GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

SPECIFICATION FOR MICROPROCESSOR BASED
CONTROL PANEL FOR AIR CONDITIONED COACHES
WITH ROOF MOUNTED AC PACKAGE UNIT

No. RDSO/PE/SPEC/ AC/ 0026 (Rev. ‘O’)- 2002

APRIL’ 2002

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SPECIFICATION FOR MICROPROCESSOR CONTROL FOR
AIRCONDITIONED COACHES WITH ROOF MOUNTED AC
PACKAGE UNIT

1.0 FOREWORD:

The present air-conditioning system on Railway coaches suffers from following dis-advantages.

1.1 The temperature inside the conditioned space is controlled based on measurement of the return air temperature at one location only due to which desired uniformity of temperature inside the coach is not ensured.

1.2 The thermostats provided for the purpose of temperature control are having only three distinct settings, which can’t be changed and have to be selected manually by operating a rotary switch.

1.3 The temperature in the conditioned space is controlled based on fixed selected thermostat settings without any relationship with humidity or requirement of air conditioning during different hours of day and night of journey, which does not ensure desired comfort level throughout the journey.

1.4 During winter a separate set of thermostats controls the temperature according to the setting of the thermostat which energizes the heater circuit.

1.5 There is no provision in the existing system to monitor the energy consumption in the coach by monitoring duty cycle of compressors and condenser motor to monitor the efficiency of the AC plant.

1.6 There is no fault diagnostic assistance for the operator in the existing system for efficient troubleshooting and isolation of any fault or defect.
1.7 The existing system does not give the most energy efficient performance under varying ambient and loading conditions as the system is not capable of responding differently under these conditions.

1.8 The existing system does not have a data logging system for recording various faults and defects for their subsequent analysis and necessary corrective actions.

1.9 As the existing system does not have provision for sharing of information between control units of air-conditioning systems of two coaches and so they are required to be monitored by individuals from individual coaches.

1.10 In existing air-conditioning control system it is not possible to restrict the combined maximum electrical load of a number of AC coaches within predefined limits as per the generating capacity of power cars as sometimes required for EOG trains.

2.0 **SCOPE:**

2.1 To overcome the disadvantages indicated above, it is proposed to develop Microprocessor control of Roof Mounted AC package unit of AC coaches.

2.2 The development of system has been divided in two phases. However the basic design of microprocessor based control system will be suitable to meet all functional and technical requirement given in the specification. There will be following three stages/type of requirement for microprocessor based control system.

   a) Microprocessor based control system for individual coaches.
   b) Microprocessor based control system for individual coaches along with multi-vehicle controls.

This specification covers design, development, manufacturing and testing of microprocessor based control unit. The unit developed will be required to perform the following functions:

2.3 To monitor the temperature and humidity conditions inside the AC coaches with respect to the temperature setting and control the same at the desired level by switching ON/OFF the compressor.

2.4 To monitor the critical parameters e.g. HP, LP, supply voltage, current of the system and working of various equipment like condensers motor, evaporators motor, and compressors etc.

2.5 Energy efficient control for AC system to ensure its optimum utilization.
2.6 In case of any fault in the system a warning alarm to be initiated and nature of fault to be displayed for its easy identification by the operator.

2.7 All the faults should be stored in the memory sequentially with respect to time along with the status of various other parameters being monitored by the system.

2.8 Provision for retrieval of stored data in the memory on a printer through an interface and memory decoder unit.

2.9 To display some of the parameters like HP, LP pressures, voltage, current coach temp, humidity and status of plant by using a push button whenever it is desired.

2.10 Provision for interconnection of units of more than two coaches with the facility for monitoring various display parameters all these unit from any of the coaches. Similarly in case of fault in any of the coach the alarm and display for the same to made available at any other nominated coach also, to facilitate centralized monitoring.

2.11 Provision for logical control of air-conditioning load of a number of AC coaches in a EOG train to restrict their combined maximum electrical load within predefined limits depending upon the generating capacity of power car.

3.0 SCOPE OF SUPPLY :

3.1 The scope of supply will include the following items.

(a) Microprocessor based control unit.
(b) Wiring and cables from all the sensors and to all the controlling contactors, indicating/display units of control panel.
(c) Pressure switches.
(d) Measuring instruments for voltage, current and power.
(e) Audio visual alarm unit.
(f) Humidity Sensor.
(g) Mounting arrangement for all the above equipments.
(h) Display units.

4.0 ENVIRONMENTAL & SERVICE CONDITIONS:

4.1 Environmental conditions:

Maximum ambient air temperature : 55 deg. c.
Minimum ambient air temperature : 5 deg. c.
Average ambient air temperature : 35 deg. c.
Max. Relative humidity : 100 %

Atmosphere : Extremely dusty and desert weather and desert terrain in certain areas. The dust contents in air may reach as high values as 1.6 mg/m cub.

Coastal area : The equipment shall be designed to work in corrosive atmosphere.

The maximum value of the condition in the coastal area will be as under:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. pH value</td>
<td>8.5</td>
</tr>
<tr>
<td>Sulphate</td>
<td>7 mg/liters</td>
</tr>
<tr>
<td>Max. Concentration of Chlorine</td>
<td>6 mg/liters</td>
</tr>
<tr>
<td>Max. Conductivity</td>
<td>130 micro sec./cm</td>
</tr>
<tr>
<td>Annual rainfall</td>
<td>Ranging between 1750 to 6250 mm</td>
</tr>
<tr>
<td>Altitudes</td>
<td>Not exceeding 1200 m</td>
</tr>
</tbody>
</table>

4.2. Service conditions:

4.2.1 Maximum speed of trains: 200 km/h

4.2.2 Vibrations and Shocks:

The solid state temperature controller shall withstand satisfactorily vibrations and shocks normally encounters in service as indicated below:

a) Maximum vertical acceleration : 3.0 g
b) Maximum lateral acceleration : 3.0 g
c) Maximum longitudinal acceleration : 3.0 g

(‘g’ being the value of acceleration due to gravity)

The vibrations are of Sine Wave form and the frequency of vibrations is between 1 & 50 Hz, amplitude ‘a’ expressed in mm is given as a function of ‘f’ by equations -

\[ a = \frac{25}{f} \quad \text{for value of } f \text{ from 1 to 10 Hz} \]
The supplier shall be fully responsible for ensuring that all equipment forming part of the supply is entirely fit for the purpose and no part of this specification shall in any way remove or reduce his obligation in this respect.

4.2.3 Protection against surges and voltage spikes: Adequate provisions will be made in the design for suppression of internal transients, spikes and to withstand external transients, spikes and surges as per limits laid down in IEC-571.

4.2.4 Operating Train/Electrical Environment: The equipment should function satisfactorily under 25 kV ac electric traction. It should not be susceptible to malfunction due to interference from overhead traction power supply lines or under abnormal conditions such as overloads and faults in the electrical circuits of the coach.

4.2.5 Interference to S&T Equipment: Signals generated by the microprocessor based control and fault diagnostic system of the coach shall not cause interference to the Rlys Signal & Telecommunication equipment.

4.2.6 The power supply: The power supply for microprocessor unit available on the Coach is 110V ac+/− 5% PWM supplies with maximum ripple content of 15%. The supplier may design a suitable power supply for the microprocessor system and other hardware. The design shall take care of surges that may be present due to switching ON/OFF of these loads. It will be suitably protected through input and output fuses. The supplier will mention the detail of design including working voltage & power consumption of the unit.

5.0 FUNCTIONAL REQUIREMENTS OF CONTROL SYSTEM:

The microprocessor based control system will have following functional requirement for control of air-conditioning system for individual AC coaches as well as sharing information with similar control systems of adjacent coaches for their centralized monitoring. Although, the general control function of RMPU will be as per the control circuits given in specification for AC control panel for Roof mounted AC package unit no ELPS/SPEC/AC/04 (rev.2) Aug. 1999 but in addition will also comply the various functional requirement as mentioned in this specification.

5.1 TEMPERATURE CONTROL:

5.1.1 The system will maintain an identification number of coach and RMPU it is going to control

5.1.2 The microprocessor in the control system will sense the temperature inside the air conditioned space at four different locations with the help of temperature sensors and
compute the average temperature based on predefined weightage of individual readings.

5.1.3 The humidity of return air leaving the air-conditioned space through return air filter will be sensed using another transducer.

5.1.4 The temperature inside the coach will be maintained as per the temperature setting selected by the operator. It should be possible to alter the assigned value of temperatures (in steps of 0.1 deg.C) for various positions of selector switch through software.

5.1.5 The cut-in should occur within +/- 0.2 deg c of set value of temperature. The difference between cut-in and cut out shall be 1 deg c minimum and 2 deg c maximum.

5.1.6 As long as the humidity of the return air is within 60% the processor will control the temperature as per temperature setting but if humidity exceeds this limit the processor will reduce the coach temperature by 2 deg.C for 15 minutes and again check the humidity after 30 minutes. The process will be repeated if humidity has still not reduced below 60%.

5.1.7 During the specified night hours, which can be changed for different seasons and places, the processor will gradually increase the coach temperature for night hours suitably from the set value.

5.2 RMPU CONTROL SYSTEM

5.2.1 Initially when the unit is switched on both the compressors will be working.

5.2.2 As soon as the compressors start only one condenser fan will be in operation. The second fan will be switched on as soon as pressure in any one of the refrigerant circuits rises above the limit of control pressure switches.

5.2.3 If duty cycle of both the compressors is recorded to be less than 40% for four consecutive cycles only one of the compressors will work alternatively. Again if one compressor is not able to achieve the desired temperature within 10 min, both the compressors will again start working simultaneously.

5.2.4 In case of reduced cooling requirement when only one compressor is working both the compressors should be automatically switched on alternatively.

5.2.5 Once the compressors are switched off the first compressor should start after a time delay of 2 minutes and the second compressor should start after 30 secs. of starting of first compressor.
5.3 FAULT STORAGE /SELF DIAGNOSTIC SYSTEM

5.3.1 A fault storage system will record various tripping and faults of the RMPU along with values of save parameters like temperature setting, LP and HP pressure, coach temp, ambient temp, and relative humidity etc as to the details of fault messages and various parameters between railway and supplier.

5.3.2 An audio and visual indication in case tripping of any unit should be initiated which the operator can reset. The acknowledgement of fault should display troubleshooting instruction to the operator and final mode of operation of AC system after trouble shooting.

5.3.3 Fresh faults occurring during the period till such time earlier faults are acknowledged shall be lined up in memory to be displayed one after the other. Occurrence of a fresh fault is to be declared by a characteristic audio beep signal.

5.3.4 When more than one fault is generated simultaneously or in quick succession, they should be stored in the order of occurrence. The faults is to be displayed first with an indication that there are more faults which can then be seen by giving appropriate command from key board.

5.3.5 The system will monitor supply voltage and current and it will record the duty cycle of compressors and condenser motor to assess the power consumption of units.

5.3.6 Power up diagnostic:

While the system is being switched on it shall ensure that all functional units are working and all backed up data are still valid i.e., no important data has been corrupted during the period when power had been turned off. In case a critical failure is detected, alarm shall be generated and system should shut itself off. In case of a non critical failure, the system shall continue to operate after generating appropriate alarm.

5.3.7 Periodic self diagnostics:

It shall ensure the validity of the functioning of the system including failure detection of peripheral units by the main processing unit and failure of any card in the main processing unit by another card in the same unit. It shall also ensure that system does not malfunction due to the software crashing.

5.4 MULTI VEHICLE CONTROL

5.4.1 It should be possible to interconnect all the processor control units of same coach and adjacent coaches. One of the processor can be made to work as master controlled while all the other control units’ work as slave units. In case of fault in any of the units the audio and visual alarm will be repeated at master unit as well...
along with identification number of the coach. It should also be possible to acknowledge the fault from master unit itself.

5.4.2 The maximum permissible load at any given time will be fixed for any number of interconnected units. If the combined electrical load of all the units exceeds the fixed value, compressors of the units having minimum temperatures will be continued to be switched off one after another till such time total load comes within specified limits.

5.4.3 Provision of LED display for relaying information to the passengers inside the coach. Any information fed from individual controller or master controller will be continuously displayed in individual or all the coaches respectively.

5.5 DISPLAY UNIT

There will be two different type of display units for each control unit. One control display unit will be for display of various information, regarding the working of system, for the operator and will also have keyboard for interaction with control system. The digital security system will be installed to ensure the feeding and extraction of data from the processor unit by only authorised person.

The control display unit shall function as an interface between operator and system. It shall have necessary keys for this purpose. Display unit shall have the following characteristics:

i) Display shall be back-lit LCD type to achieve good visibility.
ii) It shall display faults in two lines having 40 characters each;
iii) It shall be provided with key board;

The following functions shall be possible through the key board:

- Setting of time, date and train no.
- Clearing of the fault on display
- Viewing of the stored faults
- Display of digital inputs and outputs.
- Display of status of the system
- Display of the latest fault mode
- Recording messages to be displayed for passengers

Passenger display unit will have LED type display and should be able display messages upto 40 characters continuously one after another.
5.6 PROVISION FOR FUTURE EXPANSION

There should be provision for adding additional input parameters for monitoring and additional output for control/display features.

6.0 GENERAL DESIGN REQUIREMENTS

6.1 CONSTRUCTIONAL REQUIREMENT:

6.1.1 The controller shall be suitable for mounting in a non air-conditioned space and shall be specially designed to provide metallic enclosures for protection against ingress of dusty atmosphere specified in Clause 4.1.

6.1.2 The enclosure shall be fabricated from the cold rolled annealed sheet to Specification No. IS 513-1963 of minimum thickness 1.0 mm. Processes like machining, bending, spot welding etc., shall be adopted to ensure geometry of the enclosure and the aesthetic look. The enclosure shall be given two coats of primer paint and shall be finished by black enamel paint.

6.1.3 The hardware shall conform to IS 2389-1968 “Specification for precision hexagonal heads bolts, screws, nuts and lock nuts. All mild steel hardware shall be cadmium plated and passivated to IS 1572-68 “Specification for electroplated coatings of cadmium on iron and steel”. To the extent practicable the screws shall work on tapped hole (i.e.) provision of loose nuts to be avoided. The screw heads shall be preferably accessible from the front. The depth of the tapped hole shall be more than the diameter of the screw. Wherever necessary, screwing pieces shall be spot welded to obtain required thickness.

6.1.4 The name/identification plates shall be of bright anodized aluminum with black letters embossed or etched on white background. These plates shall be fitted by riveting. The nameplate shall indicate the month and year of supply in addition to the usual information.

6.1.5 The microprocessor control unit should be compact, robust and light in weight.

6.1.6 The unit shall be capable to work from 110V ac +/-10% PWM supply with maximum ripple content of 15%.

6.1.7 The unit shall be designed to take care of an over voltage of 200V for one minute at the power supply terminals.

6.1.8 Electronic components used in electronic controller or else where shall be as under:-

(i) IC (Integrated Circuits) shall be of Industrial or Mill Grade.
(ii) Electrolytic capacitors shall be rated for max. temperature of 105 deg.C.
(iii) Paper/polyester capacitors shall be rated for max. temperature of 85 deg. C.
Haul effect sensors shall be rated for 65 deg.C ambient.

The resistance shall be preferably made of metal film of adequate rating.

Switching devices such as transistors, MOSFETs and IGBTs shall have junction temperature 150 deg.C.

Devices shall have the adequate thermal margin at the ambient of 55 deg.C.

Note: Use of paper/polyester capacitors shall be preferred.

6.1.9 The unit shall have protection against open circuit and short circuit of the sensor. The design shall ensure interchangeability of sensors and controllers of a particular make.

6.1.10 System shall be modular construction.

6.1.11 There will be two CPU card each consisting of 8 bit microprocessor or above and necessary hardware for operation of the system. 100% redundancy provision to avoid single fault that may lead to system failure shall be provided.

6.1.12 Size of the Equipment: The dimension of the microprocessor based control and fault diagnostic system equipment should not exceed 600mm H x 385mm W x 305mm D. In addition, provision shall be made in the cabinet for adding at least two input/output cards and two processor cards for future expansion. By suitable change in software, it should be possible to use additional inputs/output to the processor cards.

6.1.13 The unit shall be mounted on the control panel in non-air-conditioned space. Temperature sensor shall be mounted in side the conditioned space and at the return air grill. Pressure transducers shall be mounted on compressors.

6.1.14 The unit shall be provided with reverse polarity protection against inadvertent wrong connections of power supply.

6.1.15 The cable between the sensors, display units and control unit shall form part the of the supply and shall be shielded cable. The shield to be grounded at both ends and properly lay in conduit to be grounded.


6.1.17 MIL approved components shall be used. Usage of other components shall be subject to the approval of RDSO.

6.1.18 The rating to loading ratio of various active/passive components to the worst working conditions shall be more than two. The tenderer shall submit the rating
versus loading chart for the various components used corresponding to the loading at the worst working conditions.

6.1.19 The unit shall have protection against either open circuit or short circuit of the sensor. The design shall ensure interchangeability of sensors and controllers of a particular make.

6.1.20 It will be preferable to have the entire microprocessor based hardware, RAM, EPROM, Input/output ports and opto isolation etc. so optimized that the component count is kept low without sacrificing the overall system performance and reliability. Necessary interfacing of the hardware and the connectors will be provided on the cards.

6.1.21 All the cards should be suitably protected and mounted in a robust metallic housing so that entire assembly is capable of withstanding shocks, vibrations, electromagnetic induction and electrical surges etc. Electromagnetic compactability of the entire system shall comply with provisions of IEC 801. The equipment should withstand surge & spikes as specified in IEC 571-1.

6.1.22 The temperature in the coach around the microprocessor unit will be of the order of 55 degree C. Necessary cooling fan operated at 110V AC can be mounted, if required in the microprocessor cubicle for trouble free working of the microprocessor system.

6.1.23 All the PCBs will be of Epoxy Resign Glass Fiber fabric. All ICs should be mounted on heavy-duty sockets and provision should be made for tightening of the ICs on the base.

6.1.24 All electronic components and ICs used shall be selected after proper burn in and screening tests and shall be adequately rated to withstand the service requirements. The supplier for approval of RDSO should submit a quality assurance scheme.

6.1.25 System shall have real time clock for recording date & time.

6.1.27 The provision should exist for printing data stored or down loading it using hand held unit or personal computer with MS-DOS/windows operating system.

6.1.28 The TCN software protocol and RS 485 hardware protocol will be followed for communication network between two processors for sharing of information.
7.0 SCOPE OF SUPPLY

7.1 It is proposed to provide microprocessor-based control and fault diagnostic system on existing Air-conditioned coaches manufactured at RCF/ICF.

7.2 Based upon the above criteria, the scope under this tender covers design, development including simulation studies, manufacture, supply, erection, training and commissioning of the "Microprocessor based control and fault Diagnostic system" on Air-conditioned coaches with RMPUs. The microprocessor-based system will generally comprise of the following:

a) 8 bit microprocessor system or above having necessary EPROM and RAM including decoder and transducers etc.

b) The supplier shall provide the sensors for humidity, and pressure switches, measuring instruments for voltage current and power along with interface cards required for all the transducers for satisfactory working of the system.

c) Inter vehicle communication cables along with suitable couplers to be mounted on end wall.

d) Necessary opto isolation system for all the input as well as outputs.

e) Necessary surge protection system for the inputs and outputs.

f) Suitable power supply for the microprocessor system suitable for 110V dc/ac supply from the coach inverter.

gh) Necessary shielding arrangement for the PCBs and protection circuits/devices to ensure proper functioning against RF/EMIs on the coach.

h) Suitable metallic robust enclosure for the PCBs, complete with its wiring and male/female lock type connectors for the microprocessor system.

i) One display panels with necessary keyboard in each control cabinet for displaying the status of all the inputs/outputs and fault messages. These display panels will be mounted on the control panel.

j) Interface unit for extraction to download the stored fault messages and interact with processor for any require changes in the parameter.

k) All the inter connecting cables for items supplied by the firm and cables up to the interface between processors and control cables for RMPUs.

i) Necessary hand held fault data extraction unit and the printer to get the print out of the stored fault messages.
m) Complete software for operation of the system as per details above.

n) Supply of detailed design manual and maintenance & troubleshooting manual for the users.

o) Training for users in maintenance & troubleshooting.

p) Assurance to give backup support for supply of cards for 5 years after the warranty period.

8.0 CONTRACTOR’S RESPONSIBILITY

The contractor's responsibility will extend to the following:

8.1 The supplier shall supply detailed instructions for proper installation of the equipment on the coaches. For this purpose, the supplier shall depute his engineers/supervisors to ICF/RCF/Railways during installation of the equipment in the coaches.

8.2 The supplier shall be responsible for commissioning, testing and field trials of the equipment in service and depute team of engineers/supervisors for this purpose during developmental stage.

8.3 The supplier shall arrange required instrumentation and carry out detailed tests and field trials jointly with RDSO/ICF/RCF.

8.4 The supplier will also offer special tools and instruments separately which may be required for maintenance. A separate quotation will be issued for the same.

8.5 The supplier shall recommend list of spares required for satisfactory maintenance and operation of the microprocessor-based control and fault diagnostic System for a period of five years and quote the prices for them separately.

8.6 The supplier will submit detailed design manual for the system containing following details:-

(a) Hardware: Following information will be provided by the supplier.

- Input/output pin details and associated cable no. in the loco schematic.
- The detail functioning of each card.
- Testing procedure of each card.
- Circuit diagram & PCB layout.
- Gerber files, indexing layout.
- Write up on the working of Microprocessor Control

(b) Software
- Control flow chart and algorithm for the control logic.
- Source code listing, External facility to modify the programme through handheld unit/PC.
- External facility to change parameters, if required in future, through handheld terminal/PC.

8.7 The supplier shall provide details of input & output and corresponding to coach control cables for AC unit.

8.8 The supplier will arrange for training of Indian Railway personnel in maintenance & trouble shooting of the system supplied. Forty man-days training will be provided in maintenance & trouble shooting aspects and twenty mandays Training will be provided on design and manufacturing aspects. The supplier will provide detailed technical write-up to all the trainees. The syllabus for training will have to be approved by the purchaser. The venue of training will be mutually agreed.

8.9 The supplier will supply the user's manual for maintenance and trouble shooting.

8.10 The supplier shall be responsible for carrying out improvements and modifications at his own expense on all the equipments supplied, provided such modifications/improvements are decided to be necessary for meeting the requirements of reliability, performance and safety etc, jointly between contractor and purchaser.

8.11 For the purpose of technical decisions on improvements/ modifications etc. on equipment, the final authority from the purchaser’s side will be RDSO.

8.12 Consumable materials, electrical energy for testing and commissioning of the microprocessor based system will be provided by the purchaser free of cost.

9.0 APPROVAL FOR DESIGN

9.1 The design shall be developed based on the requirements given in this specification and sound engineering practice. The entire design of the hardware shall be supplied by the tenderer with required technical data and calculations to RDSO for approval before commencing the manufacturing.

9.2 Approval of design means the approval of general design features. Notwithstanding the approval, the supplier will be wholly responsible for the performance of the complete system.
10.0 WARRANTY

7.3 The contractor shall be responsible for any defect/failure of equipment, provided in the coach due to defective design, material or workmanship up to the period of 12 months from the date of successful commissioning. The contractor shall replace all such equipments during the warranty period at his own expenses. Further, should any design modification is required to be made in any part of the equipment, the period of 12 months will commence from the date when the modified part is commissioned in service.

11.0 INSPECTION AND TESTING

Separate type, routine and acceptance for control units will be conducted. Type test will be conducted by RDSO on one unit to verify that product meets the design and performance requirement of the specification. Some or all type test may be repeated after a period of two years to confirm the quality of the product to meet the specified requirement.

In addition the manufacturer shall also repeat the type test to be witnessed by RDSO either totally or in part in following cases without any additional cost.

- Modification of equipment likely to affect its function.
- Failure or variations established during type test.
- Resumption of production after an interruption of more than two years.
- At the time of indigenisation , if the firm is having TOT with foreign collaborators in consultation with purchaser

The routine tests are to be carried out by manufacturer on each unit to verify that properties of the product corresponding to those measured during type test.

12. TESTS

The following tests shall be carried out.

a) Type Tests:
   i) Visual check
   ii) Performance test
   iii) Reverse Polarity test
   iv) Insulation Resistance test
   v) Following tests on electronic equipment i.e. controller, power supply sensor etc as per IEC 571-1:-

a) Dry heat test
b) Damp heat test
c) Combined heat humidity and dust test
d) Vibration, shock and bump test
e) Voltage surge test
f) Dielectric test

b) Acceptance Test:

Acceptance test shall be carried out on 20% of the lot offered.

i) Visual
ii) Performance Test
iii) Dielectric Test
iv) Reverse Polarity Test
v) Insulation Resistance Test
c) Routine Test

i) Visual check
ii) Performance test at rated voltage for checking operations of the unit
iii) Reverse Polarity test
iv) Insulation Resistance test
d) Visual Check

The unit shall be checked for proper manufacturing, proper fitment in its enclosure, connection and dimensions as per specification and as agreed between manufacturer and purchaser.

e) Performance Test

During prototype testing the unit along with sensors will be temporarily installed by the manufacturer on one the nominated coach. All the control functions of the unit will be checked and the unit will allowed to work for 24 hours on the coach simulating the heat load conditions of as indicated in RDSO test program no. ELPS/TP/AC/01 Jan. 1994. However for performance test to be carried out during prototype tests after all the tests given in para (A) (iv) per IEC-571-1 the unit will be tested with all sensors supplied by the manufacturer for all functions given in the specification by simulating the other conditions in laboratory at rated voltage. Similarly during acceptance test also the functions of the unit will be tested along with sensors supplied by the firm by simulating other conditions in a laboratory.

f) Reverse Polarity Test

The unit shall be functional after applying 200V for one minute in the correct polarity as well as in the reverse polarity.

g) Insulation Resistance Test
The insulation resistance of the unit between the earth (enclosure) and the current carrying parts shorted together shall be more than 10M ohms at a high ambient temperature of 55 deg.c. when measured with 500V meggar.

h) Other Tests

The tests i.e. Dry heat test, Damp heat test, Combined heat humidity and dust test, Vibration, shock & bump test, Voltage surge test shall be conducted in ERTL/Govt. approved test agency and results shall be submitted.

12.1 Prototype Units of the microprocessor based control and fault diagnostic system for the air-conditioned coaches will be inspected and tested by the Engineers of RDSO at the works of the manufacturer and they will also be involved in testing of the units on the coaches till the development is successfully completed.

12.2 After successful prototype testing and commissioning of unit on coach it will put under extensive field trials for six months.

12.3 The manufacturer shall furnish results of all the tests and inspection carried out internally and in the presence of Railways representative to RDSO.

12.4 Any defect noticed/design improvement found necessary as a result of these tests/trials shall be carried out by the tenderer in the least possible time.

12.5 All the system to be supplied against the tender shall incorporate without any extra cost, all the modifications carried out in the first prototype after the field trials of this system.

13.0 IMPORTANT DOCUMENTS REFERRED IN THIS SPECIFICATION

1. IEC-571-1 = Rules for electronic equipments on Rail vehicle.
2. IEC-801 = Electromagnetic compatibility for industrial process measurement and control equipment.
3. ELPS/SPEC/Reliability/S1/0015 Oct 2001
   = Reliability of Electronics used in Rolling Stock application.
4. ELPS/SPEC/AC/04(Rev.2) Aug.1999
   = Spec. for AC Control Panel for Roof Mounted AC Package Units.

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