



सत्यमेव जयते

भारत सरकार  
रेल मंत्रालय**GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS**अनुसंधान अभिकल्प एवं मानक संगठन  
रेल मंत्रालयRESEARCH DESIGNS AND STANDARDS ORGANISATION  
MINISTRY OF RAILWAYS**IS/RDSO-PSE/----:20--**विभिन्न रेलवे प्रतिष्ठानों पर उच्च मात्रा में कम गति वाले पंखे लगाने के लिए  
तकनीकी विनिर्देशTECHNICAL SPECIFICATION FOR HIGH VOLUME LOW SPEED FAN  
TO BE INSTALLED AT VARIOUS RAILWAY INSTALATIONS

SN	Amendment		Revision		Reason
	Number	Date	Number	Date	
-					First issued as per Rly Bd letter no.

**Approved By****PED/PS & EMU**

Prepared by: SSE/EM	Checked by: Director/EM	Verified by: ED/PS
------------------------	----------------------------	-----------------------

**INDEX**

<b>S. N.</b>	<b>ITEM</b>	<b>PAGE No.</b>
1.	FOREWORD	
2.	SCOPE	
3.	SCOPE OF WORK	
4.	APPLICABLE STANDARDS	
5.	OPERATING CONDITIONS (SERVICE CONDITIONS)	
6.	<b>GENERAL REQUIREMENTS</b>	
7.	SYSTEM DETAILS	
8.	DESIGN CRITERIA & SUBMITTALS	
9.	TESTING & INSPECTION	
10.	WITHDRAWAL OF APPROVAL	
11.	INSTALLATION & COMMISSIONING	
12.	LABELLING & MARKING	
13.	PACKING, SHIPPING & DELIVERY	
14.	ON-SITE SUPPORT TO CONTRACTOR	
15.	WARRANTY	
16.	AFTER SALES SERVICE	
17.	MAINTENANCE	
18.	TRAINING	
19.	OPERATION & MAINTENANCE MANUAL	
20.	QUALITY ASSURANCE	
21.	Annexure-1: PERFORMA TO BE FILLED IN BY PURCHASER	
22.	Annexure-2: DETAILED TESTING AND INSPECTION PLAN	
23.	Annexure-3: TYPE, ROUTINE & ACCEPTANCE TEST	

Prepared by:

SSE/EM

Checked by:

Director/EM

Verified by:

ED/PS

## **TECHNICAL SPECIFICATION FOR HIGH VOLUME LOW SPEED FAN FOR INDIAN RAILWAYS**

### **1. Foreword**

This specification defines the objectives, guidelines and requirement for the design, manufacture, supply, installation, testing and commissioning of High Volume Low Speed (HVLS) fan at Railway Stations, Offices, Workshops and Sheds etc. of Indian Railways (IR). Indian Railways, is in process to procure and install High Volume Low Speed fans at their Railway stations and other installations. During summer season the HVLS fan should be able to produce ample air in line with comfort of human beings.

### **2. Scope of Specification**

The specification covers design, manufacture and supply at site, installation, testing and commissioning of HVLS fans to be provided at Railway Installations including Railway Stations, Offices, Workshops, Sheds etc.

The contractor shall take necessary measures while designing, manufacturing and installing such HVLS fan so that ingress of water or dust shall not deteriorate the performance and reliability of HVLS fan and the finish/properties/strength of the exposed parts.

### **3. Scope of work**

#### **3.1 Contractor's scope of work**

3.1.1 The contractor's scope of work shall include but not be limited to the following works:

- (i) Provision of HVLS fan.
- (ii) Transportation of material and equipment for installation purpose.
- (iii) Spare parts, special tools, testing and diagnostic equipment and measuring instruments (if asked for in the tender).
- (iv) Training.
- (v) Documentation.
- (vi) Control and monitoring system for fan.
- (vii) Maintenance for specified period.
- (viii) Services.

3.1.2 The contractor will interface and co-ordinate with the Railway and its agency(ies) undertaking the site preparation works. The complete responsibility of interfacing and co-ordination shall be of the contractor till final commissioning and handing over of the HVLS fan to the Railways.

#### **3.2 Railways' scope of work**

As for site preparation works (civil and electrical), with the exception of items of works specifically kept under contractor's scope by this specification, all the other works will automatically fall under railways' scope. The site preparation works to be undertaken by railways may

Prepared by:  SSE/EM	Checked by:  Director/EM	Verified by:  ED/PS
----------------------------	--------------------------------	---------------------------

typically include:

- i) All associated civil works for providing HVLS fan.
- ii) Provision of earthing pits for achieving an earth resistance of maximum 5.0  $\Omega$ .
- iii) LT power supply for the HVLS fan.
- iv) This is absolutely essential for minimizing the chance of seepage water running into the HVLS fan.

#### 4. Applicable standards:

IS 302-1:2008	Safety of household and similar electrical appliances
IS 302-2:2017	Household and similar electrical appliances-Safety
AMCA 230-15	Test standard for HVLS fans and other circulation products
IS 15999:2021/IEC 60034: Part – 1: RLV 2022	Rotating electrical machines - Rating and performance
IS 15999:2011 Part 2 /IEC 60034: Part – 2-1: 2014	Rotating electrical machines - Standard methods for determining losses and efficiency from tests (excluding machines for traction vehicles)
BS EN 61000-6-3: 2021	Electromagnetic compatibility (EMC) - Generic standards - Emission standard for residential, commercial and light-industrial environments
BS EN 61000-6-1:2019	Electromagnetic compatibility (EMC) - Generic standards - Immunity for residential, commercial and light-industrial environments
IS 3043:2018	Code of Practice for Earthing
IS/IEC 60947-4-1:2018	LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR - PART 4 CONTACTORS AND MOTOR-STARTERS - SECTION 1 ELECTROMECHANICAL CONTACTORS AND MOTOR-STARTERS
IS/IEC 60947-5-1:2018	LOW-VOLTAGE SWITCHGEAR AND CONTROLGEAR - PART 5 CONTROL CIRCUIT DEVICES AND SWITCHING ELEMENTS - SECTION 1 ELECTROMECHANICAL CONTROL CIRCUIT DEVICES
IS 732: 2019	CODE OF PRACTICE FOR ELECTRICAL WIRING INSTALLATIONS
IS 1573 :1986	Specification for electroplated coatings of zinc on iron and steel.
IS 6911: 2017	Stainless steel plate, sheet and strip-specification
ASTM A576: 2000	Standard Specification for Steel Bars, Carbon, Hot-

Prepared by: SSE/EM	Checked by: Director/EM	Verified by: ED/PS
------------------------	----------------------------	-----------------------

	Wrought, Special Quality
IS 14700 (Part 3 Sec-2)-2020	Electromagnetic Compatibility (EMC)
IEC 60228:2004	Conductors of insulated cables
IEC 60502-1:2021	Power cables with extruded insulation and their accessories
IEC 60332 Parts 1: 2004	Tests on electric and optical fibre cables under fire conditions - Part 1: Test for vertical flame propagation for a single insulated wire or cable
IEC 60332 Part 3:2018,	Tests on electric and optical fibre cables under fire conditions - Part 3: Test for vertical flame spread of vertically-mounted bunched wires or cables
IS 302-2-80:2017	Household and similar electrical appliances -safety part 2-80: Particular requirements for fans.

The latest update of the above standards or their equivalent shall be applicable.

## 5. OPERATING CONDITIONS (SERVICE CONDITIONS)

The equipment shall be sturdy and suitable for the following service conditions to be normally met in service:

Ambient Temperature	+10°C to +50°C
Humidity	Relative humidity: 40% to 95%
Altitude	Max 1,200 meters above sea level (1,800 meters for J&K area)
Atmosphere	Extremely dusty and desert weather and desert terrain in certain areas. The dust content in air may be as high as 1.6mg/m <sup>3</sup> . During dry weather, the atmosphere is likely to be full of dirt and dust. The rainfall can be fairly heavy.
Coastal area	The equipment shall be designed to work in corrosive atmosphere. Stations in coastal areas have continued exposure to salt laden air.
Power supply	Three phase 400 Volt $\pm$ 10 % or single phase 230Volt $\pm$ 10%, 50 Hz $\pm$ 3%

## 6. General Requirements:

- 6.1 The HVLS fan is required to produce ample air in line with comfort of human beings. HVLS fan should be capable of operating safely, smoothly and continually in both directions.
- 6.2 The HVLS fan shall be such that the air produced by it should cover the entire space of that particular area (hall/room).
- 6.3 The HVLS fan should serve the purpose of providing appropriate higher level of air required for human being's comfort. It is intended that the HVLS fan shall be powered up by a switching device.
- 6.4 Fan should be of gearless technology with silent operation & zero

Prepared by: SSE/EM	Checked by: Director/EM	Verified by: ED/PS
------------------------	----------------------------	-----------------------

- maintenance feature. Sound Level at 100% Speed shall be <45dB measured at 3m directly below the fan.
- 6.5 Power factor of the complete system should be > 0.95.
- 6.6 In general, bolt, nuts, shims and other hardware should be zinc plated as per IS 1573 :1986. Fasteners visible to the public shall generally be of stainless-steel grade -304 as per IS 6911: 2017.
- 6.7 All contactors and safety switches shall conform to IS/IEC 60947-4-1:2018 & IS/IEC 60947-5-1:2018 respectively.
- 6.8 Safety related connectors and devices shall be of plug-in type which can be extracted without the use of a tool and shall be impossible to re-insert them incorrectly.
- 6.9 RCCB & MCCB should be provided in series for better protection.
- 6.10 Wiring should be done as per latest edition of IS 732: 2019 code of practice for electrical wiring installations.
- 6.11 Bearing should be maintenance free sealed type.

## 7. System details:

The HVLS fan shall comprise of all parts and accessories, which are necessary for its efficient operation, whether specifically mentioned or not. The key parts and accessories along with their functions and features are listed as follows:

### 7.1 Blades:

- 7.1.1 The fan shall be equipped with sufficient number of blades. The blades shall be of extruded aircraft grade aluminum alloy (as per IS: 8147: 1976, grade 6063 T6/6061 T6) with safety ring.
- 7.1.2 Blades shall be connected by means of min. two locking bolts per blades. The blades shall be connected to the hub and interlocked with zinc plated steel retainers. The entire assembly of blades shall be designed to match the airflow rate at maximum RPM.
- 7.1.3 Blades struts shall be of 1020 Low carbon steel material as per ASTM A576: 2000.
- 7.1.4 The surface of blades shall be treated with anode oxidation with a fluorocarbon paint processing.
- 7.1.5 The blade shall be aerodynamic profile with airfoil design.
- 7.1.6 **Fan size selection:**

The size of the fan required shall be decided by the purchaser as per the site conditions and in consultation with the manufacturer. However, it should be ensured that following minimum clearance are maintained:

- a) 1.5 D minimum from the centerline to walls and large obstructions all around.
- b) 0.8 D minimum from fan base to the floor or 15 feet whichever is greater.

D= Diameter of the fan.

Prepared by: SSE/EM	Checked by: Director/EM	Verified by: ED/PS
------------------------	----------------------------	-----------------------

## 7.2 Motor

- 7.2.1 The HVLS fan shall be equipped with a Switched Reluctance Motor (SRM) / Permanent Magnet Synchronous (PMS) motor designed for low-speed high torque applications.
- 7.2.2 The motor shall be suitable for operation on three phase 400Volt  $\pm$  10 % or single phase 230Volt  $\pm$  10%, 50 Hz  $\pm$  3% conforming to IS 12360:1988 Amendment no. 3 Feb. 2009.
- 7.2.3 Motor shall carry nameplate giving full details of its ratings and characteristics.
- 7.2.4 The motor shall have Class 'F' insulation with IP-55 protection and shall be designed for 110% of rated current.
- 7.2.5 The starting current of the system (motor + controller) shall not exceed 3.5 times rated current. The starting current characteristic and the speed/torque characteristic for different duty ranges shall be submitted for acceptance by the purchaser.
- 7.2.6 Provision shall be made to enable the speed to be checked at main Control cubicle.
- 7.2.7 The motor housing shall be of aluminum die cast and securely hold ten (10) removable Mild steel struts. The struts shall be designed with airfoil guides to ensure precision alignment.

## 7.3 Controller

- 7.3.1 System shall include a fan controller that shall be constructed using a factory programmed Variable Speed Drive (VSD) to minimize the starting and braking torques for smooth and efficient operation.
- 7.3.2 The VSD shall also result in minimize acceleration/ de-acceleration during the motor starting/ stopping for reducing/ limiting the starting current and the frictional wear and tear of the brake liner.
- 7.3.3 The VSD speed range of operation shall be from 20% to 120% for the system, with the actual minimum speed set as required to meet minimum ventilation and fan requirements.
- 7.3.4 Controller should be compatible for wide voltage range without any requirement of a Voltage Stabilizer.
- 7.3.5 The controller shall be designed in such a manner that generation of harmonics is minimal. OEM shall also provide suitable harmonics filters to eliminate harmonics. Ceiling limits for "total harmonics distortion" (THD) generated by motor and controller shall be as per IS 14700 (Part 3 Sec-2)-2020.
- 7.3.6 The controllers shall be housed in IP-55 protected, 1.5mm thick powder coated cabinet, lockable with a dedicated key.
- 7.3.7 The system shall have integral timers to turn the fans off after an adjustable amount of run time. Digital timers shall also have the ability to change the system from manual mode of operation to automatic mode of operation.
- 7.3.8 The controller shall have a digital LCD/LED display panel and user-friendly buttons for operation. The LCD/LED interface shall display all system faults and VSD operating parameters. Faults included shall

Prepared by:  SSE/EM	Checked by:  Director/EM	Verified by:  ED/PS
----------------------------	--------------------------------	---------------------------

be, high temp, low temp, missing sensor, broken sensor, fan over amperage condition etc.

- 7.3.9 The controller should be able to receive digital input from fire alarm panel and to switch off the fan in case of fire signal.
- 7.3.10 Wherever applicable all HVLS fans shall be interlocked to shut down immediately upon receiving a water-flow signal from the alarm system in accordance with the requirements of NFPA 72.
- 7.3.11 The controller shall be equipped with emergency stop push button to stop the fan in case of any emergency.
- 7.3.12 Fan Speed Control to be  $\pm 2$  rpm of the set speed.
- 7.3.13 Controllers shall be designed and tested for Electromagnetic Interference (EMI) emission and immunity as per BS EN 61000-6-3:2021 and BS EN 61000-6-1:2019 respectively.
- 7.3.14 The system should also offer a suitable interface port to connect the fan with SCADA system, whenever required.
- 7.3.15 Provision for sending SMS message to minimum 10 pre-specified phone numbers for identified unusual occurrences should be available in the controller.
- 7.3.16 Controller may be located near the HVLS fan or in Station control room as per requirement of Railway.

#### 7.4 Mounting

- 7.4.1 HVLS fan shall be mounted on safe and secure civil structure. The purchaser Railway will provide the details of mounting surface including load bearing capacity, vibration analysis etc. Clearance of Civil Engineering department is required for mounting surface.
- 7.4.2 The fan mounting system shall be designed for quick and secure installation. All components of mounting system shall be of welded construction using low carbon steel as per ASTM A576 and powder coated for appearance and resistance to corrosion.
- 7.4.3 Anti-vibration mounting shall be provided for installation of HVLS fan.
- 7.4.4 The fan mounting system shall be equipped with hardware not less than SAE (Society of Automobile Engineers) grade 8 for safe installation. The fan shall be equipped with an adjustable mounting arrangement.
- 7.4.5 The fan shall be equipped with a safety cord that provides an additional means of securing the fan assembly to the building structure conforming to IS 302-2-80:2017.
- 7.4.6 The fan shall include a safety cord attached to the end of ceiling attachment. The fan shall include minimum four (4) guy wires attached to the building structure to level and secure fan position. This should conform IS 302-2-80:2017. The fan shall include two guy wire per blade to prevent blade separation from the motor housing. Material of Guy wire shall be Stainless Steel.

#### 7.5 Performance of HVLS Fan:

Performance tests of HVLS fan shall be as per AMCA 230-15. Test report/certificate in this regard is required.

Prepared by: SSE/EM	Checked by: Director/EM	Verified by: ED/PS
------------------------	----------------------------	-----------------------



- a) **Air Delivery:** It is the volume of the air swept out by the fan in one minute. It is indicated by cubic feet per minute (CFM) or cubic meter per minute (m<sup>3</sup>/min).
- b) **Efficacy:** It is the measure of air flow in cubic feet per minute (CFM) per one watt(W) of electrical power used. Higher the value of CFM/W, the more efficient the fan is.
- c) The benchmarking values of air delivery and efficacy at the rated speed for the elected sizes of fans to be installed in Indian Railways are as following:

<b>Diameter (in feet)</b>	<b>Minimum CFM at rated RPM</b>	<b>Minimum CFM/W at rated RPM</b>
24	375000	300
20	275000	300
16	225000	275
12	135000	275
8	85000	155

- d) **Performance parameters at varying speed:** Up to 25% of rated speed, the efficacy of the fan shall not be less than the minimum efficacy as mentioned in above table.

## 7.6 Earthing Arrangement

All of the fan's equipment, structures and other metallic parts shall be effectively grounded by the contractor to the incoming earthing conductor to be provided by Railways. The earthing arrangements will be as per the standard practice conforming to IS-14665 and IS: 3043.

## 7.7 Cable Requirements

7.7.1 All electrical works and switchgear for the HVLS fan installation shall conform to Central Electricity Authority (Measures relating to safety and Electricity Supply) Regulations, 2010. (With latest amendment)

7.7.2 Cables to be used should comply with following requirements:

All cables except those within the enclosed controller shall comply with following requirements:

- i. Power and control cables shall be rated for 1100V and 600V grade respectively.
- ii. The conductor shall be of stranded conductor composed of plain annealed copper wire complying with IEC 60228:2004, Class 2.
- iii. The insulation shall consist of an extruded layer of cross-linked polyethylene complying with IEC 60502-1:2021.
- iv. The flame propagating criteria of US IEEE Standard 383, with a minimum test short circuit time of five minutes, in the IEEE Standard 383 test.
- v. IEC 60332 Parts 1: 2004 and Part 3:2018, Category B, tests on single and bunched cables under fire conditions.
- vi. Limiting Oxygen Index of at least 30, to ASTM D 2863.
- vii. A temperature index (TI) of 260°C to ASTM D 2863.

Prepared by: SSE/EM	Checked by: Director/EM	Verified by: ED/PS
------------------------	----------------------------	-----------------------

- viii. All insulation is to be moisture and heat resistant, with temperature ratings appropriate to the application conditions, and in no case lower than 90°C for continuous operation and 250 °C during short circuit condition (for 5 second).

7.7.3 Wiring should be done as per latest edition of IS-732:2019 code of practice for electrical wiring installations.

## 8. Design criteria and Submittals

8.1 The design shall generally meet the following criteria: -

- a) Application of state-of-the-art technology
- b) Service proven design
- c) Minimum life cycle cost
- d) Low maintenance cost
- e) Use of interchangeable, modular components
- f) Extensive and prominent labelling of parts, cable and wires
- g) Use of unique serial numbers for traceability of components
- h) High reliability
- i) Energy efficient
- j) System safety
- k) Adequate redundancy and factor of safety
- l) Fire and smoke protection (provision of smoke detectors, etc.)
- m) Use of fire-retardant materials
- n) Environment friendly
- o) Adherence to operational performance requirements
- p) Indigenization

## 8.2 Submittals

**A.** Every bidder must submit the following documents along with the offer for the scrutiny of tender committee:

- A.1 Typical general arrangement/ layout diagram.
- A.2 Clause-by-clause confirmation of compliance to/ deviation from this specification.

**B.** The contractor (successful bidder) will submit following drawings, designs, data and type test reports to the testing agency for approval during type test:

- B.1 Fully dimensioned layout in plan and elevation indicating component locations, structural supports, access spaces.
- B.2 Loads on supporting members, reaction points and loads. Contractor shall be responsible that these parameters are within safe limits and shall provide the supporting calculations.
- B.3 Type test reports of cables.
- B.4 Technical data of VVVF drive system, Main switch, Relays, contactors, sensors, safety devices & switches, push button and key switches.

Prepared by: SSE/EM	Checked by: Director/EM	Verified by: ED/PS
------------------------	----------------------------	-----------------------

- B.5 Layout of electrical system including motor, control panel; scheme for electrical grounding; control devices; control wiring diagram and sequence of operation, indicating interface connections.
  - B.6 Calculation for size selection of power cable, motor capacity selection.
  - B.7 Details of fire protection system.
  - B.8 EMI/ EMC compliance of controller.
- C.** *The contractor (successful bidder) will be required to submit following Operation and Maintenance Manuals to the purchaser and testing agency (one searchable soft copy and one hard copy per station):*
- C.1 Drawings, installation and maintenance instructions, and other data pertinent to the components used in HVLS fan systems, including detailed repair data for all components, including disassembly, inspection/ gauging/ torque requirements, inspection and testing schedules, reassembly, testing methods and other related information. Manuals shall cover all mechanical and electrical components, operating panels, controls and indicators. Exploded view drawings shall be included to facilitate repair and maintenance functions.
  - C.2 Bill of Materials (BOM) for each fan. The BOM will be a list of all assemblies, subassemblies and replacement components/ parts of the fan mentioning rating, make and model number. This detail will be required in the future for placing orders on the OEM for individual replacement parts and for other managerial purposes.
  - C.3 Detail of service centers and maintenance organization including contact details, qualification and number of employees.

### **8.3 Monitoring and Fault Diagnostic System**

- a. A microprocessor-based monitoring and fault diagnostic system to provide information on the operation, identification and display of all faults that have caused the fan to stop including emergency stops shall be provided. The system shall be able to record at least 1000 events in their order of occurrence and display them sequentially in a last in first out sequence.
- b. An alphanumeric display unit indicating the fault code and fault message shall be installed at an easily accessible and protected location.
- c. The display of the last fault can only be reset after the fault causing the stop is cleared but the historical record shall remain in the microprocessor.
- d. The system shall capture, display and retain this information related with faults in the controller memory.

## **9. TESTING & INSPECTION**

### **9.1 Type Testing**

- 9.1.1 For type testing of HVLS fan the Contractor shall submit a comprehensive type testing protocol that includes the requirements laid down in this specification to inspecting agency.
- 9.1.2 Further, the contractor shall submit the available type test reports in respect of tests listed in the protocol; these reports should pertain to

Prepared by:  SSE/EM	Checked by:  Director/EM	Verified by:  ED/PS
----------------------------	--------------------------------	---------------------------

the systems and sub-systems that are to actually form a part of fan to be supplied to IR. The contractor should also submit an action plan for carrying out the remaining type-tests.

## **9.2 Routine Testing**

- 9.2.1 At first, the Contractor shall submit a comprehensive routine testing protocol that includes the tests in the nature of routine tests as are mentioned in Annexure-3 of this specification and any other relevant tests, to inspecting agency for approval.
- 9.2.2 Routine testing entails tests and inspections that are conducted at the works of manufacturer and/or the works of its key sub-suppliers, as per the relevant standards.
- 9.2.3 The purchaser's representative/ inspection agency would have the right at its discretion, to witness routine Test(s) of the complete fan/ its Key Sub-assemblies, during the fan's manufacturing and/or accept the test results/ reports of their respective manufacturer's/ supplier's in-house quality control (reports should be furnished for systems and sub-systems that are to actually form a part of fans to be supplied to IR), as sufficient evidence of the execution of these routine tests.
- 9.2.4 At least 3 weeks' notice shall be given to the purchaser's representative/ inspection agency to be present for the routine testing and inspection.

## **9.3 INSTALLATION AND FINAL ACCEPTANCE INSPECTION/ TESTING**

After installation, the fan shall be tested by the Contractor in the presence of the purchaser's representative/ inspection agency. The important tests to be conducted are listed in Annexure-3 of this spec. for guidance. The test protocol will be submitted to RDSO for approval. After satisfactory completion of inspection/ testing, the purchaser's representative/ inspection agency will authorize the commissioning of the HVLS fan for public use by issuing the "HVLS fan installation final acceptance certificate".

## **10. WITHDRAWAL OF APPROVAL**

Approval granted to the Contractor is liable to be withdrawn in the event of noticing any major change at a later date in the design or major change from the Bill of material as approved earlier without seeking the Prototype approving authority or using any major Sub-assembly of inferior specification/ quality, thus compromising with the reliability.

## **11. INSTALLATION & COMMISSIONING**

- 11.1 All works at the installation site shall be carried out in accordance with the standard acceptable methods and practices of installation of fan and electrical equipment.
- 11.2 All equipment, sub-assemblies, structures etc. shall be installed as per its installation instructions.
- 11.3 Adequate care shall also be taken during installation of the complete fan to avoid damage to any equipment, sub-assembly or building structure.
- 11.4 Indian railways will be responsible for major civil work needed for installation and commissioning of fan at designated location. The Contractor will provide a terminal board near fan and Railways will

Prepared by:  SSE/EM	Checked by:  Director/EM	Verified by:  ED/PS
----------------------------	--------------------------------	---------------------------

provide electrical wiring and earthing (as per IS 3043:2018) up to this terminal board. Railways will provide site assembly area with proper power connection as per the extant rules.

**12. LABELLING AND MARKING**

- 12.1 All equipment and apparatus, inside or outside the switchboard, including instruments, meters and relays shall be labelled or marked adequately.
- 12.2 In addition, warning labels shall be fitted at all points, where the removal of covers/ panels may expose live equipment, operating above 50V between circuits or to earth and shall bear the inscription 'Danger- Live Parts' in red color that is clearly visible from a viewable distance.

**13. PACKING, SHIPPING AND DELIVERY**

- 13.1 All equipment shall be properly inspected before the Shipment. An inspection tag bearing the word "INSPECTED" or "PASSED" giving details of the inspection date, etc. shall be attached to the Packaged Consignment. All four sides of the packaged consignment shall contain details of the Consignee & Consignor.
- 13.2 Appropriate caution notices such as "Fragile" or "Handle with care" etc shall be displayed on the outside surface of the boxes, crates and packages.
- 13.3 The Contractor shall be responsible for the safe transportation and delivery of materials to the location, as specified by the purchaser.
- 13.4 Each HVLS fan should be equipped with all required accessories.

**14. ON-SITE SUPPORT TO CONTRACTOR**

- 14.1 The purchaser/ user railways would extend facilities on free-of-charge basis, to the Contractor for storing the product, installation, testing and commissioning equipment/tools/accessories, etc., at a suitable location, as close as possible to the installation site.

**15. WARRANTY**

- 15.1 The Contractor shall be responsible for any damage to equipment provided in the fan, due to defective design, materials, workmanship for a period as prescribed by purchaser. The Contractor shall attend to the complaint (including replacement of defective components, if required) within the time as prescribed by purchaser from the time of receipt of complaint at his own cost.
- 15.2 The period of warranty will be extendable in case of recurring problems of defective design, material or manufacturing. The Contractor shall warrant that everything to be furnished hereunder shall be free from all defects and faults in material, workmanship and manufacture and shall be of the highest grade and consistent with established and accepted standards of material of the type ordered and in full conformity with specifications and drawings. The Contractor's liability in this respect of any complaints, defects and /or claim shall be limited to furnishing and installation of replacement parts, free of any charge. The warranty clause in commercial agreement, if any, shall prevail.
- 15.3 The Contractor shall be responsible for carrying out all the modifications at his cost on any part of the equipment during the period of warranty required for satisfactory operation of the equipment as per technical

Prepared by:  SSE/EM	Checked by:  Director/EM	Verified by:  ED/PS
----------------------------	--------------------------------	---------------------------

- specification. For any technical decision the final authority will be consignee Railway.
- 15.4 All the replacements and repairs, that the purchaser shall call upon the Contractor to deliver or perform under this warranty, shall be delivered and performed by the Contractor promptly and satisfactory.
- 15.5 The warranty period would cover comprehensive maintenance inclusive of all spares, material and labour cost.
- 15.6 During warranty period, in case the HVLS fan become non-functional due to any manufacturing defect, then the HVLS fan would be considered under breakdown and the Contractor would be required to rectify the defects.
- 15.7 The consignee shall ensure that the records of breakdown are maintained on a shift basis.
- 15.8 The Contractor shall ensure that in case a failure is reported by a consignee, qualified Service Engineers shall visit the site within the time period as prescribed by purchaser. Complaints shall be lodged by consignee by fax, phone, e-mail or per bearer at address given by the Contractor.

## **16. AFTER SALES SERVICE**

- 16.1 The bidder shall indicate in the offer, the facilities available with the bidder or local agent for providing the required after sale service during warranty and post warranty periods. The bidder will also mention service organizations located in India and the availability of trained staff and maintenance spares etc.
- 16.2 The Contractor shall ensure that, in case a consignee reports a failure, qualified service engineers visit the site within the time period as prescribed by purchaser. Consignee shall log complaints by fax, e-mail or per bearer at address given by the Contractor. The responsibility to keep the current failure reporting address details will rest with the consignee.

## **17. MAINTENANCE**

- 17.1 The Contractor shall provide free-of-charge, maintenance service (and all the works specified) including required spares, for the specified warranty period.
- 17.2 During the guarantee period, the above maintenance service shall include all preventive, scheduled and corrective maintenance and additionally, all service-request calls made by the purchaser/ user railways.
- 17.3 For this, the Contractor would be required to provide a comprehensive maintenance and service plan, for review and acceptance by the purchaser or his authorized representative.
- 17.4 The maintenance work-system shall ensure safety of the personnel and equipment.
- 17.5 In the event of any failure, requiring design modifications, etc. in the HVLS fan, the Contractor shall undertake to submit its details for a review by the Purchaser or its authorized representative. On reaching consensus and post-modification, the Contractor shall undertake fresh testing and re-commissioning, if required.

Prepared by:  SSE/EM	Checked by:  Director/EM	Verified by:  ED/PS
----------------------------	--------------------------------	---------------------------

## 18. TRAINING PROGRAM

The Contractor shall fit in all training instructions/ demonstrations for correct operation and maintenance of the HVLS fan into a one-day self-contained training program. The training programme(s) will be held at contractors' head office or at any other location as agreed between Railway administration and the contractor.

### 18.1 Operators' Training

The Contractor shall provide the necessary Operators' Training to the Purchaser's authorized/ designated Staff as per the formal Training Program designed for this purpose. This shall enable them to carry out the normal/ rescue operations under normal/ emergency situations respectively as well as minor repairs by themselves.

### 18.2 Maintenance Training

The Contractor shall provide the necessary maintenance training to the purchaser's authorized/ designated Staff as per the formal Training program designed for this purpose. This shall enable them to perform minor and non-specialized maintenance of the HVLS fan.

## 19. OPERATION AND MAINTENANCE MANUALS

- 19.1 The Contractor shall provide operations and maintenance manuals, for the use by the supervisory, operating and technical staff of the purchaser.
- 19.2 Each manual shall be divided into indexed sections explaining the subject matter in logical steps. Soft copy of manuals should be in searchable PDF format. The soft copy should be such that if required by the Railways multiple copies can be made from the original soft copy of manual.
- 19.3 The operations manual shall contain the principle and operations' details of the HVLS fan under the normal and emergency conditions.
- 19.4 Details of the common faults that might occur in the HVLS fan &/or any of its key components/ sub-assemblies and their rectification shall also be included.
- 19.5 The maintenance manual shall contain the maintenance and servicing instructions for the HVLS fan along with explanatory notes and drawings as necessary.
- 19.6 The periodic maintenance schedule recommended by the Contractor for the satisfactory performance of the HVLS fan shall also be included.
- 19.7 A draft of operations and maintenance manual should be submitted to the purchaser for approval with regard to its completeness and comprehensiveness. The final version of operations and maintenance manual should be issued on the basis of purchaser's comments.
- 19.8 In any case, Operation and Maintenance manuals are to be supplied to railways well before final testing/ commissioning of HVLS fans.

## 20. QUALITY ASSURANCE

- 20.1 The Bidder shall prepare and furnish their QA plan documentation, as per their ISO: 9000 :2015 program being followed. It shall include and clearly mention the procedures ensuring that all equipment/ materials/

Prepared by:  SSE/EM	Checked by:  Director/EM	Verified by:  ED/PS
----------------------------	--------------------------------	---------------------------

systems & sub-systems are properly specified, designed, purchased, recorded, inspected, installed and tested at appropriate stages.

- 20.2 It shall also provide the confirmation that the handling, storage & delivery arrangements have been satisfactory.

\*\*\*\*\*

DRAFT

Prepared by: SSE/EM	Checked by: Director/EM	Verified by: ED/PS
------------------------	----------------------------	-----------------------



**ANNEXURE - 1****THIS PERFORMA MUST BE FILLED IN BY THE PURCHASER FOR EACH HVLS fan**

Name of the Railway Station/Building: .....

<b>S. No.</b>	<b>Description</b>	<b>Parameter</b>	<b>Information</b>
1.	Mounting ceiling details: a. RCC b. Truss (Refer cl. no. 7.4.1)	RCC/Truss	
2.	Area Coverage a. Length b. Width	Meter	
3.	Height of mounting.	Meter	
4.	Diameter of the HVLS fan required (Refer cl no 7.1.6)	Feet	
5.	Distance of controller from fan (Refer cl. no. 7.3.16)	Meter	
6.	Type of station (i.e. underground or over ground)	Underground/ over ground	

Prepared by:  SSE/EM	Checked by:  Director/EM	Verified by:  ED/PS
----------------------------	--------------------------------	---------------------------

**ANNEXURE - 2****DETAILED TESTING & INSPECTION PLAN**

<b>Type of Inspection/ Testing</b>	<b>Where</b>	<b>Frequency</b>	<b>When</b>	<b>On What</b>	<b>Who Conducts</b>	<b>Final Action</b>
Type Testing of complete Fan	Relevant manufacturer or supplier's works/ Third party	For each contract. For repeat contracts, if there is a design change or if reliability is below the target.	Latest before Commissioning of the first fan	Complete HVLS fan	Inspecting agency as per contract.	Inspecting agency will issue "type test clearance".
Type Testing of Sub-systems	Relevant manufacturer/ supplier's works/ - Third party	For each contract. For repeat contracts, if there is a design change or if reliability is below the target.	Latest before Commissioning of the first fan	Fan's key Sub-assemblies.	<ul style="list-style-type: none"> <li>- National/ International accredited testing Agency/ Lab.</li> <li>- Inspecting agency may accept certified copies of above Type Test certificates, in-lieu of actual Tests.</li> <li>- Inspecting agency may choose to be present himself to witness any test, at its own discretion.</li> </ul>	

Prepared by:

SSE/EM

Checked by:

Director/EM

Verified by:

ED/PS

Routine testing	Relevant manufacturer/ supplier's works	Each order and each fan	During manufacturing	Fan's Key Sub-assemblies	- Relevant contractor, by their in-house QC.	Inspecting agency will issue "fan's routine testing approval certificate".
Pre-dispatch verification of packing list	Fan Contractor's works	Offered dispatch Lot	Before dispatch of the complete HVLS fan to installation Site	Complete fan kit.	Purchaser's representative/ testing agency.	Inspecting agency will issue "Dispatch approval certificate".
Final acceptance inspection/ testing	At the installation site	Each order and each fan	After installation & commissioning of the complete fan & after all the above mentioned tests are satisfactorily completed.	Complete fan.	Contractor in presence of purchaser's representative/ testing authority.	Purchaser/ Inspecting agency will issues "final acceptance certificate".

Prepared by:

SSE/EM

Checked by:

Director/EM

Verified by:

ED/PS

**ANNEXURE-3****TYPE, ROUTINE & ACCEPTANCE TESTS****Part A1: Type Tests on Complete HVLS fan#**

1. One complete HVLS fan shall be made available for type testing. The selected HVLS fan shall be representative of the types to be supplied.
2. Complete HVLS fan system including drive system, in addition to the controller, enclosures, protection devices and mounting structures shall be assembled on a test rig to undergo comprehensive running and functional testing to verify compliance with the Specification.
3. The tests shall include the following minimum requirements:
  - a) Verification of the suitability of the drive system.
  - b) Measurement/ calculation of input voltage, current, frequency input electrical power, air flow rate(cfm), efficacy (cfm/watt) under various operating speeds. (Refer clause no. 7.5).
  - c) Verification of the fault indication and fault diagnosis features.
  - d) Verification of the construction of the control panels.
  - e) Complete functional tests on the isolating transformer and ripple filter, if provided.

# For certain tests, the type testing authority may choose to rely upon previous type test reports/conformance certificates, as long as they pertain to similar design and comparable rating. However, the manufacturer cannot demand this as a matter of right.

Prepared by:  SSE/EM	Checked by:  Director/EM	Verified by:  ED/PS
----------------------------	--------------------------------	---------------------------

**Part A2. Type Tests on HVLS fan Sub-systems#**

The type testing authority shall generally witness the following set of type tests for the purpose of safety verification (the list of tests can be enlarged, if required)

S. No.	Key Sub-Assy./ Part of HVLS fan	Frequency	Scope of Test
1.	Driving motor		<p><b>a.</b> Insulation test:</p> <ul style="list-style-type: none"> <li>i) Insulation resistance of windings using 1000V megger shall not be less than 200M Ohm.</li> <li>ii) Insulation resistance of thermistors subject to 1000V for 5 seconds shall not be less than 200M Ohm. Windings shall be earthed.</li> <li>iii) Main winding shall be pressure tested to 2000V r.m.s. for 60 seconds. During this test, thermistor wires shall be grounded to earth.</li> <li>iv) Cold resistance of windings shall be recorded before start of test.</li> </ul> <p><b>b.</b> Total harmonic distortion test</p> <p><b>c.</b> Dynamic test:</p> <ul style="list-style-type: none"> <li>i) No load current and speed shall be recorded at rated voltage and frequency for the windings.</li> <li>ii) Temperature rise test on full load shall be carried out on the windings. Voltage shall be 230V/400V as designed. Frequency shall be as rated.</li> <li>iii) Ambient temperature, casing temperature, input power voltage, and current shall be recorded at 15-minute intervals for the first two hours and 30-minute intervals subsequently until temperature levels off.</li> <li>iv) When the temperature has levelled off, the motor shall be switched off and the winding temperature rise shall be established using the resistance method as specified in IS 15999/IEC 60034-1.</li> <li>v) The voltage, current, power, efficiency, power factor vs. torque characteristics shall be drawn from the results obtained.</li> </ul> <p><b>d.</b> IS 15999/IEC60034 part -2-1:2014 compliance test certificate.</p>

Prepared by:  SSE/EM	Checked by:  Director/EM	Verified by:  ED/PS
----------------------------	--------------------------------	---------------------------

S. No.	Key Sub-Assy./ Part of HVLS fan	Frequency	Scope of Test
2.	Controller	1 unit of each type of controller	<p><b>a)</b> Physical construction check. The construction of the control cubicle shall be checked against the agreed drawings. Verification of the protection classification shall be conducted and/or provided.</p> <p><b>b)</b> High Voltage and other Tests:</p> <p>i) Earth leakage circuit breakers shall be tested on both poles. The current and time required to trip shall be recorded. Similarly, the DC earth leakage unit shall be tested and values should be recorded.</p> <p>ii) High Voltage testing at 2000V ac r.m.s. for 60 seconds between phase to phase and phase to earth.</p> <p>iii) Control wiring itself shall be pressure tested at 1,500V ac r.m.s. for 60 seconds between control/ auxiliary wiring and frame. Insulation tests shall be carried out before and after the above tests by a 1000V insulation tester. The insulation resistance thus measured shall not be less than 200M ohm.</p> <p>iv) All protection on electronic circuits shall be tested by a 500 V insulation tester. Wiring to all electronic components shall be meggered.</p> <p><b>c)</b> THD as per IS 14700-3-2:2020</p> <p><b>d)</b> EMC &amp; EMI compliance as per BS EN 61000-6-3:2021 and BS EN 61000-6-1:2019 respectively</p> <p><b>e)</b> Function of fire alarm system (cl. no. 7.3.9 of this specification)</p> <p><b>f)</b> Full functional test including SMS alert facility and Integration with SCADA system (cl. no. 7.3.14 &amp; 7.3.15 of this spec)</p> <p><b>g)</b> The controller should trip and stop the machine within 15 seconds if suddenly the motor current rises more than 200% of the rated current.</p>
3.	Environment tests on Control cards	1 unit of each type of control card	As per cl. no. 5 of the specification.

Prepared by: SSE/EM	Checked by: Director/EM	Verified by: ED/PS
------------------------	----------------------------	-----------------------

S. No.	Key Sub-Assy./ Part of HVLS fan	Frequency	Scope of Test
4.	Cables	-	Test certificates of each type of cable (cl. no. 7.7)
5.	IP protection for all applicable items	1 unit	Test certificate (cl. no. 7.2.6 & 7.3.6 of this spec)
6.	Over speed protection	1 unit	Test certificate
7.	Materials used	1 unit	Test certificate of blade & Strut's material (cl. no. 7.1.1 & 6.8 of this specification)
8.	Mounting structure	1 unit	Anti-fall protection, Anti-Vibration feature. (cl. no. 7.4.2 & 7.4.3 of this specification)
9.	HVLS fan (As per IS 302-2-80) tests after assembly.	1 unit	<ul style="list-style-type: none"> <li>i. Protection against access to live parts</li> <li>ii. Power input and current</li> <li>iii. Heating</li> <li>iv. Leakage current and electric strength at operating temperature</li> <li>v. Transient over voltages</li> <li>vi. Moisture resistance</li> <li>vii. Leakage current and electric strength</li> <li>viii. Overload protection of transformers and associated circuit</li> <li>ix. Endurance</li> <li>x. Abnormal operation</li> <li>xi. Stability and mechanical hazards</li> <li>xii. Mechanical strength</li> <li>xiii. Construction</li> <li>xiv. Internal Wiring</li> <li>xv. Components</li> <li>xvi. Supply connection and external flexible card</li> <li>xvii. Terminals for external conductors</li> <li>xviii. Provision for earthing</li> <li>xix. Screw and Connections</li> <li>xx. Clearances, creepage distance and solid insulation</li> <li>xxi. Resistance to heat and fire</li> <li>xxii. Resistance to rusting</li> <li>xxiii. Radiation, toxicity and similar hazards</li> </ul>
10.	Noise/ sound level	1 unit	<45db (as per cl. no. 6.4 of this spec)
11.	Reversible operation	1 unit	Functional test (cl. no. 6.1 of this specification)

Prepared by: SSE/EM	Checked by: Director/EM	Verified by: ED/PS
------------------------	----------------------------	-----------------------

<b>S. No.</b>	<b>Key Sub-Assy./ Part of HVLS fan</b>	<b>Frequency</b>	<b>Scope of Test</b>
12.	Visual checks	1 unit	It should be free from any defects and it should have good workmanship.

- # For certain tests, the type testing authority may choose to rely upon previous type test reports/conformance certificates, as long as they pertain to similar design and comparable rating. However, the manufacturer cannot demand this as a matter of right

DRAFT

Prepared by: SSE/EM	Checked by: Director/EM	Verified by: ED/PS
------------------------	----------------------------	-----------------------



**ANNEXURE - 3; contd...****Part B: Routine Tests**

<b>S. No.</b>	<b>Key Sub-Assy./ Part of HVLS Fan</b>	<b>Frequency</b>	<b>Scope of Test</b>
1.	Driving machines	Random	-- Insulation resistance of winding -- High voltage test (2kV for 1 min.) on the stator winding
		100%	-- Dynamic test for a period of 4 hours continuously without stopping, except for changing of direction, 2 hours in each direction, at rated speed and 25% load conditions. The test is to ensure that no undue vibration or abnormal temperature rise occurs in any component. -- Voltage rating, Current rating etc.
2.	Control panel	100%	-- The complete control cubicle shall be checked with a simulator to verify correct wiring connection and function of the electrical/ electronic devices. -- Insulation resistance of the control wiring and electronic components shall be conducted in accordance with the test protocol.
3.	Blade	100%	Dimensional check
4.	HVLS fan (as per IS 302-1:2008)	100%	i. Earth continuity test ii. Electric strength test iii. Functional test
5.	Visual check	100%	It should be free from any defects and it should have good workmanship

Prepared by:  SSE/EM	Checked by:  Director/EM	Verified by:  ED/PS
----------------------------	--------------------------------	---------------------------

**Annexure-3; contd...****Part C1: Acceptance checks (Site Checking and Inspection)**

A test and inspection protocol shall be prepared for acceptance test. Following are the minimum requirements:

- a) Erection of mounting structures and supporting wires.
- b) Positioning of machine equipment and control cubicles;
- c) Installation of wiring and cabling
- d) Earthing and bonding checks

**Part C2: Final Acceptance Inspection & Testing**

S. No.	HVLS fan's Parameter/ Feature to be Inspected/ Tested	Scope of Test
1.	Starting current, running current and supply voltage	Readings shall be taken at the rated speed of each HVLS fan.
2.	Power factor	>0.95 (As per cl. no. 6.5 of this specification)
3.	Emergency Power and Fire operation	In event of power failure and/ or fire, the fan should be off automatically. (cl. no. 7.3.9 & 7.3.10 of this specification)
4.	Communication facility test i.e. SMS alert facility & SCADA interfacing feature etc.	Functional tests
5.	Continuous running test	<b>Functional test:</b> Run for 12 hrs. continuously. Check for temperature of motor, any abnormal sound etc.
6.	Safety checks as per IS 302-2-80	i. Protection against access to live parts ii. Power input and current iii. Heating iv. Leakage current and electric strength at operating temperature v. Moisture resistance vi. Leakage current and electric strength vii. Provision for earthing
7.	Visual check	It should be free from any defects and it should have good workmanship.

**Note:** The contractor shall prepare comprehensive test protocols, integrating the requirements of this specification and obtain approval of inspecting agency for the same.

Prepared by:  SSE/EM	Checked by:  Director/EM	Verified by:  ED/PS
----------------------------	--------------------------------	---------------------------