separately. Flanges should be insulated with a120mm wide strip of insulation material.</li> <li>• No additional vapor barrier or coatings are required.</li> <li>• All supporting hangers should be lined with the same insulation material to avoid excess compression of insulation .(refer manufacturers instruction )</li> <li>• Ensure no air pocket during the installation of the insulation to the duct.</li> <li>• Any minor surface cuts should be covered with aluminum foil type</li> <li>• All joints should be butted firmly together &amp; sealed with high grade aluminum foil such as PPC 493 or equivalent</li> </ul>
8.3	<b>INSTALLATION METHOD :</b>
8.3.1	<b>SURFACE PREPARATION :</b> <ul style="list-style-type: none"> <li>• All duct work should be clean of duct and grease &amp; oil. To clean the duct first wipe down with a clean cloth to remove excess duct to remove grease &amp; oil a suitable solvent should be used such as methyl based spirit or acetone. Wipe ducts clean and allow solvent to evaporate.</li> <li>• Work in a reasonably clean area and avoid dusty places.</li> </ul>
8.3.2	<b>APPLYING WET ADHESIVE :</b> <ul style="list-style-type: none"> <li>• The recommended wet glue system is rubber / neoprene based contact adhesive.</li> <li>• Ensure both surface ( GI sheet and insulation are free on dust and grease)</li> </ul>

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## TENDER SPECIFICATION – INSULATION WORK

	<ul style="list-style-type: none"> <li>the surface should be wiped with a clean cloth.</li> <li>Apply glue to the both the GI surface and the insulation</li> <li>Wait until the surface are tack – dry(2-5 minute) and the solvent evaporated</li> <li>Bring the surface together and apply pressure.</li> </ul>
8.3.4	<p><b>APPLYING THE INSULATION:-</b></p> <ul style="list-style-type: none"> <li>Firstly cut the required length of insulation material required</li> <li>Cut the insulation material to the required length. Always allow excess 20mm for final adjustment do not peel the backing paper off at this stage.</li> <li>Lay duct section on the floor. To avoid damage to the insulation, use cardboard sheet on the floor.</li> <li>Peel off only a small section to start off with (150mm). Align with duct edge with the insulation sheet edge and gently lower to the duct.</li> <li>Pad firmly starting from the fixed edge move to the other edge by lowering the insulation to the duct progressively whilst padding insulation at the same time. Peel off enough paper to cover one side at the time only.</li> <li>Ensure air is expelled.</li> <li>DO NOT TRY TO LOWER ENTIRE SHEET TO ONE SIDE OF THE DUCT AT ONCE. THIS WILL LEAD TO TRAPPED AIR POCKETS.</li> <li>Once one side is fixed turn to duct expose new bare side.</li> <li>Slowly peel off enough backing paper to cover the edge and side of duct. Slowly pad the adhesive to the edge; DO NOT PULL THE INSULATION ON THE DUCT CORNER. Guide the insulation over the corner the pressing lightly. The insulation on the corner should be the same thickness as on the flat sections.</li> <li>Repeat until completely covered on the final side ensure the insulation length reaches the same level as the starting edge Trim off excess length with sharp knife until it is level with adjacent side.</li> <li>Use aluminum foil tape to seal the joint</li> <li>Provide nylon strapping at 600 mm centers to prevent sag. Strapping to be applied to widths of all ducts. Ensure strapping do not tear the aluminium foil.</li> </ul>
8.4	<b>ACOUSTIC INSULATION OF DUCTS :</b>
8.4.1	Material of construction shall be fibre-free elastomeric nitrile rubber foam with open cell structure .
8.4.2	The density of the same shall be within 140-180 Kg/m3.The material should have a

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	thermal conductivity not exceeding 0.050 W/mK. The Thickness of the material shall be 15 mm. The insulation material shall be shall be stuck to the cleaned duct surface by cold adhesive.
8.4.3	The maximum surface temperature the material should withstand is 105° C and minimum temperature should be -20°C. The Thickness of the material shall be 15mm. The material should conform to Class 1 rating for surface spread of Flame as per BS 476 Part 7.
8.4.4	The methodology as indicated above for duct thermal insulation shall generally be adopted for acoustic insulation also.
8.4.5	The corrugated surface shall be fixed facing the air path and flat surface stuck to the inside duct surface facing as specified or shown on the drawings.
<b>8.6</b>	<b>UNDER DECK INSULATION :</b>
8.6.1	Material of construction shall be cross linked polyolefin / polyethele foam material with closed cell structure and with factory applied reinforced aluminium foil. The insulation material shall be suitable for operation from 15 deg C to 100 deg C, inert to a wide range of chemicals & ecologically/ chemically neutral.
8.6.2	The density of the same shall be within 25 Kg/m3. The material should have a thermal conductivity not exceeding 0.032 W/mK. The Thickness of the material shall be 20 mm.
8.6.3	The insulation material shall be shall be stuck to the cleaned surface of below slab by cold adhesive and held in position by GI screw and plastic washers at 600 mm centers.
8.6.4	The minimum fire rating properties of the material shall be Class 0 when tested to BS476 part 6&7. The longitudinal and transverse joints should be sealed with 75 mm wide reinforced aluminium foil tape. Joints shall be over lapped to a minimum of 50 mm width.
<b>8.7</b>	<b>DUCT INSULATION –MEASUREMENT :</b>
8.7.1	The duct areas to be insulated should be measured and recorded before application of insulation. Then, the thickness of insulation shall be added twice to the depth and width and the insulation area shall be calculated and paid for.
8.7.2	The rate per sq.mt. of insulation shall be inclusive of basic insulation material, all finishes as specified.

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## TENDER SPECIFICATION – TESTING, ADJUSTING AND BALANCING-TAB

9.0	TESTING / ADJUSTING / BALANCING – TAB –AIR SIDE :
	<i>Scope: Scope of this section comprises of the Testing, Adjusting and Balancing - TAB , of Air distribution system confirming to the specifications.</i>
9.1	GENERAL CONDITIONS :
9.1.1	After completion, all duct systems shall be tested for air leakage
9.1.2	The entire air distribution system shall be balanced to supply the air quantities as required in the various regions and rooms to maintain the specified room conditions.
9.1.3	The air quantity shall be measured and if need be the motor pulley need to be changed to site requirement when balancing the system.
9.1.4	The entire air distribution system shall be balanced to supply the air quantities as required in the various regions and rooms to maintain the specified room conditions.
9.1.5	The leakage through the ducting system shall not exceed more than 6% of the total air quantity as per DW/144 standards.
9.1.6	The vendor should carry out the duct leak testing at site in few ducts as required by the consultant if the consultant/client/project managers notice the poor quality of workmanship or if the test reading not finding satisfactory.
9.1.7	The final balance of air quantities and its temperatures through each grille, register or diffuser shall be tested and recorded and submitted to the project manager for approval.
9.2	LEAK TESTING PROCEDURE :
9.2.1	<ul style="list-style-type: none"> <li>• Once the leakage-testing rig is in place, the following test procedure may be adopted:</li> <li>• Connect test apparatus to section of ductwork to be tested.</li> <li>• Adjust test apparatus until the static pressure differential is obtained.</li> <li>• Check that the measured leakage is within the permitted rate. (No addition shall be made to the permissible leakage rate for access panels or dampers</li> </ul>

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## TENDER SPECIFICATION – TESTING, ADJUSTING AND BALANCING-TAB

	<p>where these are included in the ductwork).</p> <ul style="list-style-type: none"> <li>• Maintain the test for fifteen minutes and check that the leakage rate has not increased.</li> <li>• Reduce pressure in section to zero by switching off the fan; then immediately re-apply test pressure to establish that the air leakage rate is not greater than the previous reading.</li> </ul>
<b>9.3</b>	<b>AIR BALANCING :</b>
9.3.1	On completion of the work, the system shall be demonstrated to the satisfaction of the Engineer and air flow at each fan outlet and all air distribution outlets is correctly adjusted and regulated, to fulfill its specified functions and as per designed air flow rate.
9.3.2	The work shall be carried out in accordance with the approved commissioning schedule and shall cover, but not necessarily be limited to, the following activities.
9.3.3	The entire air distribution system shall be balanced with the help of an anemometer. The measured air quantities at fan discharge and at the various outlets shall be within $\pm 5$ percent of those specified / quoted. Branch duct adjustments shall be permanently marked after the air balancing is completed so that these can be restored to their correct position if disturbed at any time.
9.3.4	Air circuit clean-up shall be carried out and all internal debris and foreign matter removed prior to the commencement of commissioning.
9.3.5	The functioning of the total system and all ancillary units shall be demonstrated and shown to be operating consistently within the prescribed limits.
9.3.6	All instruments, control and safety equipment shall be correctly calibrated under the supervision of a qualified, specialist engineer.
9.3.7	Calibration data shall be submitted together with test certification.

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9.3.8	All warning and safety controls shall be proven by producing the actual circuit conditions(s) required for actuation whenever practicable. Injected signals or other synthetic means of simulating unsafe or other synthetic means of simulating unsafe conditions may be utilised with the approval of the Engineer.
9.3.9	Noise and vibration levels shall be shown to be within the permitted limits.
9.3.10	<ul style="list-style-type: none"> <li>• Measure the flow at each outlet of the terminal branches</li> <li>• Find out the index terminal and keep the damper fully open</li> <li>• Balance the other outlets proportionally to the same percentage of flow set in the branch duct.</li> <li>• Check the flow in each outlet and record including the index terminal.</li> <li>• Take the total flow in the main duct again and record by using traverse duct method.</li> <li>• After Total System balance, the following values shall be measured and recorded.             <ol style="list-style-type: none"> <li>1. Fan RPM</li> <li>2. Motor voltage and amperes</li> <li>3. Static pressure entering the Fan</li> <li>4. Static pressure leaving the fan</li> </ol> </li> </ul>
9.3.11	<p>Static pressure entering and leaving the fan shall be measured as follows:</p> <ul style="list-style-type: none"> <li>• Static pressure readings leaving the fan shall be taken as far as from the fan as is practical, but shall be before any restrictions in the duct (such as duct turns )</li> <li>• No readings shall be taken directly at the fan outlet or through the flexible connection</li> <li>• Static pressure entering the fan shall be measured in the inlet duct upstream of any flexible connection and downstream of any duct restriction.</li> <li>• Static pressure entering a double inlet fan shall be measured through the wall of the plenum, which houses the fan</li> <li>• In all cases, the reading shall be taken to represent as true a value as possible. True value is actual measured static pressure.</li> </ul>

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9.4	<b>BALANCING AIR TERMINALS PROCEDURE</b>
9.4.1	<ul style="list-style-type: none"> <li>• Depending upon location and access to air terminals, various types of airflow measuring instruments will be utilized to record the actual airflow at terminals.</li> <li>• Assuming adequate access provided, a direct reading balometer would be used which gives a direct reading of volume rather than velocity, which cancels out the need for effective grille areas, terminal configuration consideration and velocity corrections.</li> <li>• If access is restricted then a rotating vane anemometer shall be used and the velocity reading obtained would be converted to volume (velocity x free area = volume) and a comparison between the pitot traverse reading will be made to obtain a correction factor which would be incorporated to give a true velocity reading.</li> <li>• Alternatively, the effective area provided by the register / grille manufacturer will be incorporated in the design velocity calculations.</li> <li>• Air quantities shall be measured according to CIBSE Application Guide 3/89 Standards.</li> <li>• Any main branch may be chosen to start with but as normal practice and having carried out a rough balance of main and sub-branches, start with the most remote branch and then sub-branch.</li> <li>• Locate the terminal, which is discharging the lowest percentage of its design flow rate. This is generally the last terminal in the run. if not, adjust the damper in the last terminal unit until it is working with the same percentage as the lowest one previously measured.</li> <li>• Measure the flow from the terminal next to the index and work out the percentage flow as close as possible to that of the index. Fix the damper in position.</li> <li>• Repeat the procedure for the next terminal, again comparing it with the index.</li> <li>• As the dampers are closed along the run, more air will be driven towards the downstream terminals and the volume of air discharged at the terminal index will rise. This does not affect the balancing procedure since each terminal being adjusted is related in turn with the index.</li> <li>• When all the terminals have been balanced on a sub-branch, each terminal</li> </ul>

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	<p>will be running with an equal percentage of the design flow rate, within the allowable tolerances.</p> <ul style="list-style-type: none"> <li>• The flow rates at each terminal must be measured and recorded. Once again a summation should be made to check that the total is in reasonable agreement with the measured sub-branch flow.</li> <li>• Test results shall be recorded in the approved test sheets and documents.</li> </ul>
9.5	<b>MECHANICAL AND ELECTRICAL 72-HOUR SYSTEMS ACCEPTANCE TEST :</b>
9.5.1	<ul style="list-style-type: none"> <li>• The purpose of the 72-hour systems test is to demonstrate that the overall system will function reliably and in accordance with the design documents.</li> <li>• Systems that are capable of producing trend logs for control points shall be utilized to produce these logs to record the status of temperature, pressure, humidity, etc., during the test. The points to be monitored will be determined by Contractor and Client.</li> <li>• The 72-hour test is a prerequisite to obtaining a notice of Substantial Completion for the mechanical, electrical, and control systems. Equipment and systems warranties shall begin with Substantial Completion and acceptance by Client.</li> <li>• Successful completion of the 72-hour test is a prerequisite to obtaining a notice of Substantial Completion for the mechanical, electrical, and control systems. Equipment and systems warranties shall begin with Substantial Completion and acceptance by Client.</li> <li>• All HVAC systems and associated control and alarm interlocks shall be operated for a period of 72 consecutive hours. During the 72-hour period, all systems shall function in a completely automatic mode without any equipment shutdown of malfunction. All systems shall operate to maintain design sequences and conditions.</li> <li>• Any system shutdown, malfunction, or deviation from design sequences during the 72-hour test will be cause to discontinue the test and restart after faults are corrected. Client will determine if a failure is severe enough to discontinue the test.</li> </ul>

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## PROFORMA FOR TEST RESULTS & NOTES ON TEST INSTRUMENTS AND CAPACITY COMPUTATIONS

S.No	Item	Test Results	
1.	Ambient conditions	D.B.Temp	- deg C
		W.B.Temp	- deg C
		% RH	
2	Compressors	R.P.M	
		Suction pressure	- kg / sq.cm
		Discharge pressure	- kg / sq.cm
		Oil pressure	- kg / sq. cm
3	Motors	R.P.M	
		Voltage	- Voltage
		Current	- amps
4	Fresh air intakes	Face area	-Sq.m
		Air quantity	- Cu.m/min
5	Room conditions at the working plane (No. of readings shall be taken and	Temperature	

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	averaged out)	D.B.	-deg C
		W.B.	-deg C
6	Controls	Function of each control shall be tested and report furnished	

**NOTES :**

**A. Test Instruments**

1. All instruments for testing shall be provided by the air conditioning contract.
2. Thermometers used for measurement of temperature of water/ refrigerant shall have graduation of 0.1 deg C and shall be got calibrated from N.P.L. or any recognized test house before hand
3. Thermometers used in the psychrometers shall have graduations of 0.2 deg C and shall be calibrated as at (2) above.
4. If due to any reason, internal load mentioned in the tender specifications is not available psychometric computations for actual load conditions will be done and the plant, if found satisfactory will be accepted.

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<b>TECHNICAL DATA SHEETS:</b>
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<b>10.0</b>	<b>TECHNICAL DATA SHEETS:</b>	
	<i>Scope: Scope of this section comprises of furnishing all the technical data of various equipments. Failure to furnish the data as schedule below will lead to rejection of the quote submitted by the vendor.</i>	
10.1.1	Minimum clearance required between machines	
10.1.2	Whether any platform or pedestal required. If yes, then what is the minimum height required?	
10.2.0	<b>COMPRESSOR</b>	
10.2.1	Manufacturer's Name	
10.2.3	Type of Compressor	
10.2.4	Model	
10.2.5	No. of compressor per machine	
10.2.6	Power consumption at design conditions, KW	
10.2.7	Minimum operating charge of refrigerant	
10.2.8	Country of Origin	
10.2.9	Refrigerant	
10.2.10	Capacity in Kcal/hr :	
10.2.11	Specific Power Consumption : KW/TR	
10.2.12	Condensing Temperature	
10.2.13	Evaporating Temperature	

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<b>TECHNICAL DATA SHEETS:</b>
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10.3.0	CONDENSER	
10.3.1	Type of fans	
10.3.2	Make :	
10.3.3	Model :	
10.3.4	Make of fan	
10.3.5	No of fans	
10.3.6	Fan dia	
10.3.7	Fan static pressure (mm Wg)	
10.3.8	Fan speed	
10.3.9	Power consumption of each fan (KW)	
10.3.10	Fan motor type	
10.3.11	Fan motor enclosure	
10.3.12	Fan motor ratings	
10.3.13	Air flow rate (CMH)	
10.3.14	Coil face area (Sq.Mtre)	
10.3.15	No. of rows	
10.3.16	Fin density - No. of fins/cm	
10.3.17	Material of tube	
10.3.18	Tube OD	

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<b>TECHNICAL DATA SHEETS:</b>
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10.3.19	No. of tubes	
10.3.20	Length of tubes	
10.3.21	Material of fin	
10.3.22	Overall weight (Kgs)	
10.3.23	Entering air (DB °C)	
10.3.24	Leaving air (DB °C)	
10.3.25	Design Ambient temp	
10.3.26	Qty of Condenser fans	
10.3.27	Air Flow per fan	
10.3.28	Motor kW per fan	
10.3.29	Type of Unit Horizontal/Vertical	
<b>10.4.0</b>	<b>Fan Section -AHU</b>	
10.4.1	Manufacturer	
10.4.2	Type of Fan	
10.4.3	No. of fans	
10.4.4	Air quantity : ( CFM )	
10.4.5	Total static pressure ( mm )	
10.4.6	Fan outlet velocity ( m/sec )	
10.4.7	Fan speed ( rpm )	
10.4.8	Fan motor ( hp )	
10.4.9	Fan wheel dia ( mm )	
10.4.10	Fan Efficiency - %	
10.4.11	Motor- BKW – Kw.	

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<b>TECHNICAL DATA SHEETS:</b>
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10.4.12	Fan Motor - KW	
10.4.13	Balancing (static and/or dynamic)	
10.4.14	External Static Pressure : MM of W.G	
10.4.15	Outlet velocity : M/Sec.	
10.4.16	Rated speed : R.P.M.	
10.4.17	B.H.P. : H.P.	
10.4.18	MOC of Impeller :	
10.4.19	MOC of Casing :	
10.4.20	Shaft dia :	
10.4.21	Drive : (V- Belts)	
10.4.22	Belt Guard provided : Yes / No	
10.4.23	Guaranteed Noise level of the Package unit:	
10.4.24	Drive Arrangement	
10.4.25	No of belts in case of belt drive	
10.4.26	Material and thickness of fan wheel and blade	
10.4.27	Materials and thickness of housing	
10.4.28	Fan outlet area ( sq . m )	
10.4.29	Type of bearing	
<b>10.5.0</b>	<b>Cooling Coil -AHU</b>	
10.5.1	Total heat cap. TR	
10.5.2	Air quantity through coil CFM	

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## TECHNICAL DATA SHEETS:

10.5.3	Tube material	
10.5.4	Tube O.D.	
10.5.5	Manufacturer :	
10.5.6	No. Quoted :	
10.5.7	Cooling Coil Performance	
10.5.8	Cooling Capacity SH/TH : Kcal/Hr.	
10.5.9	Evaporating temperature :	
10.5.10	No. of rows :	
10.5.11	No. of circuits :	
10.5.12	Heat transfer area (air side/ Ref side) :	
10.5.13	Coil Face Area :	
10.5.14	Tube thickness	
10.5.15	Fin material	
10.5.16	Fin thickness	
10.5.17	No. of fins/inch	
10.5.18	Entering air temperature.DB.	
10.5.19	Entering air temperature.WB.	
10.5.20	Leaving air temperature. DB	
10.5.21	Leaving air temperature.WB	
10.5.22	Apparatus Dew Point	
10.5.23	Bypass factor	
10.5.24	Face area Sq.Ft.	

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## TECHNICAL DATA SHEETS:

10.5.25	No. of rows deep	
10.5.26	Drain sizes & end connection	
10.5.27	Air side pressure drop	
10.6.0	<b>Filter Section ( AIR FILTER )-AHU</b>	
10.6.1	Manufacturer	
10.6.2	Type	
10.6.3	Gross Filter area ( Sq.ft. )	
10.6.4	Thickness ( mm )	
10.6.5	Size :	
10.6.6	No. quoted :	
10.6.7	Pre-Filters Performance	
10.6.8	Capacity : Cu.M/hr.	
10.6.9	Face velocity : m/sec.	
10.6.10	Pressure drop (clean) : mm W.G	
10.6.11	Pressure drop (dirty) : mm W.G	
10.6.12	Efficiency %	
10.6.13	Velocity through filter ( fpm )	
10.6.14	Filter media	
10.6.15	Frame work material	
10.7.0	<b>MOTORS :</b>	
10.7.1	Manufacturer	
10.7.2	Model	
10.7.3	Motor HP	

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<b>TECHNICAL DATA SHEETS:</b>
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10.7.4	Type and frame reference	
10.7.5	Class of Insulation	
10.7.6	Electrical Characteristics	
10.7.7	Starting Current (Amps)	
10.7.8	Full Load Current (Amps)	
10.7.9	Motor Speed RPM	
10.7.10	Method of Starting	
10.7.11	Starter manufacturer	
10.7.12	Rated output HP	
10.7.13	Range of working voltage (V)	
10.7.14	Rated output (KW)	
10.7.15	Type of bearing	
10.7.16	Temperature rise	
10.7.17	Degree of protection	
<b>10.8.0</b>	<b>INSULATION :</b>	
10.8.1	Insulation material	
10.8.2	Name of manufacturer	
10.8.3	Trade name	
10.8.4	Type	
10.8.5	Density, Kg/Cum	

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<b>TECHNICAL DATA SHEETS:</b>
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10.8.6	Insulation thickness	
10.8.7	Type and material of vapour seal	
10.8.8	Insulation application procedure	
10.8.9	Duct Acoustic Lining materials	
10.8.10	Duct insulation Material	
10.8.11	Thermal Conductivity	
10.8.12	Density	
10.8.13	"K" value at 10 deg C mean temperature	
10.8.14	Thickness	
<b>10.10.0</b>	<b>ENERGY RECOVERY VENTILATOR</b>	
10.10.1	Make	
10.10.1	Model	
10.10.2	Supply air flow – CMH	
10.10.3	Supply Duct connection – mm	
10.10.4	Exhaust air flow – CMH	
10.10.5	Exhaust duct connection – mm	
10.10.6	Supply blower – watts	
10.10.7	Return blower – watts	
10.10.8	Bed drive motor – watts	

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**TECHNICAL DATA  
SHEETS:**

10.10.9	Power consumption at rated air flow –W	
10.10.10	Noise level –dbA	
10.10.11	Dimensions – mm ( L X W X H )	
10.10.12	Approx shipping weight – kg	
10.10.13	AC power source	
10.10.14	Efficiency --%	

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## TEST READINGS:

<b>11.0</b>	<b>TEST READINGS :</b>	
	<i>Scope: The following minimum readings shall be taken after commissioning and balancing of the complete Air Conditioning System. From the test readings the equipment capacities shall be computed and the quoted capacities should be established. Any discrepancies found out should be rectify free of cost. The Air conditioning Plant will be taken over by the Owner only after successful completion of the above.</i>	
11.1.0	COMPRESSOR	
11.1.1	Suction Pressure - Kg / sq.cm. :	
11.1.2	Suction Temperature - deg C :	
11.1.3	Discharge Pressure - Kg / sq.cm :	
11.1.4	Discharge Temperature - deg C :	
11.1.5	Condensing Temperature - deg C :	
11.1.6	Voltage - volts / Current A / Power kW :	
11.1.7	Computed compressor capacity based on the above operating parameters and compressor rating charts :	
<b>11.2.0</b>	<b>AIR- COOLED CONDENSER</b>	
11.2.1	Entering air temperature - deg C :	
11.2.2	Leaving air temperature - deg C :	
11.2.3	Air flow as measured through condenser coil : LPM	
11.2.4	Calculated condenser heat rejection from the above	

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## TEST READINGS:

11.3.0	<b>EVAPORATOR COIL</b>	
11.3.1	Entering air dry bulb temperature - deg C	
11.3.2	Entering air wet bulb temperature - deg C	
11.3.3	Leaving air dry bulb temperature - deg C	
11.3.4	Leaving air wet bulb temperature - deg C	
11.3.5	Air flow rate across cooling coil - CMH :	
11.3.6	Calculated coil capacity Kcal / hour :	
11.3.7	Fresh air flow rate - CMH :	
11.3.8	Fan motor current - Amps :	
11.3.9	Power consumed by fan motor - KW :	
11.4.0	<b>INSIDE CONDITIONS :</b>	
11.4.1	Dry bulb and RH readings at every 10 sqmtrs of conditioned area shall be recorded and tabulated. This shall be carried out using digital temp. & Humidity measuring instruments. :	
11.5.0	<b>ELECTRICALS :</b>	
11.5.1	Name Plate details of all motors and the equipment being serviced by the motor. :	
11.5.2	Starter type, make & model for each motor :	
11.5.3	Back-up fuse rating and model used for each motor :	

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## TEST READINGS:

11.5.4	Over load relay type model and setting details of each motor. :	
11.6.0	<b>ENERGY RECOVERY VENTILATOR</b>	
11.6.1	Name Plate details of all motors and the equipment being serviced by the motor. :	
11.6.2	Fresh air flow rate - CMH :	
11.6.3	Exhaust air flow rate - CMH :	
11.6.4	Fresh Air temperature  Inlet – DB/WB Deg C  Outlet – DB/WB Deg C	
11.6.5	Exhaust Air temperature  Inlet – DB/WB Deg C  Outlet – DB/WB Deg C	
11.6.6	Heat recovered - kW	
11.6.7	Efficiency - %	
11.6.8	Noise level – dbA	
11.6.9	Power consumption-Watts	

*The above test readings shall be duly documented and submitted as a bound volume along with O&M manual together with as-built drawings. This manual shall be submitted in four copies viz., three copies to the Owners and one copy to the Consultant which could be utilized for future reference for service purposes*

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