

# **TECHNICAL SPECIFICATIONS**

## **HVAC-**

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## **GENERAL SPECIFICATIONS**

### **INTRODUCTION**

#### **Scope**

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

- ii) VRV/ VRF type Air-conditioning System
- vi) Mechanical ventilation system :
  - a) General Ventilation

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

These General Specifications are subject to revision from time to time.

Each air-conditioning work has its own particular requirements. These General Specifications shall be supplemented with tender specifications as may be required for a particular work. The tender specifications, wherever they differ from these General Specifications, shall have over-riding value and shall be followed for that particular work.

#### **Related Documents**

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

#### **Terminology**

The definition of terms used in these specifications shall be in accordance with IS: 3615- —Glossary of terms used in refrigeration and air-conditioningll.

#### **Site Information**

The tenderer should, in his own interest, visit the site and familiarise himself with the site conditions before tendering. For any clarification, tenderer may discuss with the Engineer-in-Charge.

#### **Heat Load Calculations and Equipment Selection**

- i) The successful bidder/ contractor should give detailed heat load calculations , immediately after award of work separately for all the seasons in which, the specified conditions are to be maintained.
- ii) The equipment selection and duct design shall be made on the basis of the above heat load calculations wherever required.
- iii) The Contractor can refer and utilize the design done by the department/ consultants for the department, however, there shall be no commitment to provide the same to the contractor, nor the contractor shall be absolved of the responsibility of correct design and performance of the air-conditioning system provided by him.
- iv)

#### **CONFORMITY WITH STATUTORY ACTS, RULES, STANDARDS AND CODES**

- i) All components shall conform to relevant Indian Standard Specifications, wherever existing, amended to date. A list of such standards is appended in Appendix `B`.
- ii) **All works shall conform to National Building code as well as relevant BIS codes.**
- iii) All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 2003 and Indian Electricity Rules, 1956 amended to date. They shall also conform to CPWD General Specifications for Electrical works, Part-I: Internal, 2013 and Part-II: External, 1994 and Part IV (Sub-station), 2013, as amended to date.
- iv) **All components shall conform to Energy Conservation Building Code 2007 of India as amended or revised up to date. 1.3 SAFETY CODES AND LABOUR REGULATIONS**
  - i) All the safety procedures outlined in the safety codes listed in Appendix `C` shall be complied with.
  - ii) In respect of all labour employed directly or indirectly on the work for the performance of the air conditioning contractor's part of work, the contractor at his own expense, will arrange for the safety provisions as per the statutory provisions, B.I.S recommendations, factory act, workman's compensation act, CPWD code and instructions issued from time to time. Failure to provide such safety requirements would make the tenderer liable for penalty as provided in the labour laws/ GCC for each violation. In addition the Engineer-in-charge, shall be at liberty to make arrangements and provide facilities as aforesaid and recover the cost from the contractor.
  - iii) The contractor shall provide necessary barriers, warning signals and other safety measures while laying pipelines, ducts cables etc. or wherever necessary so as to avoid accident. He shall also indemnify CPWD against claims for compensation arising out of negligence in this respect. Contractor shall be liable, in accordance with the Indian Law and Regulations for any accident occurring due to any cause. The department shall not be responsible for any accident occurred or damage incurred or claims arising there from during the execution of work. The contractor shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the contractor due to the above provisions thereof.

#### **WORKS TO BE ARRANGED BY THE DEPARTMENT**

Unless otherwise specified in the tender documents, the following works shall be arranged by the Department:

- (i) Space for accommodating all the equipment and components involved in the work,
- (ii) False ceiling and/ or return air enclosure excluding return air duct wherever provided as required,
- (iii) Make up water tank for condenser water,
- (iv) Masonry ducts/ service trench within and outside the building for carrying pipe lines and cables wherever specified.
- (v) If top floor is air conditioned, over-deck insulation.
- (vi)

#### **WORKS TO BE DONE BY THE CONTRACTOR**

Unless otherwise mentioned in the tender documents, the following works shall be done by the contractor and therefore, their cost shall be deemed to be included in their tendered cost whether specifically indicated in the schedule of work or not: -

- i) Foundations for equipment including foundation bolts and vibration isolation spring/ pads,
- ii) Support columns and beams for cooling towers,
- iii) Suspenders, brackets and floor/ wall supports for suspending/ supporting ducts and pipes,
- iv) Suspenders and/ or cable trays for laying the cables
- v) Excavation and refilling of trenches in soil wherever the pipes are to be laid directly in ground, including necessary base treatment and supports,
- vi) Sealing of all floor slab/ wall openings provided by the Department or contractor for pipes and cables, from fire safety point of view, after laying of the same,
- vii) Painting of all exposed metal surfaces of equipment and components with appropriate colour  
viii) Making openings in the walls/ floors/ slabs or modification in the existing openings wherever provided for carrying pipe line, ducts, cables etc.
- viii) Providing wooden/ metallic frames for fixing grills/ diffusers.
- ix) Making good all damages caused to the structure during installation and restoring the same to their original finish.
- x) Balancing of all HVAC systems in accordance with generally accepted engineering standards. A written balance report shall be provided (wherever asked for) to the Engineer-in-Charge or his representative for HVAC systems serving zones with a total conditioned area exceeding 500m<sup>2</sup>.
- xi) A set of three copies of operations manual shall be provided to the Engineer-in-Charge or his representative containing following information at a minimum
  - a) HVAC equipment capacity,
  - b) Equipment operation and maintenance manuals,
  - c) HVAC system control maintenance and calibration information, including wiring diagrams, schedules, and control sequence descriptions,
  - d) A complete written narrative of how each system is intended to operate.

#### **QUALITY OF MATERIALS AND WORKMANSHIP**

- i) The components of the installation shall be of such design so as to satisfactorily function under all conditions of operation.
- ii) The entire work of manufacture/ fabrication, assembly and installation shall conform to sound engineering practice. The entire installation shall be such as to cause minimum transmission of noise and vibration to the building structure.
- iii) All equipment and materials to be used in work shall be manufactured in factories of good repute having excellent track record of quality manufacturing, performance and proper after sales service.
- iv) None of the equipment/ machines supplied shall be more than Six months old from date of supply at site, Copy of Excise Gate Pass/ Invoice/ Shipment /Custom Clearance certificate/ details (in case of Imported equipment) shall be submitted to prove the date of manufacture & genuineness of the equipment/ machines supplied.

### **CARE OF THE BUILDING**

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

### **GUARANTEE**

- i) The contractor shall guarantee the complete system to maintain the specified conditions under all conditions of ambience and internal loads subject to the condition that designed outside conditions & designed internal loads are not exceeded. Also the inlet/ outlet temperatures at the specified flow of water in the chiller unit shall be guaranteed.
- ii) All equipment shall be guaranteed for a period of 12 months from the date of acceptance and taking over of the installation by the Department against unsatisfactory performance and/or breakdown due to defective design, material, manufacture, workmanship or installation. The equipment or component or any part thereof so found defective during the guarantee period shall be repaired or replaced free of cost to the satisfaction of the Engineer-in-Charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk & cost of the contractor. The decision of Engineer-in-Charge in this regard shall be final.
- iii) Any leakage of refrigerant and/or oil due to defective design, manufacture, workmanship or installation during the guarantee period shall be made good by the contractor free of charge.

### **PAYMENT TERMS**

The following percentage of contract rates shall be payable against the stages of work shown herein:

S.No.	Stage of work	Machinery & Equipment	All other items
I	After initial inspection (wherever specified) & delivery at site in good condition on pro-rata basis	80%	70%
II	On completion of pro-rata installation	10 %	20 %
III	On commissioning and completion of successful running in period	5 %	5 %
IV	On completion of major seasonal test	5 %	5 %

When the major seasonal test cannot be carried out on commissioning of the installation due to any reason not attributable to the contractor, the installation will be handed over to the Department for beneficial use after completion of successful running in test of 7 days subject to a minimum aggregate of 120 hours as per para 1.15 above. The balance payment shall be released to the contractor on his furnishing a bank guarantee in the specified format from a scheduled bank for an equivalent amount. The bank guarantee shall be valid for a period of 6 months. However it will be extended till the successful completion of the major seasonal test. This bank guarantee shall be independent of the one furnished for performance guarantee.

The following shall be considered major seasonal test for the purpose of the above payment terms: -

- a) Air-conditioning system : Summer or monsoon
- b) Central heating system : Winter

## **TENDER DRAWINGS, DRAWINGS FOR APPROVAL & COMPLETION DRAWINGS**

### **Tender Drawings**

The drawings appended/ uploaded with the tender documents are intended to show the areas to be conditioned, space allotted for various equipment, tentative duct, cable and pipe routes. The equipment offered shall be suitable for installation in the spaces shown in these drawings.

The contractor shall prepare & submit three sets of hard copy & one Digital/ soft copy in AutoCAD format of following drawings and get them approved from the Engineer-in-Charge before the start of the work. The approval of drawings however does not absolve the contractor not to supply the equipment/ materials as per agreement, if there is any contradiction between the approved drawings and agreement.

- i) Lay out drawings of the equipment to be installed in various rooms
- ii) Drawings including section, showing the details of equipment including their foundations etc.
- iii) Plumbing drawings showing the layout of entire piping, dia & length of pipes, valves and isometric drawings showing connections to various equipment.
- iv) Ducting drawings showing sizes, locations of dampers, grilles & diffusers.
- v) Electrical wiring diagrams for all electrical equipment and controls including the sizes and capacities of the various cables and equipment,
- vi) Dimensioned drawings of all electrical and control panels,

- vii) Drawings showing the details of all insulations and vapour barrier works,
- viii) Drawings showing details of supports for pipes, cable trays, ducts etc.
- ix) Any other drawings relevant to the work.

The department shall, at its discretion, use the soft copy of such drawings to prepare and examine the integrated services layout, resolve conflicts, and advise the contractor to modify the execution drawings suiting & adjusting to all the services requirements. The contractor shall be bound to modify & execute accordingly.

### **Completion Drawings (Not applicable in case of Window and Split AC)**

One set of Digital/ soft Copy and one set of the following laminated drawings shall be submitted by the contractor while handing over the installation to the Department. Out of this one of the sets shall be laminated on a hard base for display in the A.C. plant room. In addition one set will be given on compact disc.

### **AFTER SALES SERVICES**

The contractor shall ensure adequate and prompt after sales service in the form of maintenance, spares and personnel as and when required and shall minimise the breakdown period. In case of equipment supplied by other manufacturers the firm shall furnish a guarantee from the manufacturer for the same before the plant is taken over.

### **INTRODUCTION TO VRV/ VRF SYSTEM :**

In a generalising definition, Variable refrigerant flow (VRF) can be explained as a multiple Split Air-conditioning system using principle of control of flow/ quantity of refrigerant through the Indoor Unit to control the cooling/ heating effect. VRF system uses refrigerant as the cooling and heating medium. This refrigerant is compressed and liquefied by a single outdoor condensing unit (ODU), and is circulated within the building through copper refrigerant pipes to multiple fan-coil units (FCUs) called the IDUs ( Indoor Units).

VRF ODUs are typically provided with rectifier-inverter power system, which provided a Variable Voltage & Variable Frequency (V3F) supply to compressor motor, in order to support variable speed. This in turn provides variable refrigerant flow through the refrigerant lines meeting the demand of cooling/ heating. The speed of the motor is controlled through a feedback system sensing the refrigeration demand from the IDUs. VRFs come in two system format, two pipe and three pipe systems. In a 2 pipe system all of the zones must either be all in cooling or all in heating. A three pipe Heat Recovery (HR) systems has the ability to heat certain zones while others require cooling. In this case the heat extracted from the zone requiring cooling is put to use in the zone requiring heating. This is made possible because the heating units are functioning as a condenser.

### **APPLICATIONS:**

These systems are basically extensions of split type A.C's and are much less efficient as compared to central A.C. plant hence should not be provided except in following casesi.

In the existing building, requiring central AC but the space for providing AC plant, height of ceiling for ducting, water supply for chilled water based AC plant, is not available. It is not possible to provide central A.C. plant and run the chilled water lines up to cool the rooms with fan coil units to cool the rooms. Such system is normally provided where high diversity in demand is available i.e. small Guest houses, small hotels, small offices, Art Galleries, etc.



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