(Revision-01)

INDIAN RAILWAYS

PARTICULAR SPECIFICATION

FOR

BG LIGHT WEIGHT ALUMINIUM PASSENGER CARS

TO BE BUILT AT RAIL COACH FACTORY

PALAKKAD KERALA

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Contents

Glossary

The following abbreviations are used in this Specification:

Abbreviation	Full Name
AAR	Association of American Railroads
AC	Alternating Current
ASIC	Application Specific Integrated Circuit
ASHRAE	American Society of Heating, Refrigeration and Air-conditioning Engineers
ATP	Automatic Train Protection
BG	Broad Gauge
BS	British Standards
DB	Dry Bulb
DC	Direct Current
EN	Euro Norm (European Standard)
EP	Electro Pneumatic
FEM	Finite Element Method
GPS	Global Positioning System
GSM	Global System for Mobile
GSM-R	Global System for Mobile – Railways
HT	High Tension voltage as defined in Indian Electricity Rules
IC	Integrated Circuit
IEC	International Electro technical Commission
IEEE	Institution of Electrical and Electronic Engineers
IR	Indian Railways
IRS	Indian Railway Standard
IS	Indian Standard
RDSO	Research Designs and Standards Organization
ISO	International Standards Organization

EOG	End On Generation
HOG	Head On Generation
PWD	Passenger With Disability
RMPU	Roof Mounted AC Package Unit
Km/h	Kilometers per hour
LED	Light Emitting Diode
MCB	Miniature Circuit Breaker
PCB	Printed Circuit Board
PIS	Public Information System
PA	Public Address
RAMS	Reliability, Availability, Maintainability and Safety
RFP	Request For Proposal
SI	System International
SIL	Safety Integrity level
UHF	Ultra High Frequency
UIC	International Union of Railways
VHF	Very High Frequency
VCU	Vehicle Control Unit
VCD	Vigilance Control Device
WB	Wet Bulb
WC	Water Closet (i.e. a flush toilet)
VRLA	Valve-Regulated Lead–Acid
PACIL	Passenger Alarm Chain Indication Light

Chapter 1
Definitions and Interpretation

Unless the context otherwise requires, capitalised terms not defined in this Specifications and Standards, shall have the same meaning ascribed to such terms in the Agreement. Capitalized terms which are not defined herein or in the Agreement, shall have the same meaning ascribed to such terms in the applicable standards. The abbreviations used in this Manual shall have the full form ascribed to them in the Glossary.

In this Manual of Specifications and Standards (the "Manual"), the following words and expressions shall, unless repugnant to the context or meaning thereof, have the meaning hereinafter respectively assigned to them:

Term	Definition
Partner	Shall mean the firm/company with whom the Joint venture has to be done under contractual agreement and terms for setting up a factory at Palakkad, Kerala for manufacture of light weight ALUMINIUM Passenger cars of EOG design.
IR	Shall Mean the Indian Railways on behalf of the President of Republic of India who is inviting for joint venture for setting up a factory at Palakkad, Kerala for manufacture of light weight ALUMINIUM Passenger cars of EOG design.
Contract	Means the contract agreement , the letter of acceptance, the letter of tender, these conditions , the specification , the drawing, the schedule, and further documents (if any) which are listed in the contract agreement or in letter of acceptance.
Inspecting Authority	Shall Mean the organization or its representative nominated by the IR to inspect on his behalf.
Sub-Contractor	Means any person, firm or company from whom the partner may obtain any material or fittings to be used for the work.
Proven Design	The rolling stock, including all sub-systems and equipment shall be of proven design i.e. the design of equipment, components ect. Shall be based on sound, proven and reliable engineering. Sub-systems and equipment of similar design philosophy shall have been in use and have established their performance reliability on passenger trains in service over a period of five years or more. Where similar equipment or sub-systems of a different rating are already proven in service, then the design shall be based on such equipments.

Availability	Shall mean that a railcar, equipment or system forming part thereof is available and fit for performing the specified functions in accordance with the provisions of this Manual and the Agreement.
IP or Ingress Protection	Shall mean the degree of protection provided by enclosures in accordance with IEC 60529.
L-10	Shall mean the life of a bearing in accordance with ISO 281.
Maintainability	Shall mean the probability that a maintenance action for a equipment or system, under specified conditions of use, can be carried out at a specified time interval when the maintenance is undertaken in normal conditions and following Good Industry Practices.
Maintenance	Shall include visual inspection, adjustment, replacement or repair carried out on any equipment, sub-system or system, which results in such equipment, sub-system or system being preserved within maintenance tolerances or returned to its design tolerances.
Manual	Shall mean this Manual of Specifications and Standards.
Railcar	Shall mean a passenger carrying railcar, built in conformity with the provisions of this specification.
Rail Level	The plane which passes through the top of the cross-sectional centre line of both running rails.
Reliability	Shall mean a high degree of probability that an equipment or system can perform a required function under specified conditions and for a specified period, in conformity with the operational parameters specified in this Manual and the Agreement.
Service	Shall mean the railway service available for the use of passengers.
Specifications and Standards	Shall mean the specifications and standards relating to the quality, quantity, capacity and requirements for the passenger trains comprising the railcars and the equipment, sub-systems or systems thereof, as set forth in this Manual.
Sub-system	Shall mean and include all equipment(s) forming part of such sub-system.

Chapter 2
General Requirements

2.1 General

2.1.1 This specification describes the requirements for design, development, manufacture, supply, testing, delivery and commissioning into service of modern fully furnished and finished BG, integral, light weight ALUMINIUM PASSENGER CARS of EOG/HOG design to be manufactured in joint venture between private sector partner and IR at Palakkad, Kerala.

2.1.2 The railcars shall meet all the requirements under the operating and service conditions specified in Chapter 2 of this specification.

2.1.3 The partner shall, in addition to observing and complying with this specification, be bound by the Terms and Conditions of Contract that may be applicable for design, development, manufacture, supply, testing, delivery and commissioning into service of aluminium passenger cars .

2.1.4 This specification is intended to cover everything required for manufacture & operation of the stock, even if not explicity mentioned herein.

2.1.5 The railcar manufacturer has the option of offering alternative superior designs duly detailing the reasons for adopting the design and the benefits that would accrue to Indian Railways as a result of using alternative design. The alternative superior design may include a coach fitted with Articulated Bogies / Tilted Bogies / independent Wheel Set design or any other special design of running gear and coach. However, the coach should meet all the requirements of performance, safety and operational criteria as per the specification. All necessary design calculations in the line with those mentioned in the specifications shall be submitted, duly complying with relevant European/UIC/International Standards.

2.1.6 Should there be any doubt as to the meaning of the clauses the tenderer should at once notify the authority inviting tenders who may send a written instruction to all tenderers. It shall be understood that every endeavor has been made to avoid any error which can materially affect the basis of the tender and the successful tenderer shall take upon himself' and provide for the risk of any error which may subsequently be discovered and shall make no subsequent claim on account thereof.

2.2 Objective

The objective of this document is to define the criteria for technical evaluation of railcars offered by firms seeking to set up a factory at Palakkad in Kerala for manufacture of light weight ALUMINIUM PASSENGER CARS of EOG/HOG design.

2.3 Scope

2.3.1 This specification covers the requirements of design, development, manufacture, supply, testing, maintenance for seven years, delivery and commissioning into service of modern fully furnished and finished BG, integral, light weight state of the art ALUMINIUM PASSENGER CARS of EOG/HOG design including the training of design, operating and maintenance personnel.

2.3.2 The scope shall also include the following:

i. Provision of all documentation and support material associated with the operation and maintenance of the cars

ii. Ongoing technical support and defects liability coverage until the completion of the warranty period and making good defects.

iii. Training of engineers, operations and maintenance staff including providing the training materials, training kits and demonstration equipment.

iv. Initial supply and installation of all consumables and materials required for testing and commissioning.

v. Submission of final drawings, design calculations and other documents including operations and maintenance manuals for review and acceptance by the IR's Representative with regard to completeness and adequacy.

vi. Manufacture of railcars in India, progressively, within a defined time frame, and in a programmed manner.

2.3.3 The Aluminium Passenger Cars are to be used for long distance passenger transportation on locomotive hauled trains.

2.4 Variants/Rake of the Aluminium Passenger Cars

2.4.1 Aluminium cars will generally be in the following variants :-

AC (EOG/HOG) Cars	AC First class sleeper Car
	AC 2-Tier Sleeper Car
	AC 3-Tier Sleeper Car
	AC Hot Buffet Car

	AC Generator Car cum Luggage cum Brake van
	AC 2nd Class Chair Car
	AC Executive Class Chair Car
	AC Restaurant Car

2.4.2 Generally railcars shall be supplied in complete rake form having different variants of cars or as per specific order from IR.

2.4.3 Generally railcars shall be supplied in LHB Rajdhani/Shatabdi type rakes and AC Restaurant Car variant will not be the regular part of these rakes.IR may include AC Restaurant Car variant in any special purpose rake through specific order.

2.5 References to various standards

2.5.1 In addition to the provisions of this Manual, the codes, standards and specifications applicable for design of the Passenger cars and for their operation and maintenance are-

a) Indian Standards;
b) RDSO specifications
c) IRS
d) EN
e) UIC
f) AAR
g) BS
h) IEC
i) ISO
j) NF-F
k) ICF/RCF Specifications
l) ORE
m) VDE
n) UL

2.5.2 In case of any conflict or inconsistency between the provisions of the codes specified in clause 2.5.1 above and the provisions contained in this specification, the provisions contained in this specification shall apply.

2.5.3 The latest version of the aforesaid codes, standards and specifications shall be considered applicable.

2.5.4 The specifications and standards stipulated in this Manual are the minimum. The partner may adopt alternative internationally recognized codes and specifications, if it can demonstrate to the IR that such alternative is superior or more pertinent to the passenger cars than the specifications and standards provided in this specification. The partner shall seek prior written approval of the IR for any alternative specifications and standards proposed to be used.

2.6 Vehicle Design and Architecture

2.6.1 Proven Design

The rolling stock, including all sub-systems and equipment shall be of proven design i.e. the design of equipment, components etc. Shall be based on sound, proven and reliable engineering. Sub-systems and equipment of similar design philosophy shall have been in use and have established their performance reliability on passenger trains in service over a period of five years or more. Where similar equipment or sub-systems of a different rating are already proven in service, then the design shall be based on such equipments.

2.6.2 Basic Design Philosophy & Requirements

2.6.2.1 The design philosophy should meet the following criteria:

(i) Good aesthetics
(ii) State-of-the-art Interiors with world class furnishings
(iii) Injury free design
(iv) Lightweight integral car body
(v) Service proven design
(vi) Design life 35 years
(vii) Crashworthiness
(viii) Electrically operated automatic body side plug type entrance doors, saloon sliding doors, lavatory doors and endwall/vestibule doors
(ix) Jerk free Couplers
(x) Optimised Air brake system
(xi) Dust and Noise suppression system
(xii) Minimum life cycle cost
(xiii) Low maintenance and overhaul cost
(xiv) Ease of maintenance
(xv) (Use of interchangeable, modular components
(xvi) (Extensive and prominent labeling of parts and wires
(xvii) Use of unique serial numbers for traceability of components
(xviii) High reliability
(xix) Low energy consumption

(xx) System safety
(xxi) Adequate redundancy in system
(xxii) Fire detection and suppression system
(xxiii) Use of fire retardant materials
(xxiv) High Passenger comfort including low noise level
(xxv) Environmentally friendly toilets and other Interiors
(xxvi) Adherence to operational performance requirements
(xxvii) Safe Passenger evacuation in emergency
(xxviii) Maximum possible commonality of structure, components, equipments, and sub-systems amongst different cars

2.6.2.2 The actual mix of features required in different variants of Aluminium passenger cars shall be as per agreement with IR.

2.6.2.3 All materials (including surface coatings, metals, insulants, adhesives, fluids, grease etc.) used in the manufacturing of the passenger cars shall not give rise to health hazards for the users, crew and staff.

2.6.2.4 The partner shall manufacture the aluminium passenger cars based on standards &specifications and in accordance with good industry practice.

2.6.2.5 Adequate margin shall be built into the manufacturing to protect against high ambient temperatures, seasonal humidity, corrosive conditions, and the effects of lightning strikes, etc. prevailing in India.

2.6.2.6 Railcars shall incorporate all essential features necessary to yield high traffic use, low maintenance requirements, easy maintainability, high reliability in operation and high efficiency. The tenderer shall incorporate all the items as required for proper functioning of the railcars in accordance with the current international practices.

2.6.2.7 The specification has been prepared for the general guidance of the partner to prepare the key designs for the proposed railcars.

2.6.2.8 Lubricants and cooling oils: partner shall study the currently used lubricants/cooling oils in Indian Railways and employ as far as possible such lubricants/oils. Full lubrication scheme and schedule for the railcars shall submitted. Where imported lubricants or cooling oil are being used, partner shall study and furnish details of equivalent Indian lubricants/oils.

2.7 Clause by clause comments:

2.7.1 The bidder shall furnish clause by clause comments on compliance or otherwise of each clause of this specification. The bidder shall indicate deviations in their offers clearly against the respective clauses and also furnish lists of deviations as per the tender. Complete details as required vide the respective clauses shall be furnished by the bidder.

2.7.2 The comments like 'noted' against the respective clauses shall be considered as 'not complied' for the specific clause. Therefore, the bidder shall clearly indicate the compliance or otherwise by writing 'complied' or 'not complied'.

2.8 Approval of Design

2.8.1 After the contract is signed, the partner shall within 60 days of signing of contract, furnish to IR the detailed schedule programme for submission of design documents for approval, which shall be staggered over a 120 day period, to enable IR to plan for expeditious clearance. Any calculation that is evaluated on the basis of software simulations shall be supported with sample calculations.

2.8.2 The following key areas of design including specifications followed shall be got approved by RDSO within 10 months of signing of contract:

i. Shell along with Finite Element Modeling with standard computer software carried out for stress analysis of the car structure including crashworthiness design and vibration analysis of carbody.
ii. Bogie and suspension design along with standard computer simulation software carried out for stress analysis of the bogie. Simulation reports for vehicle stability and riding quality using frequency domain and time domain analysis.
iii. Brake system
iv. Lavatory design
v. Draw and buffing gears
vi. Wheel axle and roller bearing
vii. Fire detection and suppression system
viii. Noise and Dust suppression system
ix. Passenger information System (PIS)
x. Design of doors and retractable ramps
xi. Design of complete interiors including partitions, interior paneling, roof paneling, flooring, luggage racks, curtains, carpets, public information system, seat/berth cushioning and covering, noise suppression measures, heat insulation and passenger amenities and fittings.
xii. Layout of all type of cars
xiii. Interior and exterior colour scheme

xiv. Design of Seats/Berths& Chairs
xv. Power supply system
xvi. Air conditioning system
xvii. Complete lighting system
xviii. Electrical couplers
xix. Alternators and batteries
xx. Power generation equipment
xxi. Load imbalance calculation of each car type
xxii. Thermal and noise insulation measures

2.8.3 The passenger cars layouts are defined by the distribution of seats/Berths, Toilets, Partitions, on board/underslung equipments, emergency exit, lights fans, laptop /mobile charging sockets etc. It shall be designed in order to fit with long distance transport capacity requirements and comfort needs. The partner shall provide a conceptual layout in the technical proposal. The layout shall be reviewed during preliminary design phase.

2.8.4 The partner shall deliver all necessary data, system design parameters, key drawings, calculations, drawings and specifications documents in English language as required by RDSO for examination and shall provide explanation and clarification of the drawings for approval. For the purpose, the partner shall depute his respective technical experts for design discussions and finalization approval or decision by IR shall normally be given within four weeks of submission of all clarifications by the partner to the satisfaction of the IR. After the final design is approved the partner shall furnish complete set of specifications as mentioned in the approved drawings and documents within 45 days of design approval.

2.8.5 The calculations supplied should also cover the important areas viz. Safety against derailment, Spring and damper characteristics under tare and loaded condition, Crashworthiness, of the car-body, Simulation reports for vehicle stability and riding quality using data for projected dynamic augment with un-sprung masses as on IR tracks, EBD calculations with and without load on level and gradient sections, Vibration analysis of the car-body, etc. Partner shall also submit basic design, functional specifications, software specification, block diagrams, Schematic drawings, loading calculations, circuits, wiring diagrams, drawings of control equipment and panels etc. and ratings of all sub -supplier's deliveries. Details of tonnes capacity calculations, components rating calculated under the ambient conditions as specified etc shall be got approved from RDSO.

2.8.6 "Approval" to the drawings denotes "general acceptability" of the design features. Notwithstanding such an approval, the partner will be wholly and completely responsible for the performance of the complete system and equipment supplied

by him. The RDSO will not be responsible for the correctness of the dimensions indicated on the drawings, the materials used or the strength of parts. The partner shall, when submitting proposals or designs for approval of RDSO, confirm that it meets all the requirements of specification and draw specific attention to any deviation or departure from the specification involved in his proposals or designs.

2.8.7 The Design shall be developed in SI units and partner shall submit the complete material / technical specification of components. The specification shall specifically be indicated on relevant drawings/documents.

2.8.8 Design shall be developed based on the requirements given in this specification and sound engineering practices.

2.8.9 In case of any discrepancy, clause by clause compliance to the specification given as per clause 2.7 shall only be considered. Other details given by bidder shall be considered only for indicative purpose and shall not amount to the acceptance of the design/equipments/ scheme.

2.8.10 The partner shall furnish details of its "Quality Assurance and Control System" at the design approval stage for the approval of RDSO. The quality checks to be made at various stage of manufacture, final assembly and commissioning with tolerance would be indicated . The system would also cover the quality assurance for bought out items.

2.9 Prototype

2.9.1 The partner shall manufacture and supply duly equipped prototype cars of each of the variants as specified in clause 2.4.1.

2.9.2 The shells shall be subjected to squeeze load testing at the partner's works, which will be witnessed by RDSO officials. Car types having similar type body shell can be exempted from the squeeze load test in consultation with RDSO.

2.9.3 The partner shall be responsible for carrying out improvements and modifications as may be considered necessary after tests and trials at his own expense on all the equipment supplied, provided such modifications/improvements are decided to be necessary for meeting the specified requirements of reliability, performance, safety etc. jointly between IR and partner.

2.9.4 Series manufacture shall not be proceeded with until prototypes have been approved by the IR or its authorized representative. The partner shall associate with IR for instrumented trials for evaluation of cars for finalizing definitions of all parameters

required for final optimization consistent with the specified performance requirements. The trials shall be carried out on the prototype units on IR as per EN/UIC specifications. Data so obtained shall be utilized to affect further modifications and optimizations to the specification and production documentation, including drawings, & calculations.

2.9.5 After prototype instrumented trials, modifications, if any, and IR clearance, regular production shall commence and one rake of approximately 600 meter excluding locomotive will be put in revenue service for parallel trials for a period of 6 months to determine any problems with centre buffer couplers, wheels, braking system, noise suppression, interior furnishing, lavatories, Fire detection & suppression system, passenger Information System, air conditioning system, EOG/HOG power supply system. If any problems are noticed with any of assembly/sub-assemblies during this period, the assembly/sub-assemblies will be replaced with improved design assembly/sub-assemblies on all in-service rakes and future rakes.

2.9.6 Partner shall not proceed with any proposed modification arising out of prototype test unless it is approved by IR.

2.9.7 During the prototype tests/ trials or during the warranty period, if any problems are thrown up or feedback information is obtained, which warrants a re-check of the design/ manufacture/ quality of the equipment and components, action will be taken as may be necessary by the partner to carry out the required investigations and to incorporate the improvements considered most appropriate, with approval of IR , to reach compliance with the specification & to ensure specified reliability and performance without any extra costs to the IR. Such improvements will be carried out in all cars and will be validated for the warranty period.

2.9.8 Modifications mutually agreed to and complying with the specification, will be incorporated by the partner at his own cost in the cars in a manner approved by IR. Drawings incorporating the modifications as found necessary as a result of test, trial and feedback will be submitted to IR.

2.10 Reliability, Availability, Maintainability and Safety (RAMS)

2.10.1 The partner shall manufacture the Aluminium Passenger cars to meet the Reliability, Availability and safety, as specified in the Agreement.

2.10.2 The Reliability, Availability, Maintainability and Safety (RAMS) of the Aluminium Passenger cars shall conform to BS EN 50126-1. The partner shall develop RAMS targets both for the complete system and for the major sub-systems.

2.10.3 Where possible components critical for safety shall fall into a safe operating mode in case of malfunction. Partner shall demonstrate, with reference to internationally accepted norms that the design is such that the likelihood of malfunction is reduced to an acceptable level. The system safety plan shall identify and list safety critical components and this list shall be updated periodically.

2.10.4 The partner shall establish and operate a detailed RAMS assessment system in support of the design, manufacture and subsequent testing, commissioning, operation and maintenance of the Aluminium Passenger cars.

2.11 Partner's Responsibility

2.11.1 The partner shall be entirely responsible for the execution of the contract strictly in accordance with the terms of this specifications and the conditions of contract, notwithstanding any approval which RDSO or the Inspecting Authority may have given in respect :

i. Of the detailed drawings prepared by the partner;
ii. of his Sub-contractors for materials;
iii. of the parts of the work involved by the partner;
iv. of the tests carried out either by the partner or by RDSO or the Inspecting authority;
v. Partner shall take prior approval of the IR for appointment of subcontractors for executing part of the work or purchasing the equipments, assemblies/sub-assemblies.

2.11.2 The partner shall depute a team of engineers for commissioning, testing and field trials of the equipment in service. The partner shall arrange the required instrumentation and carry out detailed tests and field trials jointly with RDSO. The partner shall supply specialised tools and instruments required for mounting of the equipment on the railcars. In addition, contractor shall ensure availability of tools, testing equipment, measuring instrument s & spare parts in adequate quantity for test and field trials, to be done as part of commissioning.

2.11.3 Supply of drawings, operating manuals, maintenance manuals, and software manuals etc. regarding all aspects of the railcars. Interfaces to other systems on the Railways, as detailed in this specification or resulting from the partner's specific design solutions proposed shall be documented in detail.

2.11.4 The supply of functional specifications, drawings, design calculations, FEM analyses, catalogues, and samples to the RDSO for design checking and approval of all subcontract or's deliveries and designs. Also to liaise with the RDSO regarding

the design and implementation of key items of equipment as detailed in this contract .

2.11.5 In addition to the equipment and services specified in this specification the partner shall supply all materials, cartage, tackle, plant, spare parts, samples, special tools and appliances which may be necessary for the complete and efficient installation, testing and commissioning of the railcars, even though such material or work may not be specifically mentioned in this specification. The partner or shall also supply all labour necessary and technical supervision for the installation, testing and commissioning of the railcars.

2.11.6 The partner shall submit a detailed design documents in liaison with RDSO to ensure that it conforms to all the requirements detailed in this specification.

2.11.7 Railcars manufactured and supplied against this specification, shall be of proven design and shall be constructed using proven body shell design and bogie design and with subassemblies that are capable of satisfying the system requirements.

2.11.8 The partner shall be entirely responsible for the execution of the contract in accordance with the requirements of this specification. The partner shall comply with provisions of the General Conditions and Special Conditions of the contract in scheduling, executing, and obtaining the RDSO approval of this design.

2.11.9 In the event of the partner's failing to carry out any work, for which he is liable under this clause, within a reasonable time of two months, or if in the opinion of the RDSO the urgency of the case demands it, IR may, without prejudice to his other rights under the contract , carry out the work himself at the expense of the partner.

2.12 Guarantee

2.12.1 The partner shall be responsible for any defect or failure of railcars or equipment providing the railcars due to defective design, material or workmanship up to 24 months from the date of placement in service or 36 months from the date of delivery whichever is earlier. The partner shall replace such equipments during the guarantee period at his own expenses. Further should any design modification is required to be made in any part of the equipment, the period of 24 months would commence from the date when the modified part is commissioned in service.

2.12.2 Railcars shall be subjected to detailed trials as discussed in chapter-7 of the specification. Any modifications found necessary as a result of these tests or further service trials shall be incorporated by the partner at his own cost in the railcars in a

manner approved by the IR. All key and manufacturing drawings incorporating the modifications shall be submitted to RDSO for final approval.

2.13 Service Engineering

2.13.1 The partner shall arrange to make available, the maintenance practices to be followed for cars and sub-systems fitted on cars against this specification. The following will be clearly spelt out:

i. Maintenance standards including clearances and tolerances at various locations and permissible limits of wear for good riding comfort and safe running.
ii. Inspection procedures and periodicity of various inspection schedules in detail including the gauging practices followed.
iii. Maintenance procedures in detail.

2.13.2 The following shall also be spelt out in detail:

i. Machinery and equipment required for maintenance.
ii. Gauges, jigs and fixtures, tools and special tools required during maintenance.
iii. Space and layout requirements for maintenance facilities.

2.13.3 The partner shall supply detailed instructions, drawings and relevant specifications for proper installation of the equipment in cars to Railways and RDSO. For this purpose, the partner shall depute a team of engineers to Railways during installation and pre-commissioning of the equipment in the different type of cars.

2.14 Service manuals and spare parts catalogues

Detailed maintenance and service manuals for each type variants specified in clause 2.4.1, shall be specially prepared and at least 40 copies of the same shall be supplied free of charge. 40 copies of detailed spare parts catalogues listing all components manufactured or purchased by the partner including all car types shall be supplied.

2.15 Spare Parts

2.15.1 The partner shall indicate in an itemized list, life expectations of components subject to wear under Indian conditions.

2.15.2 The major assemblies required as standby spares shall be clearly indicated along with the cost of these assemblies along with the offer. The cost of these assemblies quoted by the firm shall not be considered for commercial evaluation of the offer.

2.15.3 In addition, it is proposed to stock sufficient minor components and spares to meet the normal renewals and replacement on account of wear or occasional failures required up to and inclusive of the first major overhaul. The partner shall therefore, within 45 days of final design approval, submit classified list of spares giving description, specification, sources of supply, service life, shelf life, and numbers required and price for each type of car ordered. The list will be reviewed by IR and the list of spares to be ordered finally shall be advised by the IR within 3months thereafter. The total value of the spares to be supplied shall be limited to 5% of value of the cars ordered during the first year.

2.16 Training

2.16.1 Training to design, operation and maintenance officials of Indian Railways shall be provided free of cost. The man hours of training to be provided are as under:

a) 400 man days training on design concepts & features, and 100man days of training on maintenance philosophy &requirements to officials of RDSO before commencement of supplies is to be provided where the partner has existing manufacturing facilities.

b) 250man days of training on maintenance and operation to be provided to maintenance and operations officials.

2.16.2 The cost of air travel, hotel accommodation and transport for travel between air to hotel for training outside India will be borne by Indian Railways. All other costs shall be borne by the partner.

2.17 Inspection

2.17.1 All the materials or fittings used for the work covered by specification shall be subject to inspection by the Inspecting Authority and shall be to his entire satisfaction.

2.17.2 The Inspecting Authority shall have power to:

i. Adopt any means he may think advisable to satisfy him that the materials or fittings specified are actually use throughout the construction.
ii. Take samples for such test as he may consider necessary by an approved metallurgist selected by him, whose report shall be final and binding on the partner.
iii. Inspecting Authority can visit at partner's works any reasonable time without previous notice, to inspect the progress and quality of the work. The partner

shall provide free of charge all equipment, gauges, labour and other facilities, required by him for this purpose.

iv. To reject any material or fitting that does not conform to the relevant specification or good industry practice which shall be marked in a distinguishable manner and shall be disposed off in such a manner as the inspecting Authority directs. Such rejected parts shall be replaced by the partner without extra charges.

v. Tests of materials and fittings shall as for as possible be carried out at the works of the makers of the materials or fittings. The partner shall provide such additional materials or fitting as may be required or arrange for test pieces to be incorporated in forgings and casting as required by the Inspecting Authority and for their removal in his presence for test purposes. All tests in the works of the partner and his sub-contractors shall be at the cost of the partner. Independent tests shall be paid for by the IR or the partner depending on whether the tests show the material is or is not to specification.

vi. No work shall be dispatched or packed until it has been passed by the Inspecting Authority, but such passing shall in no way exonerate the partner from his obligation in respect of quality and performance of cars.

vii. In the event of dispute between the Inspecting Authority and the partner, the decision of IR shall be final and binding.

2.18 Modification of Drawings

The partner, after inspection and approval of the proto type shall correct, where necessary, the drawings and schedule of materials to confirm in every particular with the sample railcar.

2.19 Photographs

2.19.1 While first batch of each variant of railcars under construction, coloured photographs of various assemblies and sub-assemblies, especially the bogie and the body in various stages of production, and of part which cannot be conveniently photographed after assembly such as sidewall, end wall and roof framing , underframe , etc shall be taken.

2.19.2 After completion side and three quarter views of each type of railcars shall be taken and also views of the interior furnishing.

2.19.3 The photographs shall not be less than 380x255mm for the side views of the completed cars, or less than 255x200 mm for other views.

2.19.4 Prints along with the soft copy of these photographs shall be furnished to IR.

Chapter 3

Operating, Service Conditions and Design Constraint

3.1 Operating Routes

The Passenger cars shall be able to operate on all BG routes of Indian Railways.

3.2 Service Conditions

i. Ambient temperature : -5ºC to 55ºC

ii. Altitude : Sea level to 2500m

iii. Max. Sun temperature : 70ºC

iv. Relative humidity : 10% to 100%

v. Rainfall : Very heavy in certain areas

vi. During dry weather, the atmosphere is likely to be dusty.

vii. The equipment shall be working in plain, Ghat section with a maximum gradient of 1 in 37 & also in desert climate.

viii. Environment – Railcars shall also be working in coastal area with salt laden and corrosive atmosphere.

ix. The equipment, sub system and their mounting arrangements shall withstand maximum accelerations in vertical, longitudinal & transverse directions according to standard EN12663 for P1 category vehicles.

x. ~~Curve and Grade~~ : ~~The cars shall be capable of negotiating curves of 175 meters radius and of operation on grades of 1 in 37 and turn outs of 8 ½ degrees.~~

3.3 Passenger Capacity& Payload

3.3.1 The partner shall furnish the seating /sleeping capacity of all type of cars given in clause 2.4.1.

3.3.2 The seating / sleeping capacity of all type of cars (other than restaurant car) shall not be less than that of existing LHB coaches of same variant .In case shorter length cars (In comparison to LHB cars) are offered, then overall passenger capacity of approximately 600 meter rake length train shall not be less than that of similar 24 LHB

cars rake. For chair car variants, rake length of Shatabdi formation with 24 LHB cars and for sleeper variants of cars, rake length of Rajdhani formation with 24 LHB cars shall be considered.

3.3.3 24 cars Shatabdi formation shall (for the purpose of this specification) be considered to consist of 03 nos. AC Executive Class chair car,19 nos. AC 2nd class chair car and 02 no. AC Generator Car cum Luggage cum Brake van cars.

3.3.4 24 cars Rajdhani formation shall (for the purpose of this specification) be considered to consist of 02 no. AC First class, 06 nos.AC 2-tier,12 nos.AC 3-tier, 02 nos. Hot Buffet car and 02 no. AC Generator Car cum Luggage cum Brake van cars.

3.3.5 The partner shall design the payload of all type of cars as per P1 category cars of EN12663.

3.4 Track Parameters

3.4.1 The following shall be the track standards of the test and operating sections.

S. No.	Parameters	Specified Values	
		High speed Routes	Main Line Routes
A.	Unevenness (Base 3.6m)	6mm in general and 10 mm at isolated spots	15mm
B.	Alignment (Versine for chord of 7.2 m)	5mm in general with10 isolated 7mm on curves and 10mm on straight	7mm
C.	Twist (Base 3.6m)	2mm/m with isolated spots of 3.5mm/m	3.5mm/m
D.	Gauge Variation	+6mm -3mm	±6mm
E.	Gauge widening on curves .	i. For curves up to 40, the gauge variation shall be from +13mm to -3mm ii. For curves more than 40, the gauge variation shall be from +19 mm to -0 mm.	
F.	Track structure	46/52/60Kg rails with wooden/metal/concrete sleepers to 1540/1660 per km density on consolidated and stable formation.	

3.4.2 Partner may ensure further details of track as deemed fit based on age cum condition basis, overdue renewals and condition of formation etc. As per provisions of chapter –III of IRPWM-2004 regarding permanent way renewals.

3.5 Gauge and Moving Dimensions

The passenger cars shall conform to the Indian Railways Schedule of Dimension – 1676 mm gauge revised 2004 with latest amendments.

3.6 Station Platforms

3.6.1 The Passenger cars shall allow passengers to board and alight from the train at station platforms between 760 mm and 850mm above rail Level.

3.6.2 In addition to the requirement stated in Clause 3.6.1 above, mainline passenger railcars shall allow passengers to board and alight from the train at station platforms with a maximum height of 455 mm above Rail Level.

3.6.3 The trains may be maintained or stored in areas that have only ground-level access. It is required that the passenger cars have the capability for ground-level maintenance access, passenger emergency evacuation and fire/rescue access to the car interior.

Chapter 4
Performance Requirements

4.1 Key Dimensions

a.	Gauge	:	1676mm
b.	Limiting Car Profile	:	Maximum Moving Dimensions 1D of Indian Railways Schedule of Dimension-1676 gauge revised 2004 with latest amendments.
c.	Schedule of Dimensions	:	Indian Railway Schedule of Dimensions 1676mm gauge (BG) Revised 2004 with latest amendments.
d.	Maximum Width over body	:	3250 mm
e.	Height of buffers & coupler from rail level under tare condition	:	1105 mm +0 -15mm
f.	Maximum Distance apart between any two adjacent axles if bogie vehicles are used.	:	12345 mm
g.	Maximum Distance apart for bogie centers if bogie vehicles are used	:	14900mm
h.	Maximum buffer drop under full load	:	75mm
i.	Maximum operating speed	:	160 kmph (upgradable to 200kmph in future)
j.	Maximum axle load	:	16.25t/19t provided track loading density is within permissible limit for IR track.
k.	Train Formation	:	Train length excluding loco – approximately 600 meter (rake length equal to 24 LHB cars).

4.2 Maximum Service Speed & Test Speed

4.2.1 The passenger cars shall be designed to operate at a maximum service speed of 160 kmph and shall perform satisfactorily up to test speed of 180 kmph on High Speed routes under C & M Vol-I.

4.2.2 The speed of railcars shall be upgradable to 200 kmph & dynamic simulations in confirmation of the same shall be submitted by the partner.

4.2.3 Necessary modifications, if required, to achieve speed of 200kmph shall be submitted by the partner.

4.3 Ride Index

4.3.1 The Ride Index shall not exceed 2.75 in both vertical and horizontal directions in inflated condition of secondary suspension.

4.3.2 The RI Calculations shall be done as per para 2.1 of ORE Report no.8 of C-116 using FFT method (Fast Fourier Transformation Method).

4.4 Kinematic Envelopes

4.4.1 The partner shall develop and furnish a typical family of Kinematic Envelopes as per UIC 505 to define the Aluminium car's behaviour on the lines. Width of the vehicle (external faces at widest point) may be set at minimum to preferred width of 3250 mm or the width of proposed cars according to structure gauge, swept envelope, dynamic movement and passing clearances. The configuration of the vehicle, length of element, distances between bogie pivots, face profiles, swept envelope shall be adapted to the characteristic of the line, infrastructure structural gauge and passing clearances.

4.4.2 The Kinematic envelope shall be calculated taking into account the permissible track construction and wear tolerance. Cars shall provide the same kinematics performance in either direction of travel.

4.4.3 During the detailed design phase, the partner shall develop and furnish detailed calculations showing lateral and vertical shifts due to each factor separately and Kinematic Envelopes of the proposed Aluminium car's for both inflated and deflated conditions of springs, taking into account all car displacements resulting from the simultaneous occurrence of all normal conditions specified and any one abnormal condition specified below. Track curves and tolerance shall be taken into account.

4.4.4 **Normal Conditions**

(i) All vehicle speeds up to maximum design speed of 200 kmph.
(ii) All vehicle loads between tare and crush load.
(iii) Any degree of vehicle wheel wear between new and fully worn.
(iv) Any degree of vehicle suspension, wear or adjustment from new to fully worn, including all service tolerances and potential variations in setting.
(v) Maximum cant deficiency.
(vi) Maximum cant excess.
(vii) Vehicle lateral and rolling movements due to wind forces.
(viii) Vehicle yaw and vertical movements.
(ix) Track tolerances.

4.4.5 **Abnormal Conditions**

Any combination of bogie air spring deflated.

4.5 Jerk Limitation for service brake

Under all normal operating conditions, the rate of change of railcar acceleration or deceleration shall be less than 0.7 ± 0.5 m/s3. Failure of the jerk limiting system shall not limit braking effort. Emergency brake applications and any associated ramp down of tractive effort shall not be jerk limited. Reduction of attractive effort due to a Loco interruption (including passing through neutral sections) need not be jerk limited.

4.6 Methodology of jerk measurement

4.6.1 Vehicle accelerations shall be measured by placing accelerometer with suitable inbuilt filter on the floor in longitudinal direction.

4.6.2 Prior to each test run, time, wind speed, wind direction and humidity to be recorded by portable measuring instruments. Weather related data can be retrieve from weather institute.

4.6.3 Train shall be accelerated up to about maximum service speed and put in for approximately 5 seconds in coast and then full service brakes will be applied untiltrain stand still.

4.6.4 Repeat clause 4.6.3 for opposite direction.

4.6.5 Minimum five readings against clause 4.6.3 & 4.6.4 shall be taken.

4.6.6 Calculate the derivative of readings from accelerometer and shall be filtered with 1 Hz low pass filter to find the jerk rate of the vehicle.

4.6.7 Detailed test plan should be submitted for approval to IR prior to the jerk measurement trials.

4.7 Railcar weight & Balancing

4.7.1 The railcars shall comply with all applicable strength and testing requirements, and shall minimize weight to the extent possible. In the selection of the type and thickness of material to be used, the partner shall be guided by the desire to obtain the maximum strength and reliability with the minimum weight which is obtainable at reasonable cost. The partner shall base its structural design on the specific loads, deflections and properties of structural sections called for in this specification. For structures not specifically covered, the partner shall base its design on its experience, subject to successful stress analysis and structural testing. The structure and equipment supplied shall resist these loads, including fatigue loads, with factors of safety.

4.7.2 The equipment shall be so designed such that the total overall axle load for all the different variants of aluminium passenger railcars, fitted with necessary equipment and other accessories and laden does not exceed 16.25 t/19t provided track loading density is within permissible limit for IR track.

4.7.3 Axle load limitation shall be taken into account while finalising and designing the equipment layout giving due consideration to weight unbalancing during tare and payload.

4.7.4 All equipments shall be distributed within the railcar, so as to optimize the weight distribution and reduce the maximum axle load.

4.7.5 The weight per meter length of the aluminum passenger car body shell shall not exceed 370kg & 320 kg for Generator car and rest of other variant respectively.

4.7.6 The weight of the aluminium passenger car rolling assembly should not exceed 6.65 ton.

4.7.7 Calculations for lateral and longitudinal equipment balancing shall be provided for all variants of rail cars.

4.7.8 Weight calculations, for each type of car including all sub-components, shall be submitted as part of the design submissions prior to commencement of manufacture.

4.8 Reliability

4.8.1 Every complete car, as well as each constituent component, assembly, subsystem and system element shall be designed in such a manner as to perform its function reliably in revenue service. Each car under all system operating conditions shall operate with a minimum failure rate.

4.8.2 The railcars shall be designed to achieve a high level of Reliability conforming to EN50126-1, particularly under the extreme environmental conditions experienced in India.

4.8.3 No single-point failure shall cause complete failure or inability to control the brakes on a passenger train.

4.8.4 Where the system design of the equipments incorporates component redundancy as the method of reducing the consequences of a single point failure, such redundancy shall not allow hidden faults to remain undetected.

4.9 Environmental Noise Standards

4.9.1 **General**

4.9.1.1 The noise levels emitted from the railcars shall be as low as possible and the railcars shall be designed to prevent drumming, rattles or vibrations throughout the design life.

4.9.1.2 During the measurements, endwall doors between cars, body side doors, intermediate doors and windows of the vehicle shall be kept closed, unless their influence upon the sound level inside the vehicle is to be investigated.

4.9.1.3 All noise levels specified below are in decibels referred to 20 micro Pascal as measured with “A” weighting network of standard Type 1 sound level meter with time weighting F.

4.9.2 **Limits of Interior Noise**

The noise level inside the railcar except AC Generator car shall not exceed 60 dB (A) when stationary and shall not exceed 65 dB (A) at maximum service speed with all auxiliary equipment operating at its greatest noise output. The noise level shall be

measured in the railcar along the centre line at a height of 1600 mm above the floor. The measurement shall be done as per ISO 3381.

4.9.3 **Limits of Stationary Noise**

The limiting value for noise emission of the railcars shall be 65 dB (A) at a distance of 7.5 m from the centre line of the track, 1.2 m and 3.5 m above the upper surface of the rails. The measurement shall be done in accordance with the standard EN ISO 3095.

4.9.4 **Limits of Starting Noise**

The limiting value for noise emission of the railcars shall be 82 dB (A) at a distance of 7.5 m from the centre line of the track, 1.2 m and 3.5 m above the upper surface of the rails. The measurement shall be done in accordance with the standard EN ISO 3095.

4.9.5 **Limits of Passing - by Noise**

The limiting value for noise emission of the railcars shall be 81 dB (A) at a distance of 7.5 m from the centre line of the track, 1.2 m or 3.5 m above the upper surface of the rails. The passing – by noise shall be measured at 80 km/h and at maximum service speed. The value to be compared with the above limits is greater of the measured value at 80 km/h and the measured value at maximum service speed but referred to 80 km/h by following equation:

$$L_{pAeq\ Tp}(80km/h) = L_{pAeqTp}(v) - 30*\log(v/80)$$

Where

$L_{pAeq\ Tp}(v)$ = Measured value at maximum service speed

v= Maximum service speed

The measurement shall be carried out in accordance with the standard EN ISO 3095.

4.10 Dust and Noise Suppression system

Dust and Noise Suppression system of proven design suited to IR conditions shall be provided in railcars specified in clause 2.4.1.

4.11 Design Life

4.11.1 The railcars shall be designed for a life of 35 years.

4.11.2 The railcars shall be designed so as to minimise the risks posed by obsolescence. In particular, equipment shall, so far as practicable be modular, with clearly defined interfaces between modules.

4.12 Maintenance

Modular constructions shall be adopted and easy access for inspection and maintenance shall be given special consideration in the design and layout of the railcars.

4.13 Fire

4.13.1 The railcars shall be designed and constructed in accordance with BS EN 45545-4 Please refer to clause 5.35.2 of this specification.

4.13.2 A reliable fire detection and suppression system shall be provided, in accordance with Clause 5.35.3 hereof. Efficient means of communication between passenger and train driver/guard shall be provided.

4.14 Safety

4.14.1 Safety shall be of primary importance in the design of the car. The car shall present a safe, hazard-free environment to passengers, crew members and the general public. Passage through the car shall be easy and safe. No sharp edges or corners or pinch points shall occur where passengers, crew, or maintenance personnel may come into contact with them. Adequate handholds shall be provided throughout the car. Passengers and crew shall not be exposed to tripping hazards, exposed electrical voltage, toxic materials or similar hazards. Location, illumination levels, colours, graphics and surface finishes shall be selected to maximize visibility of door thresholds, windows, controls and other objects with which the passengers and crew must interface.

4.14.2 Normal and emergency equipment and controls which the passenger or crew may operate shall be clearly identified, and operating procedures shall be presented in both text and graphic formats. Passenger emergency signs shall also be embossed in Braille raised typeface.

4.14.3 All safety signs and evacuation signs shall be of photo luminescent material.

4.14.4 The railcars shall operate safely over the operating routes of Indian Railways.

4.14.5 The design and construction of the railcars shall not introduce uncontrolled risk to the Indian Railways or any other third parties.

4.14.6 The risks associated with the railcars shall be to a level that is tolerable and as low as reasonably practicable. To demonstrate this, the Partner shall apply internationally recognised safety criteria and submit details of these as part of the Designs and Drawings.

4.14.7 The Partner shall conduct a safety assessment in accordance with the requirements of EN 50126-1 to demonstrate that the safety targets and requirements detailed in this Clause 4.13 of this specification.

4.14.8 The partner shall produce all necessary safety documentation to address the requirements of EN 50126 and to assist the IR to ensure the safe operation and maintenance of the railcars over their entire design Life.

Chapter 5
Technical Requirements

5.1 Overall Requirement

5.1.1 This specification covers the particular requirements of design, construction, supply and commissioning into service the fully furnished and finished Broad Gauge light weight aluminium passenger cars.

5.1.2 Railcars shall perform satisfactorily up to test speed of 180kmph on IR High Speed routes maintained as per C& M Vol-I standard and should be upgradable to 200 kmph. The railcars shall have the following key features:

i. A design offering high level of safety.

ii. As much equipment as possible equipments shall be mounted either on the under frame or roof so as to maximise the space available to accommodate passengers. Where equipment is located inside the railcar body, it shall be located behind panelling and shall not reduce the space available to accommodate passengers.

iii. A robust interior design.

5.1.3 Mainline railcars shall have gangways between intermediate railcars to allow passengers to walk between them.

5.1.4 In developing the detailed design, the Partner shall acquaint itself and take note of passenger loading density especially during peak time, the route, environmental and operating conditions especially the monsoon and dusty atmosphere
.

5.2 Environmental Protection

Use of materials likely to cause environmental damage during the manufacture, Maintenance, operation and disposal of railcars shall be avoided. The materials listed in this clause are a minimum list of restricted material and the partner shall provide adequate evidence that all materials used shall not cause environmental damage.

The following material shall not be used:

i. Asbestos;
ii. Chlorofluorocarbons;
iii. Polychlorinated Biphenyls (PCBs);

iv. Exposed Lead and paints containing lead;
v. Chromates;
vi. Cadmium, except in Nickel Cadmium batteries; and
vii. Cyanide.

5.3 Operating Environment

5.3.1 All equipment shall be suitably protected from dust and water. As a minimum, equipment shall be sealed to the standards stated below :

i.	Under frame mounted equipments	:	IP65
ii.	Equipment mounted inside the railcar body	:	IP54

5.3.2 The equipment below the under frame sole bar shall be designed to withstand or be protected from repeated impacts from ballast up to 102 mm at speed of up to the maximum specified speed.

5.4 Railcar Design

5.4.1 Materials

5.4.1.1 The carbody design shall be made of Aluminium alloy extruded sections and plates typically used for rolling stock construction.

5.4.1.2 Aluminium alloy extruded sections should generally have hollow double layer cross section and be internally stiffened with ribs that triangulate the section geometry, or any other proven solution.

~~5.4.1.3 Machined, forged parts and castings should also be of aluminium alloys.~~

5.4.1.4 The vehicle side wall, roof, end wall and under frame shall be manufactured of Aluminium alloy hollow extrusion sections, fully welded with each other with localised backing plates. Where dissimilar materials are used, measures shall be provided to mitigate corrosion in the body due to electrolytic action.

5.4.1.5 Aluminium alloy 6005Ain fully heat treated condition or any other aluminium alloy superior to this shall be used for the underframe and side walls.

5.4.1.6 Aluminium alloy extrusion of grade 6106 or any other aluminium alloy superior to this shall be used for the roof extrusions.

5.4.1.7 Aluminium alloy extrusion of grade 6082or any other aluminium alloy superior to this shall be used for heavy gauge sections such as bolsters and head stocks.

5.4.1.8 The mechanical strength of Aluminium alloy extruded sections and plates shall be as per to EN755-2 & EN485-2 respectively.

5.4.1.9 Bimetallic contact between the aluminium alloys and any other material shall be avoided by means of the application of special, normally zinc rich product either in foil form or as varnish.

5.4.1.10 Partner has to develop a general application standard which sets forth which materials are to be used and the procedure to be followed for each type of joint of materials with a view to prevent corrosion.

5.4.1.11 Fiber-glass reinforced plastic (FRP), glass reinforced plastic (GRP) or any suitable composite materials may be proposed for appropriate elements of car interiors.

5.4.1.12 Throughout the design life of 35 years, the car body material shall not corrode or be etched by the environmental conditions that exist in India, to the extent that the original appearance of the car does not deteriorate to the extent that it cannot be restored by normal washing.

5.4.2 **Railcar body Structure**

5.4.2.1 Carbody shall be made of light aluminium alloy extruded sections and plates, fully welded to each other with localized backing plates.

5.4.2.2 Carbody design shall be such that weight saving is accomplished in the structure itself.

5.4.2.3 The car body shell structure shall consist of four main subassemblies:

a) Underframe
b) Sidewalls
c) Endwalls
d) Roof

5.4.2.4 The subassemblies are manufactured and welded individually so that lesser amount of welding will required for final carbody assembly. Most of the welds will be executed in subassembly stage rather than final assembly stage.

5.4.2.5 Large subassemblies shall be extremely suitable for automatic welding. Possibility of inserting welding preparations on the edges of the sections shall be ensured for achieving high quality welds.

5.4.2.6 The railcar body shall be lightweight and corrosion resistant and rugged to withstand the tractive and braking effort as well as impact and accidental damage.

5.4.2.7 The Mechanical strength of railcar body shall conform to EN 12663, P1 with the additional stipulation that 1500KN static tensile load shall be considered for design and testing purposes. Also design of railcar body shall be compatible in respect of crashworthiness with EN 15227 standard.

5.4.2.8 The design of the coach body shall be such as to ensure that under fully loaded condition the structure shall not sag below the horizontal plane throughout the vehicle's life of 35 years.

5.4.2.9 The railcar body shall be designed to achieve a life as specified in Clause 4.10 of this specification.

5.4.2.10 The railcar body shall be of an integral design, where under frame, sidewalls, end walls and roof shall be integrated so that the body structure contributes to strength of under frame and the unit as a whole behaves as a rigid tube in its ability to withstand loads. The body ends of the railcar shall incorporate an anti-telescopic feature.

5.4.2.11 The partner shall submit for IR approval, the types of materials and their respective locations to be used in the components of the carbody.

5.4.2.12 The method used by the partner to prevent corrosion from the inside surfaces of closed structural sections (i.e. inside of tubular sections) shall be identified at the design review. At a minimum, each such element shall include a drain hole.

5.4.2.13 There shall be no corrosion that reduces the load carrying ability below the design strength requirements for the design life of the vehicle. This can be met by material selection, coating or corrosion allowance and shall be submitted for review and approval at the design review.

5.4.2.14 Cross sectional views shall be provided on car shell drawings and must be submitted for approval at the design review.

5.4.2.15 Car shell drawings shall show the location of all principal framing members, their cross sectional area, material and metal thickness. Thickness of all sheathing materials shall be provided. This information shall be of sufficient detail to permit manufacture of structural parts necessary to repair damage to a car.

5.4.3 **Crashworthiness**

5.4.3.1 In order to deliver structural crashworthiness the railcars shall be designed to meet the requirements of EN 15227.

5.4.3.2 The car body design shall be suitable for passenger train compositions and shall be such that it is capable of absorbing collision energy in a manner so as to localize structural deformation at low energy levels.

5.4.3.3 Overriding requirements laid down in EN 15227 shall be achieved either though couplers having in built anti-climbing feature or by any other suitable method.

5.4.3.4 The car structure and its supplemental energy absorption devices shall be designed to minimize accelerations transmitted to passengers, by absorbing collision energy, whilst not permitting one vehicle to over-ride another, nor to telescope one into another. A suitable proven energy absorption feature with associated collapse shall be incorporated into the coupler. The coupler shall sustain no permanent damage when a fully loaded 24 car train (approximately 600 m length rake) collides with dead end at an impact speed up to 10 kmph. At higher energy levels it shall ensure that the collision energy is absorbed by progressive deformation of the vehicle end structure.

5.4.3.5 The partner shall submit predicted values for the following in respect of fully loaded cars. The Partner shall submit a detailed technical proposal and simulations / analysis to specify the following in respect of the fully loaded vehicle:-

(i) The maximum collision speed at which there is no structural damage to the car body and the coupler.
(ii) The minimum collision speed at which the coupler energy absorption device fails.
(iii) The minimum speed at which actual structural damage commences.
(iv) The maximum speed at which the car structural collapse features deform completely, without damage to the main car body structure.

5.4.4 **Fabrication**

5.4.4.1 The car body shall be fabricated in such a way so that the shells are identical to the maximum extent practical.

5.4.4.2 Welded construction is preferred to assemble the different elements of the vehicle body shell (side walls, endwall, roof, under frame).

5.4.4.3 Full details of the technique/technology employed for joining the modular elements of shells shall be furnished, along with details of quantity and service records of vehicles assembled using such techniques.

5.4.4.4 Fabrication practices shall ensure that the life of the vehicle is not shortened because of fatigue, corrosion, breakage or wear.

5.4.4.5 Maintenance practices shall be considered so that parts are not easily lost and cannot be installed in more than one orientation.

5.4.4.6 A sufficient number of jigs, fixtures and templates shall be used to assure interchangeability of components and uniformity of structure throughout the fleet.

5.4.4.7 Underframes, side walls, end walls and roofs shall be built on jigs. All weld and bolt patterns shall be identical on all cars. To the extent possible all equipment hangers shall be interchangeable on all cars without the use of shims or elongated holes.

5.4.4.8 All structural welding practices shall be according to the latest requirements of American Welding Society or equivalent International standards.

5.4.5 **Equipment Mounting**

5.4.5.1 All equipment mounting shall withstand maximum accelerations in vertical, longitudinal & transverse directions according to standard EN12663 for P1 category vehicles.

5.4.5.2 All equipment mounting shall withstand fatigue loading for 107 cycles according to standard EN12663 for P1 category vehicles.

5.4.6 **Lifting and Jacking**

5.4.6.1 The railcar body shall lend itself to repeated lifting in workshops by overhead cranes or jacks without risk of damage.

5.4.6.2 Suitable lifting pads shall be provided and marked in a readily distinguishable manner on the railcar body.

5.4.7 **Appearance**

5.4.7.1 The design of the railcar exterior shall generally be aesthetically pleasing, and shall minimize build up of dirt.

5.4.7.2 The exterior surfaces shall be flat within the following tolerances when measured over a distance of one meter and in similar proportion for shorter length on railcar body shell without any filler.

Sides	≤ 0.5 mm
Ends	≤ 3 mm
Roof radius and center part of roof	≤ 3 mm

5.4.8 **Emergency Ingress / Egress Locations**

5.4.8.1 A location shall be provided in the railcar where emergency services may cut through to gain access to the interior of a railcar that has rolled on to its side. This space shall be clearly labelled to enable emergency services to immediately identify the appropriate space and cut lines. The location shall be adequate to enable a stretcher born patient to be removed from the railcar. To the extent possible, the region to be cut shall be devoid of any cables/ pipes or miscellaneous equipments that may impede access.

5.4.8.2 **Positioning of emergency exits-** vehicles shall have a minimum number of emergency exits on each side .The following rules apply.

- The distance to be covered between any seat and emergency exit must be less than 16m.
- The number of emergency exits per vehicle must be at least 2 for less than 40 passengers and at least 4 for more than 40 passengers,
- The emergency exit must be provide an access space of at least 700x 600 mm.
- The emergency exit must not be located in the deformable crumple zone designed to improve crashworthiness.

5.4.8.3 **Operation of emergency exits-** In an emergency, it must be possible to leave the train in following ways :

- Through windows, by pushing out window or pane or by breaking the glass.
- Through the compartment doors, by rapid un-mounting of the door or breaking the glass.
- Through the access doors, by pushing out pane or breaking the glass.

5.4.8.4 Adequate nos. of emergency exits on each side shall be provided and clearly labelled.

5.4.8.5 Window fitted as emergency exits must be made of tempered or laminated glass. Where tampered glass is used, the coaches shall be equipped with hammers to break the glass.

5.4.8.6 Where laminated glass is used, evacuation is possible by:

- Either pushing out the pane.
- Using special laminated glass that can be broken with a hammer, requiring little time to get through.

5.4.9 **External Fittings**

5.4.9.1 Rainwater gutters shall be provided as follows:

- Continuous gutters from one end of the railcar to the other shall be provided
- Additional gutters of suitable design over the doorways shall be provided.

5.4.9.2 Gutters shall be designed taking into account the climatic conditions prevalent in India.

5.4.9.3 Tail lamp bracket to IRS drawing No. C/BF-1113 shall be fitted at each end of shell.

5.5 Rolling Assembly Design

5.5.1 General Requirements of Rolling Assembly Design and Features

5.5.1.1 Each car shall have two 4-wheel bogies or rolling assemblies of robust welded design suitable for taking brake equipments, suspension unit, suspension etc. and capable of withstanding the maximum static and dynamic load conditions as specified in this specification. The maximum permissible static load per axle shall be 16.25 t/19tt (provided track loading density is within permissible limit for IR track) and shall be designed to operate at a maximum service speed of 160 km/h and shall be upgradable to 200 km/h. The weight of the bogies or rolling assemblies shall be as low as possible and shall not exceed 6.65 ton and consistent with strength & robustness.

5.5.1.2 In case of bogies are used the wheel base shall be 2200mm (min.) to 2600 mm (max.).The partner shall propose suitable bogie wheel base in order to limit the rail wear when moving on small radius curves and achieve stable performance.

5.5.1.3 Suspension design shall be coil steel or conical rubber suspension. The bogie or rolling assembly could be with bolster or bolster less. The rolling assembly includes frame, wheel/axle sets, and all components related to the suspension system. Interfaces requiring welding or the removal of metal on structural members, including suspension components mounted to the car body, shall be considered part of the rolling assembly.

5.5.1.4 Rolling assemblies shall utilize proven designs, components, and configurations designed to operate as per this specification. Evidence of design and operating environment similarity will be a pre-requisite to approval of any such concessions.

5.5.1.5 Rolling assemblies shall have a service life of 35years without structural repairs under standard maintenance practices and service. Elastomeric elements, dampers and other consumable bogie mounted components, with the exception of items like brake shoes, shall have a minimum service life of 5 years.

5.5.1.6 Rolling assembly designs shall comply with the requirements of this section of the Technical Specifications with the lowest possible bogie weight.

5.5.1.7 The rolling assembly systems shall safely function at all speeds up to and including the safe design speed without any loss of stability, under all conditions of track and car wear on the system.

5.5.1.8 The rolling assembly design shall minimize flange contact especially on curves on all tracks to minimize wheel and rail wear.

5.5.1.9 All rolling assemblies shall have components that are interchangeable to the largest extent possible. Rolling assemblies frames shall be identical for all bogies. All similar rolling assemblies must be interchangeable without modification to the bogie assembly.

5.5.1.10 Bogies or rolling assemblies shall have provision for jacking the assemblies safely and without damage to any of its components. In case of using pads jacking pads shall be provided beneath all bogie frames for use during maintenance and re-railing. Jacking pads shall have an anti-slip finish. Lifting eyes shall be provided to permit bogie assemblies to be lifted once removed from beneath the car. Appropriate means shall be provided to prevent suspension elements from over-extending during jacking or lifting actions.

5.5.1.11 Under the worst condition the clearance between lowest part of the bogie rolling assembly and rail level shall be as per the moving gauge. There shall be at least

102mm clearance between the lowest element on the rolling assembly and the top of the rail under the worst conditions of maximum loading.

5.5.1.12 There shall be sufficient clearance (but not less than 25 mm between the rolling assembly and car body to allow the car to operate with a deflated secondary suspension system such that damage does not occur at maximum operating speeds under conditions of maximum loading and maximum wheel and suspension system component wear, including creeping or settling.

5.5.1.13 Vulnerable equipment, such as conduit, wiring and piping, shall be located as far as is possible above the clearance plane.

5.5.1.14 All rolling assemblies shall be designed and manufactured by a builder having a history of producing proven bogies/wheel set.

5.5.1.15 Rolling assemblies shall be easily removable from the car body for maintenance, without the use of any special tools. Car body to rolling assembly connections shall not contain any press fit joints. Any joints on the rolling assembly, which could become frozen or locked over time, shall be sealed from moisture and appropriate materials shall be used to prevent such conditions from occurring.

5.5.1.16 Rolling assembly mounted equipment shall be designed to operate satisfactorily in the environment.

5.5.2 Rolling Assembly Frames

5.5.2.1 The frame shall be of copper bearing steel plates to EN10025-2 grade S355J0, and shall be fabricated by welding. Special care shall be taken in the design and construction of all joints in the rolling assembly frame and the attachment of heavy equipment thereof to ensure that the connections are rigid and are of adequate strength to withstand the severest strain under the worst operating conditions, and further that sudden changes in section are avoided to prevent concentration of stress at or near the joints.

5.5.2.2 Any alternative, steel equivalent to copper bearing steel with similar chemical composition and mechanical properties in regards to strength and corrosion resistance may be used by the partner with prior approval by the RDSO.

5.5.2.3 In case of using bogies safety stops shall be provided on the top of the bogie frame to match with similar blocks on the underside of the superstructure, and shall support the latter at an adequate height to prevent fouling with platforms and other fixed structures, in the event of failure of the pneumatic suspension.

5.5.3 **Suspension**

5.5.3.1 All rolling assemblies shall have suspension systems designed to meet the requirements of this section of the Technical Specifications. Suspension components shall have characteristics optimized to perform with the track geometry as defined in technical specification and shall achieve the ride quality identified in this specification without causing undue rail, wheel, or car component wear. In case of separate primary and secondary suspension, the primary suspension shall consist of helical springs or conical rubber spring with non-linear characteristics and articulated or rigid axle guidance, with or without external hydraulic shock absorber. Care to be taken for ballast hitting and dust sealing.

5.5.3.2 Elastomeric springs, if used, shall have a minimum amount of "creep". Elastomeric springs shall be subject to an approved program of preloading or exercising at assembly of the bogie to compensate for the deflection caused by initial "creep" of the elastomer. Provision shall be made in the rolling assembly design to compensate for "creep" and keep the rolling assembly properly levelled and trammelled.

5.5.3.3 Coil springs, if used, shall meet the requirements of AAR M-114 or EN 13298. Suspension characteristics shall be selected so as to avoid resonance between the various elements of the car systems including the car body. Rolling assemblies and body frequencies shall be suitable separated.

5.5.3.4 In case of separate primary and secondary suspension, the primary suspension shall consist of elastomeric elements, such as chevrons, coiled steel springs, or conical rubber springs. The primary suspension shall be capable for sustaining track perturbations under given vertical and lateral load conditions up to a maximum frequency of 12.0 Hz.

5.5.3.5 In case of separate primary and secondary suspension, the secondary suspension shall be of air springs spaced as far as possible, firmly located on the spring plank and bolster and with stops to prevent excessive deflections due to overloading or excessive rolling of the superstructure.

5.5.3.6 In case Y frame bolster less rolling assembly, the air spring shall be placed suitably and firmly between rolling assembly frame and body bolster with additional reservoir located as near as possible to the air spring. The anti roll bar mechanism can be incorporated to prevent excessive rolling of car body. The value of roll coefficient shall be less than 0.3 as per UIC 515-4 and 615-4.

5.5.3.7 Springs for suspension shall be designed to cater for actual service conditions and the final design of springs shall be submitted to the IR for approval.

5.5.4 Rolling Assembly Design Validation

5.5.4.1 Approval of Design Data

The partner shall submit for the approval the design data and calculations for all rolling assembly components including, but not limited to, the bogie frame, wheel/axle sets, bearings, and suspension systems. The data shall include a general description of system operation, drawings or layouts with components clearly identified.

5.5.5 Stress Analysis Requirements

5.5.5.1 A structural finite element analysis of the proposed rolling assembly design, including rolling assembly frame, radius rods and their attachments, shall be submitted for review. This shall include data on stresses under static and dynamic conditions. Allowable stress values including, endurance limit data for base material and connections shall be clearly identified for the material proposed. The material strength data shall be substantiated by citation of published sources. The stress analysis shall demonstrate that the bogie frame members and structural connections comply with the requirements of Technical specifications and shall be submitted for approval before bogie production commences.

5.5.5.2 Welded and bolted connections shall be analyzed in detail to demonstrate compliance with static and fatigue strength requirements of this Specification.

5.5.5.3 If existing rolling assembly designs are being used, the partner may demonstrate the integrity of the rolling assembly frames and bolsters through previously conducted stress analyses and static and fatigue testing. In such a case:

a. The partner shall categorically demonstrate that analyses and tests have input load values, load combinations and allowable stress and fatigue life criteria closely comparable to those proposed for the Project.

b. The partner shall demonstrate that the rolling assembly design is compatible with the collision requirements of the Technical Specification.

5.5.6 **Rolling Assembly Strength**

5.5.6.1 The mechanical strength of the rolling assembly frame shall comply with the requirements of UIC 615-4, UIC 515-4 or JIS E 4207 for static test under exceptional loads and fatigue tests. The maximum stress developed under static load shall not exceed 85% of the yield strength of the material. The dynamic effects due to the inertia of the motors and transmission shall also be simulated along with traction and braking forces.

5.5.6.2 The number of seated passengers shall be taken as one per seat, and standing passengers as 4/square meter according to UIC-515-4 / UIC 615-4 for all the above mentioned strength analyses.

5.5.6.3 Loads shall be taken in accordance with UIC 615-4 and UIC 515-4, except as noted. The partner shall insure that any other loads that may arise on the rolling assemblies due to the particular configuration chosen are adequately taken into account.

5.5.7 **Vehicle Dynamics Simulation**

5.5.7.1 It is mandatory for the partner to conduct vehicle dynamic simulations on the coach rolling assembly in following domain of analysis and submit the results in the form of a report to the RDSO, before finalizing optimized suspension design of coach bogie.

5.5.7.2 Frequency domain analysis for evaluating critical speeds.

5.5.7.3 Time domain analysis –for evaluating riding quality and safety against derailment on given BG track up to maximum test speed (10% higher than operating speed) as per UIC norms. The simulation results shall exhibit satisfactory riding and stability performance up to maximum test speed.

5.5.7.4 The vehicle dynamics software package used for conducting simulation studies should be specified in the report.

5.5.7.5 The natural frequencies of vehicle suspension in bouncing, pitching and rolling mode under tare and gross load condition as obtained by simulation / calculation along with damping factor is to be furnished by the partner.

5.5.7.6 The partner shall submit a detailed dynamic model to demonstrate the running behaviour and performance characteristics of the proposed service proven rolling assembly design.

5.5.8 **Derailment Safety and Stability**

5.5.8.1 The design of the rolling assembly, including the wheel profile, shall prevent the generation of high Lateral to Vertical force ratios on any wheel that could result in derailment under all track conditions defined in specification, and at all permitted car speeds over the alignment, up to 10% above the maximum speed permitted, the L/V ratio shall not exceed Nadal's limit under railhead coefficient of friction conditions up to and including 0.5. Yard operation and deflated secondary suspension conditions shall also be considered.

Nadal's limit is the limiting L/V ratio for a single wheel and is defined as:

$$\frac{L}{V} = \frac{\tan(\delta) - \mu}{1 + \mu\tan(\delta)}$$

Where:

L is the lateral force component exerted by the single wheel on the rail.

V is the vertical force on a single wheel.

δ is the flange angle of the wheel relative to the rail.

μ is the wheel to rail coefficient of friction.

Dynamic requirements shall be compliant with the specific Indian regulations and legislation.

5.5.8.2 The rolling assembly suspension, in conjunction with the carbody, shall be designed to enable cars to operate satisfactorily on track with the maximum specified track twist. The maximum off load of wheels shall not exceed 50% of nominal wheel loads in inflated up to maximum permissible speeds and shall not exceed 65% of nominal wheel in deflated conditions up to maximum permissible speeds.

5.5.8.3 The axles yaw stiffness and the rotational resistance of the complete rolling assembly shall be such that the lateral flange forces generated when negotiating the track alignments for the route specified are not so high as to lead to excessive rail wear and wheel flange wear, but shall be sufficient to obviate rolling assembly or wheel hunting.

5.5.8.4 The partner shall submit calculations to confirm that the derailment quotient Y/.Q shall not exceed 1.0 under the most adverse conditions, where Y & Q are the instantaneous lateral force on the wheel flange and the instantaneous vertical load on that wheel tread respectively under the most adverse conditions.

5.5.8.5 The partner shall submit a proposal covering the scope of the analysis and the model for review by RDSO. The maximum values of acceleration measured at central pivot level shall not exceed 0.27g in both Vertical and Lateral.

5.5.8.6 The Ride Index shall not exceed 2.75 in both vertical and horizontal directions in inflated condition of suspension.

5.5.8.7 The RI Calculations shall be done as per para 2.1 of ORE Report no.8 of C-116 using FFT method (Fast Fourier Transformation Method).

5.5.8.8 In case of using bogies, rotational resistance (X factor) test under inflated and deflated air spring conditions would be carried out at the manufacturer's works under tare conditions, at rotational speed of 0.8 degrees/second. The procedure shall be as detailed in EN14363. Analysis of track twist performance shall be done for the leading wheel set using the wheel unloading factor ΔQ/Qo and the bogie rotational factor X. The wheel unloading factor, ΔQ/Qo shall be equal to or less than 0.6 and the rotational resistance factor, X shall be equal to or less than 0.1. The rotational resistance shall neither cause excessive flange wear nor cause any possibility of flange climbing but shall be adequate to avoid bogie hunting on straight track. The Partner shall show by analysis that no flange climbing occurs on any curve and moving at all possible speeds.

5.5.8.9 The Dynamic Analysis, to evaluate the running behaviour of the cars with the proposed bogie design, shall be carried out by means of theoretical calculations applying multi-body simulation techniques. The following parameters, at a minimum, shall be evaluated / analyzed.

i. Natural frequency of the suspension
ii. Stability of the car
iii. ΔQ/Q for the track twist
iv. In case of bogies, its rotational resistance
v. Wheel wear index at the tread and flange
vi. Derailment quotient Y/Q
vii. Carbody accelerations
viii. Curving capability and any tendency to hunt
ix. Ride index lateral and vertical

5.6 Wheels, Axles and Roller Bearings

5.6.1 Railcar axles shall be designed in accordance with BS EN 13103– 'Railway Applications – Wheel Sets and Bogies – Non-Powered axles – Design method' or other equivalent internationally recognised standard.

5.6.2 Wheel sets shall be in accordance with EN13260 – "Railway Applications – Wheel Sets and Bogies – Wheel Sets – Product Requirements" or other equivalent internationally recognised standard.

5.6.3 Axles shall be manufactured in accordance with EN13261– "Railway Applications – Wheel Sets and Bogies – Axles – Product Requirements" or other equivalent internationally recognised standard.

5.6.4 Wheels shall be manufactured in accordance with EN13262– "Railway Applications – Wheel Sets and Bogies – Wheels – Product Requirements" and wheel shall be designed in accordance with EN13979-1+A1 – "Railway Applications – Wheel Sets and Bogies – Monobloc Wheels – Technical Approval Procedure – Part 1 – Forged and Rolled Wheels" or other equivalent internationally recognised standards (EN/UIC).

~~5.6.5 Material of wheels may alternatively be in accordance with IRS R – 19/93 Pt. II and material of axles shall be in accordance with the IRS R -16/95.~~

5.6.6 Wheel and axle dimensions shall meet the requirements of Indian Railways Schedule of Dimensions, 1676 mm gauge.

5.6.7 The design of the wheel shall be so optimize for IR operating conditions so as to eliminate issues like wheel shelling etc.

5.6.8 All roller bearings shall have L-10 life of 3 x 106km, when computed as per method given in ISO Standard ISO 281/1.

5.7 Couplers and Draft-gear

5.7.1 Each car shall be provided with High tensile AAR 'H' type Tight Lock Centre Buffer Coupler at the front and rear end and should be capable of being coupled with AAR type "E" / H centre buffer couplers fitted on locomotives .In case of articulated cars any other service proven couplers can be provided between intermediate connections of two cars.

5.7.2 In case the draft gear is of purely mechanical type with elastomer spring pads, the draft gear should preferably be balanced in terms of latest revision of RDSO specification no. RDSO/CG/2011/CG-03.

5.7.3 The “Coupler System” should allow a vertical angle of deflection of ± 7 deg. and horizontal angle of deflection of ± 18 deg.

5.7.4 The coupler shall, in conjunction with the draft-gear automatically effect mechanical coupling in straight lines, curves with radius greater than 250 m and also (with some limitations) in transition between straight lines and a curve. It shall permit separation of cars manually from the track.

5.7.5 Height of the coupler shall be 1105mm (+0 / -15 mm) in the same alignment of the under frame structure under tare.

5.7.6 The coupler and draft-gear shall be capable of gathering, engaging and coupling units on all track conditions detailed in the environmental chapter. Under these track conditions, the design of coupler head shall enable coupling of two couplers with a maximum vertical displacement of their centre lines of by 90mm without manual assistance and horizontal gathering range of the coupler heads shall be 110mm on either side of longitudinal centre lines of the cars without manual assistance.

5.7.7 The coupler shall be equipped with a self-centring device to prevent the coupler from swinging transversely when uncoupled. The couplers shall care for all suspension conditions and dynamic movements encountered during operation.

5.7.8 The couplers shall be easily replaceable in the event of becoming damaged, it shall not impede the anti-climbing feature (if provided in coupler) in the event of a collision.

5.7.9 The couplers shall provide jerk free operation and incorporate longitudinal resilience sufficient to absorb shock loads during the transmission of traction and braking forces. The longitudinal stiffness characteristic of all couplers shall be identical.

5.7.10 Capacity of draft gear shall be adequate to meet operating requirements of the fully loaded 26 railcars with all types of single/multiple locomotive units over IR.

5.7.11 Couplers should be suitable for over-riding and crashworthiness requirements in reference to EN15227.

5.7.12 Required type test for couplers and draft gear to be conducted as per the latest international standards with the test plan being submitted for approval of IR.

5.8 Gangways

5.8.1 The railcars shall have suitable gangways at each end connecting to the adjoining railcars.

5.8.2 The gangway, comprising two gangways half, is the flexible part of the vehicle absorbing all relative movements between the car bodies and ensuring the passenger a safe and comfortable passage-way from on car to another.

5.8.3 The design and construction shall be maintenance free and guarantees a long service life.

5.8.4 Gangways shall be completely weather, draught and vandal proof and suitably sealed against dust and noise as per international standards.

5.8.5 The floor plate in the inter-railcar gangway shall be maintained as nearly as possible at the same height as the rest of the railcar floor. The height difference shall be kept to a minimum, and shall not exceed 20 mm whilst stationary or moving. Height changes shall be suitably ramped so as not to cause inconvenience to passengers.

5.8.6 The design of the floor shall be such that the relative movement between adjacent vehicle ends does not cause sliding floor plates to lift in such a way as could cause injury, in particular to sandal-clad or bare feet.

5.8.7 The gangway floor shall be designed to meet the same strength requirements as the rest of the railcar floor.

5.8.8 The inter-car gangways shall be arranged so that litter left in the gangway cannot accumulate, and is readily removable, without having to disconnect gangways.

5.8.9 The centre line of the gangway shall be coincidental with the centre line of the Vehicles.

5.8.10 The gangway shall be provided with sufficient thermal and acoustic insulation to ensure that the overall air conditioning performance and noise performance of the train are achieved.

5.8.11 The gangway shall maintain its performance and remain stable over the full range of relative vehicle movements encountered in normal operation.

5.8.12 Sealing of the gangway shall eliminate leakage of water into the saloon area.

5.8.13 The gangways provided at the ends of the railcars, shall be designed to allow the railcars be easily separated.

5.8.14 Minimum width of vestibule passage on 175M curve and with buffers/couplers under full compression shall be 800mm.

5.9 Railcar Interior

5.9.1 The passenger cars Interiors are defined by the distribution of seats/berths/chairs, lining, toilets, partitions, on board equipments, lights etc. It shall be designed in order to fit with long distance transport capacity requirements and comfort needs. The partner shall provide a conceptual layout in the technical proposal. The layout shall be reviewed during preliminary design phase.

5.9.2 The requirements include but are not limited to:

(i) Type of Seats/ Berths & Chairs (width, comfort etc) and supports;
(ii) Number of Seats/Berths & Chairs
(iii) Distribution of Seats/Berths/Chairs and supports.
(iv) Lavatories

5.9.3 All passengers transported in a train consisting of different variants of railcars, shall be able to move in the complete passenger train without any fixed obstacle made up by car components or seats in their way.

5.9.4 Aesthetically pleasant Interiors shall be provided.

~~5.9.5 Open gangways between Sleeper cars are required.~~

5.9.6 This objective shall be met by:

(i) the surface of floor all at the same level, no step is authorized,
(ii) adequate open space for standing passengers next to the saloon doors,
(iii) maintaining a minimum free passage in the area accessible to the passenger with wheel chairs (relevant standard UIC 565-3),
(iv) ensuring good visibility of all obstacles inside the car under any light condition

5.9.7 The passenger cars shall be designed to transport all population, including valid people, children, passengers with luggage, senior citizens, slightly disabled people, blind or deaf people, handicapped persons, including non-ambulatory persons in wheelchairs.

5.9.8 The dimensions of the « standard » Passenger are characterised by the anthropometric models of the male and female of the Indian population.

5.9.9 Design of the passenger cars shall be suitable for passengers from the size to children of 1m meter height to the 95th percentile of male population. Average weight of each passenger is estimated to be 80 kg.

5.9.10 Where applicable the interiors of the railcar(s) shall meet the interior load case requirements given in UIC 566 or equivalent international specification.

5.9.11 The railcars shall be provided with aesthetically designed comfortable Seats/Berths with a rigid surface. The seats/berths shall be constructed of a material having the same level of vandalism resistance as stainless steel. The seats/berths shall be designed to prevent slipping when the railcars Train accelerates and decelerates.

5.9.12 Compartment for physically challenged passengers shall be provided in at least one of the variants of sleeper as well as seating type cars. The compartment shall be positioned so that there is direct access from the body side doors on each side of the railcar into the compartment. A partition with a door shall be provided between the disabled compartment and the remainder of the railcar.

5.10 Floor

5.10.1 Flooring shall remain non-slip and not present a hazard to passengers when wet.

5.10.2 The transition between saloon floor and gangway vestibule between cars shall be smooth and free from steps and unduly steep gradients, which would impede the flow of passengers between cars.

5.10.3 The non-skid floor structure shall be floating floor type comprising of aluminium or stainless steel honey-comb boards/ply boards with cork, rubber cushion, glass wool insulation and floor covering to achieve low noise level inside the cars and less weight

5.10.4 The floor installation shall be continuous over the complete area of the saloon without floor traps, gaps, or holes.

5.10.5 The floor covering shall have a proven record of successful use in comparable Railway applications; a service life of 15 years should be provided.

5.10.6 It shall be feasible to replace all, or sections of the floor covering and coving during the life of the car if necessary. The floor design shall allow the floor covering to be removed without damage to the floor sub-structure

5.10.7 Mounting structure of floor shall be designed to withstand any loads that may be applied over 35 years in normal operation of passenger cars.

5.10.8 Floor covering material shall be laid with the minimum number of joints. Floor covering shall be so arranged to ensure that the bend radius required at the plinth base does not coincide with a joint in the covering that will affect the visual continuity between the plinth and floor. Where joints occur, they shall not coincide with those of the floor boards. Joints shall be sealed against the ingress of dirt, moisture and water. Any sealant used shall be coloured to match the background colour of the floor covering.

5.10.9 The total floor structure shall provide a fire barrier of 30 minutes duration in accordance with NFF 16103 or equivalent internationally accepted standard.

5.10.10 The sub-floor shall be insulated for anti-drumming and noise suppression.

5.10.11 Floor covering shall show no significant signs of wear. Test results for abrasion shall be submitted.

5.10.12 Flooring shall remain colour fast under the following BS 1006conditions specified below. Flooring with minimum colour fastness according to EN ISO 4892-2 is also acceptable.

(i) Light
(ii) Shampoo
(iii) Dry cleaning
(iv) Water spotting
(v) Acid spotting
(vi) Alkali spotting
(vii) Rubbing

5.10.13 Flooring shall be easily cleaned with the minimum of effort using readily available cleaning agents meeting the requirements.

5.10.14 Flooring shall not require glazing, polishing or any other post-production refinishing in short intervals to maintain its finish; the cleaning procedure shall be submitted.

5.10.15 Flooring shall suit regular cleaning schedules and during service and shall not appear dirty between scheduled cleaning.

5.10.16 The flooring shall not be damaged or discoloured by materials usually encountered in depot or service use.

5.11 Habitability

Adequate height from floor to ceiling considering anthropometric data of Indian population shall be provided in the saloon areas and at ends close to the gangways and in the gangways.

5.12 Lining

5.12.1 External panelling, including the under surface of the car roof, floor sheet and all interior surfaces of car body side panels shall be coated with suitable anti-drumming compound for noise suppression.

5.12.2 The body side and roof outer skin shall have a suitable thickness of approved acoustic insulating material bonded to their interior surfaces.

5.12.3 The design of interior fittings shall be safe under all conditions of passenger impact, during emergency braking and buffing under full load condition.

5.12.4 All non-metallic materials shall satisfy the requirements of flammability, toxicity and smoke emission limitations.

5.12.5 All interior surfaces must be finished with good blending and good slow ageing properties to provide a pleasant, high-quality interior and for ease of cleaning and maintenance.

5.12.6 All internal panel surfaces shall be smooth finished with modern low flammability, low smoke emission and low toxicity material in accordance with latest international norms. All internal panels shall be resistant to graffiti, scuffing, vandalism and cleaning agents. Rounded corners or covings shall be provided wherever mutually perpendicular flat plane surface about.

5.12.7 All linings should be of modular design, easily and rapidly removed and replaced independently from each other by specialist personnel, but difficult to dismantle for non-specialists.

5.12.8 Since these measures cannot be totally effective, the fittings and materials shall be easily cleanable (paint, graffiti, glue, etc.). They shall therefore withstand frequent use of various cleaning products (alkaline or acid detergents, petroleum solvents, mechanical action of brushes) without losing their colour or a noticeable deterioration of their surface aspect.

5.12.9 As far as possible, fastening devices, fixings and securing screws shall not be visible from within the saloon.

5.12.10 Gaps between all interior lining panels, kick strips, seat/berth shell, etc. shall be minimized. The effects of thermal expansion shall be taken into account and all unsealed gaps shall not exceed 2 mm in depth wherever feasible. Suitable cushioning at panel joints shall be provided to suppress noise.

5.12.11 All non-metallic materials within the car saloon shall not give rise to generation of static charge on persons or equipment within the saloon.

5.13 Air Ducts and Diffusers

5.13.1 The cold and warm air is carried from the one or two carriage ends via a supply duct through perforated ceiling or supply air grills in to the railcars.

5.13.2 The design of duct shall ensure that the air supplied over the entire duct length with a uniform flow and inlet rate into the passenger compartment. The ducting is connected to the RMPU via a silencer and a vibration-dampened duct connecting piece.

5.13.3 Modular type duct shall be provided. Considerations shall include, but are not limited to, thermal insulation performance, as required, to prevent condensation on the exterior of the duct under all conditions, acoustic insulation such that the interior noise requirements are met, weight, appearance, and ability to repair.

5.13.4 The air velocity within the duct work is not specifically limited but shall be such that, in combination with the acoustic insulation, shape, and diffuser design, the interior noise and vibration requirements.

5.13.5 Fresh air shall be drawn from grilles into the suction plenum. The grille shall be designed to prevent water ingress resulting from adverse weather or train washing.

5.13.6 Conditioned air from each unit shall be directly introduced into duct discharge into the car through ceiling outlets.

5.13.7 The duct shall be constructed from anodized aluminium / suitable composite material and all edges and joints of duct insulation shall be sealed.

5.13.8 The partner shall take into consideration the requirement of maintenance access for duct cleaning as and when required.

5.13.9 A model of the proposed duct made of plywood or any other suitable material shall be prepared to evaluate the design parameters, including air velocity from the outlets and air distribution inside the car.

5.13.10 Air diffusers shall be mounted on each side of ceiling panel, blending well with the car interior design.

5.13.11 Conditioned air shall be delivered to the passenger areas through adjustable diffusers which may be integral with the main interior lighting fixtures.

5.13.12 The diffuser shall be installed in the vertical side of each duct. Colour of the diffusers shall be in accordance with the interior design requirements.

5.13.13 Necessary calculations in support of the duct design shall be provided by the partner.

5.14 Toilet System

5.14.1 All sleeper & chair cars (except restaurant car and generator van) shall generally include four & three modular design toilets respectively or basis of no. of modular toilets per coach will be minimum one toilet per 25 passengers with a minimum of two toilets per car of each Indian and western style. The minimum area for each toilet shall be approximately 1.3 sq meters.

5.14.2 Indian style toilets shall be of squatting type with washing facility and western style toilet shall be of sitting type with plastic cover.

5.14.3 Passenger car's toilet shall have environment friendly toilet System. Toilets should not discharge human waste at the stations and final disposal of the waste should be in an environment and maintenance friendly manner.

5.14.4 Minimum no of toilets and its type in restaurant and generator van may vary and shall be finalised in consultation with IR.

5.14.5 The height difference between toilets floor and rest of the car floor shall be minimized.

5.14.6 No. of toilets and distribution of toilet type in all cars shall be incorporated in layouts and got approved from IR.

5.14.7 Each toilet shall include the following equipment:

i. Mirrors
ii. Wash basin
iii. Toilet paper dispenser (In Western style WC)
iv. Liquid soap dispenser& soap holder
v. Waste container
vi. Coat hooks (Two)
vii. Lighting and fan
viii. Flush push button
ix. Grab handle
x. Water tap near WC and 01 bowl/mug for water with stand.
xi. Lavatory engaged / free indication light shall be provided at both ends inside the railcar at convenient location, this light shall be generally visible throughout the railcar.
xii. Rail for securing Wheel chair (in toilet for disable only).
xiii. Table for babies

5.14.8 The soap dispenser shall be integral part of the toilet wall panel to make it vandal proof.

5.14.9 The toilet tanks shall be mounted so as to be readily removable for repairs. Only a side filling arrangement shall be provided for filling water.

5.14.10 Suitable device for extraction of foul air from toilets shall be provided.

5.15 Water Tanks

5.15.1 Under-slung and interconnected water tank/s with a capacity sufficient to cater a minimum requirement of 20 litre water per passenger shall be provided. Water shall be suitably pressurised or pumped for supply of water from tank/s to lavatories. In addition, each lavatory shall be provided with one overhead water tank of minimum 30 litter capacity. Protection against corrosion as well as anti-corrosive features shall be adopted while material selection is being done.

5.15.2 No. of tanks may be vary according to water requirement of the particular variant of the car.

~~5.15.3 Minimum water capacity requirement per car shall be as under:~~

~~S.No~~	~~Type of car~~	~~Water requirements (in litres)~~
~~1.~~	~~AC First class sleeper Car~~	~~1370~~
~~2.~~	~~AC 2-Tier Sleeper Car~~	~~1820~~
~~3.~~	~~AC 3-Tier Sleeper Car~~	~~1820~~
~~4.~~	~~AC Hot Buffet Car~~	~~2055~~
~~5.~~	~~AC Generator Car cum Luggage cum Brake van with compartment of PWD~~	~~1370~~
~~6.~~	~~AC Restaurant Car~~	~~2055~~

5.15.4 Mechanical strength of the water tanks and their suspension shall meet the requirement as per Para 2.1.4 of UIC566 or equivalent international specification.

5.15.5 The underslung tanks shall be able to withstand flying ballast.

5.15.6 The tanks shall be provided with a discharge facility and shall be easily cleanable when necessary.

5.15.7 Passenger cars are designed for a service life of 35 years. The water tanks are to be developed accordingly.

5.16 Seats/Berths & Chairs

5.16.1 The seats/berths & chairs shall provide an adequate level of comfort, have a good appearance and be scuff and vandal resistant and their mountings shall be capable of withstanding the loads arising in service conditions.

5.16.2 The seats/berths & chairs arrangement with the size, colour, profile and shape of the individual seats/berths chairs shall be ergonomically designed.

5.16.3 The seats/berths & chairs shall be formed of either metal aluminium alloy or FRP mouldings on metal supports.

5.16.4 The Middle and Upper berths of AC sleeper cars shall have arrangement which shall provide resistance to passenger movement longitudinally along the vehicle during acceleration and braking etc.

5.16.5 The head room between the berths in sleeper cars shall be adequate for passengers.

5.16.6 Silicon foam cushioning material to RDSO specification RDSO/2013/CG-13 with latest amendment/revision shall be used in Seats/Berths & chairs.

5.16.7 Seats/Berths & Chairs shall be upholstered and shall not have sharp edges or protrusions that could cause injury to passengers or staff.

5.16.8 Fire retardant upholstery for the seats/berths& chairs shall be proposed by partner for the approval of the IR.

5.16.9 The material used for upholstery should not become readily soiled, shall be easily cleaned, impervious and chemically unaffected by water, paint human waste ,graffiti removers, wash plant solution ,cleaning solution ,food and drink spills. Seat covers shall be removable to allow for quick replacement or cleaning.

5.16.10 Seat/Berth modules in similar situations in a vehicle shall be interchangeable.

5.16.11 The lower seats/berths shall be cantilevered out from the sidewall, to provide a clear unobstructed car width floor, for ease and speed of cleaning. The seating arrangement shall in itself be easy to keep clean and shall not impede the cleaning of any other part of the car interior. The seat /berth fixtures shall be arranged so that no fixing or strut is visible. Permanent fixings shall form part of the floor and body sides.

5.16.12 The proposed minimum seat/berth depth, measured from the seat's/berth's forward edge to the forward surface of the seat's/berth's back, minimum seat/berth width and leg room shall be proposed by the partner for the approval of the RDSO.

5.16.13 Seats/Berths shall meet the requirements of UIC 566 or equivalent standard.

5.16.14 Reclining chairs with armrest and backrest shall be provided both in executive and 2nd class chair cars. Chairs of executive class car shall have sliding & rotating arrangement also.

5.16.15 Middle armrest(s) of chair cars shall be of movable type.

5.16.16 Reclining chairs shall be equipped with bottle holder, snack table, magazine bag and adjustable foot rest etc.

5.16.17 Partner shall also submit design of seating/sleeping plan and detailed 3-D model of seats/berths for approval of IR.

5.17 Luggage Racks

5.17.1 Light Luggage Rack in Compartment of Sleeper Car's

The partner shall provide at least one light luggage rack in each compartment of all AC sleeper railcars at a suitable height above window. Due care shall be taken in its design so as to avoid any injury to passenger. These racks shall run longitudinally along the sidewalls and securely fixed, however fixing may be done on partition wall in case of two berth coupe in FAC. The luggage racks shall be of sufficient strength to adequately support luggage and resist damage due to vandalism. The luggage racks shall be lightweight and injury free but of sturdy design and to be tested according to International standards.

5.17.2 Luggage Rack (for Chair Car Variants)

The partner shall provide at least two luggage racks at longitudinal side in all variant of chair cars at a suitable height above window. Due care shall be taken in its design so as to avoid any injury to passenger. Luggage racks shall be securely fixed and shall run longitudinally along the sidewall. The design of the luggage rack shall be large enough for oversized luggage and prevent sliding of the luggage. The luggage racks shall be of sufficient strength to adequately support luggage and resist damage due to vandalism. The luggage racks shall be lightweight and Injury free but of sturdy design and to be tested according to UIC 566 or equivalent International standards. These racks will be opened and presented at its bottom an area with glass, allowing the vision of luggage by passenger from his seat.

5.18 Handholds and Ladder

5.18.1 Handholds and Ladder shall be seamless, corrosion resistant material tubing with satin finish. The design of any joints in the handholds or ladder shall resist the effects of vibration, or of passengers moving or twisting them.

5.18.2 The Handholds and ladders shall suffer no permanent deformation when subject to loading conditions arising in service, in accordance with UIC 566.

5.18.3 Ladder shall be provided in sleeper cars for stepping up on upper/middle berth.

5.18.4 The design of Handholds and Ladder shall be injury free.

5.19 ~~Curtains~~ Roller Blinds

~~5.19.1 Curtains shall be provided in all type of car's specified in clause 2.4.1.~~

~~5.19.2 A curtain track shall be provided at the top of the window area and aisle side along the length of the car for curtain installation. The curtains shall be free hanging at the bottom, but secured in the open position with a tie-back of the same fabric that is permanently attached to the curtain and secured with heavy duty Velcro-style hook and loop fastener.~~

~~5.19.3 Colour and pattern of the curtains shall be approved from the IR.~~

~~5.19.4 The curtain shall be able to withstand normal cleaning without stretching, pilling, puckering, shrinking, rippling, zippering, fading or other adverse effect to its appearance or function. Curtains shall be machine cleanable using water and detergent followed by machine drying. The vendor shall provide recommended cleaning instruction in the service and inspection manual. The curtains shall not require dry cleaning.~~

~~5.19.5 As an alternative to curtains, adjustable height, roll-down, tinted, translucent or opaque, shades may be provided for any windows designated by the partner. Shades shall prevent sunlight from coming through the windows. The shades shall be positional over the full height of the windows. Vibration and normal vehicle motions shall not cause the shades' adjusted position to change.~~

Manually operated roller blinds in shades matching with car interiors shall be provided in all type of car's specified in clause 2.4.1. Roller blinds shall be fixed above window and shall be got approved from IR.

5.20 Disabled Occupants

5.20.1 A dedicated space for compartment of PWD shall be provided in at least one of the variant of sleeper as well as seating type cars, to accommodate a wheelchair with its occupant. Detailed proposal showing PWD compartment arrangement, including the need for a doorway flap or ramp shall be submitted to IR for approval.

5.20.2 The wheelchair parking area shall be free of vertical stanchions and other obstructions, and shall include equipment useable by a wheelchair occupant to restrain the wheelchair while the vehicle is in motion. Passengers shall be able to walk on and off the vehicle without being impeded by either the wheelchair and its restraint or the retracted restraint when a wheelchair is not on-board.

5.20.3 Minimum area for PWD's compartment shall be as per international norms.

5.20.4 Lavatory door should be of minimum 910mm opening with electric sliding or two folds inward opening.

5.20.5 Lavatory floor should be anti-slip.

5.20.6 All hand rails should be of 40mm dia & fixing arrangement such that it should take 250-300 Kg load.

5.20.7 Western style toilet (sitting type) with toilet paper roll & hand shower at height of 550mm should be provided in lavatory.

5.20.8 Cushioning of PWD's berth/seat should be as per standard of AC 2-tier berth & berth number engraved in Braille also.

5.20.9 Electrical switches in compartment should be at 1200mm height.

5.20.10 Switch for mobile/laptop charger should be provided.

5.21 Automatic Body Side Entrance Plug Type Doors

5.21.1 The minimum door opening of passenger and disabled passenger doors shall be 825mm and 925 respectively.

5.21.2 The free passing through height of open door shall be 1865 mm minimum.

5.21.3 All cars shall have minimum 04 (four) electrically powered, automatic sliding plug type doors, 02 (two) on each side. Depending on the length of the car number of doors can be accordingly reduced ensuring that all the emergency exit & evacuation requirements are met as per latest international standards. Number of doors on each side of AC Generator Car and AC Restaurant Car may vary and shall be finalized during layouts submitted by the partner for approval of IR.

5.21.4 The plug type door hand holds of railcar shall not project outside the railcar profile to facilitate mechanized railcar washing.

5.21.5 The plug type doors shall be vibration free and insulated against heat and sound transmission.

5.21.6 The plug type doors shall be sealed against draughts and water. Any ingressed water shall drain rapidly without affecting surrounding equipment or systems.

5.21.7 Plug type doors shall be as light and rigid as possible.

5.21.8 The plug type doors are provided with double glazed window. The height of the door window has to be aligned with the height of the sidewall window.

5.21.9 The plug type doors are to be provided with sufficient heating insulation in context with Indian climate conditions.

5.21.10 The design of all parts and components of entrance plug type doors shall meet the Fire prevention requirements of EN45545-2.

5.21.11 The vehicles to be delivered to Indian Railways are designed for a service life of 35years. To the extent entrance doors are to be developed and designed accordingly.

5.21.12 The passenger body side plug type door shall fully open in less than 4.5 (four point five) seconds and shall close within 6 (six) seconds from the instance the door is operated.

5.21.13 The end of the closing stroke (e.g. approximately 100mm) shall be damped or cushioned to reduce impact and minimise possible injury to passengers.

5.21.14 Obstacle detection shall be provided by the partner.

5.21.15 The plug type door mechanism shall have safety provision where by the railcars train shall not start unless all doors have been closed and electrically locked.

5.21.16 It shall be possible to manually push back each closed plug type door leaf to enable entrapped objects such as clothing and other articles, to be withdrawn, even after the mechanical lock has engaged. The force required to push back each plug type door leaf shall not be less than 80N nor more than 150N.

5.21.17 The plug type doors shall be designed so as to retain the passengers during all service conditions and shall minimise risk in the event of an accident.

5.21.18 The strength of the entrance plug type doors shall be as per EN 14752 or UIC566 and the doors shall be able to resist the loads without deformation or damage.

5.21.19 Provision shall be made for passengers to open railcar plug type doors to permit evacuation from a stopped railcars train in an emergency. There shall be an internal and external manual release mechanism in each railcar.

5.21.20 A door closing warning shall be provided by audible and flashing light indication.

5.21.21 A visual plug type door open indication on the exterior of the railcar adjacent to each doorway shall be provided. This shall be visible both from the platform and by looking down the side of the train (subject to any curvature of the track).

5.21.22 It shall be possible to monitor the status of each plug type door on the TCMS.

5.21.23 An indication confirming that all doors are closed shall be provided in the Loco.

5.22 Automatic Saloon Sliding doors

5.22.1 Saloon sliding door shall be electrically powered, automatic sliding shutter type with operating speed of 0.1m/sec (approx.).

5.22.2 No. of saloon sliding door for each variant of cars shall be as per the layouts approved by IR.

5.22.3 Door leaf built by aluminium profiles with hardened safety glass applied to the frame by means of EPDM rubber gasket with locking string.

5.22.4 The shutter carries external and internal handles along with hand safe gasket.

5.22.5 Ventilation grid made up of aluminium extrusion shall be provided for air passage applied on the bottom of the shutter by means of EPDM rubber gasket. If it is not included, suitable means for proper air circulation must be provided.

5.22.6 Doors shall be as light and rigid as possible.

5.22.7 Doors should have smooth running without jerks and noise.

5.22.8 The doors should have pleasant and good looking appearance.

5.22.9 It should be possible to open the door during closing stroke also.

5.22.10 It should be possible to open/close the door in case of electrical fault. Maximum Force necessary for opening/closing the door in this case shall be 90 N.

5.22.11 Door closing mechanism should have time delay device to increase the closing time of doors at the time of closing stroke. It should take 30 sec to 120 sec before closing. The time delay device should be adjustable. Movement should be slower at end of closing of stroke for last 200mm (0.05m/s).

5.22.12 The Mechanical strength of the Saloon Sliding doors shall be as per UIC566 and the doors shall be able to resist the loads without deformation or damage.

5.22.13 The design of all parts and components of Saloon Sliding doors shall meet the Fire prevention requirements of EN45545-2.

5.22.14 The shutter may optionally have a lock, for the locking of the door in closed position, actuated by square key.

5.22.15 The free passing through height of open door shall be 1865 mm minimum.

5.22.16 The minimum door opening of Saloon Sliding door shall be 600 mm.

5.23 Automatic End wall Doors

5.23.1 Endwall doors comprise of manually or electrically powered, having one or two sliding shutters with operating speed of 0.1m/sec (approx.).

5.23.2 No. of endwall doors for each variant of cars shall be as per the layouts approved by IR.

5.23.3 The doors should have pleasant and good looking appearance.

5.23.4 It should be possible to open/close the door in case of electrical fault. Maximum Force necessary for opening/closing the door in this case shall be 90 N.

5.23.5 It should be possible to open the door during closing stroke also.

5.23.6 Doors shall be as light and rigid as possible.

5.23.7 Double or single leaf vestibule doors should have smooth running without jerks.

5.23.8 Door closing mechanism should have time delay device to increase the closing time of doors at the time of closing stroke. It should take 10 sec to 120 sec before closing. The time delay device should be adjustable. Movement should be slower at end of closing of stroke for last 200mm (0.05m/s).

5.23.9 Door leaf of Endwall door has Sandwich construction with an aluminium/stainless steel frame. External and internal surfaces have sandwich construction with a Fire barrier.

5.23.10 Doors shall be equipped with a square key lock which shall be operated by square key from inside and with a handle/square key from outside (both in open and closed position).

5.23.11 Each shutter has a replaceable toughened and transparent glass window.

5.23.12 The Mechanical strength of the End wall doors shall be as per UIC566 and the doors shall be able to resist the loads without deformation or damage.

5.23.13 The design of all parts and components of Endwall doors shall meet the Fire prevention requirements of EN45545-2.

5.23.14 The free passing through height of open door shall be 1865mm minimum.

5.23.15 The minimum door opening of Endwall doors shall be 675 mm.

5.24 Automatic Lavatory doors

5.24.1 Lavatory door comprises of electrically powered shutter/shutters for closing/opening of the Lavatory room.

5.24.2 Doors shall be as light and rigid as possible.

5.24.3 Door leaf of Lavatory doors has Sandwich construction with an aluminium frame. External and internal surfaces have sandwich construction and the shutter carries external and internal handles along with hand safe gasket.

5.24.4 Ventilation grid made up of aluminium extrusion is provided for the air passage, applied on the bottom of the shutter/shutters. If it is not included, suitable means for proper air circulation must be provided.

5.24.5 The doors should have pleasant and good looking appearance

5.24.6 The door is equipped with release lock which can be closed from inside by knob and outside by square key.

5.24.7 The free passing through height of open door shall be 1865 mm minimum.

5.24.8 The minimum door opening of lavatory doors shall be 600 mm.

5.24.9 The strength of the lavatory doors shall be as per UIC566 and the doors shall be able to resist the loads without deformation or damage.

5.24.10 The design of all parts and components of lavatory doors shall meet the Fire prevention requirements of EN45545-2.

5.25 Loading door

5.25.1 Loading doors shall be provided in AC Generator car cum Luggage cum brake Van.

5.25.2 The minimum door opening of loading doors shall be 1500mm.

5.25.3 The free passing through height of open door shall be 1865 mm minimum.

5.25.4 The mechanical strength of the loading door has to meet the requirement of UIC 566.

5.25.5 All materials used, especially profiled joints, are to be resistant to chemical substances of purifying agents.

5.25.6 Loading doors shall be vibration free and of modular design.

5.25.7 The doors shall be sealed against draughts and water. Any ingressed water shall drain rapidly.

5.25.8 The doors shall be as light and rigid as possible.

5.25.9 The vehicles to be delivered to Indian Railways are designed for a service life of 35years. To the extent loading doors are to be developed and designed accordingly.

5.25.10 The design of all parts and components of loading doors shall meet the requirements fire prevention requirements of EN45545-2.

5.26 Side and Door Windows

5.26.1 Window design must allow passengers to have a good vision on the outside and especially on the station information.

5.26.2 All side windows shall be double glazed with outer glass laminated and inner glass toughened .The gap between inner and outer glass shall be filled with the inert gas Krypton/Argon.

5.26.3 The body-side and door windows shall be designed to minimize solar gain and provide a level of thermal insulation consistent with the requirements of the air conditioning system.

5.26.4 All glass shall be tinted. The colour may be achieved by tinting the body of the glass. The tint shall not fade throughout the service life of the car.

5.26.5 Saloon windows shall be provided and be flush mounted with the exterior of the car body.

5.26.6 Each window, including glazing shall meet the requirements and of sufficient strength to resist penetration of solid steel ball when tested as per annexure 'A' of IS: 2553 Part-II.

5.26.7 Glazing shall imperatively be safety glass (compound or toughened) and the thickness shall be selected to withstand mechanical stress and contribute to sound and heat insulation.

5.26.8 All side windows and door window shall transmit less than 5% of the incident ultra violet radiation.

5.26.9 Deflection at window openings under a compressive load of 2000KN and tensile load 1500KN shall not damage the window.

5.26.10 Glazing strength shall meet the requirements of UIC 564-1/ UIC 566 or Equivalent Standard.

5.26.11 Glazing of windows shall resist to an act of vandalism and shall be high enough to prevent easy breakage.

5.26.12 Window seals shall be designed to prevent ingress of water to the inside. The sealing material shall be so selected that it lasts at least the mid life interval overhauls of car body.

5.26.13 Door windows shall have a window similar to the windows provided in the car body as far as possible in respect of solar gain, thermal insulation, replacement criteria, strength, resistance to pressure, and the transmission of light, and solar heat gain.

5.26.14 Door windows shall be replaceable without removal of the door leaf.

5.27 Lavatory Windows

5.27.1 Hopper window having both fixed and openable part shall be provided in lavatories. The lower part of the window shall be fixed and upper part shall be openable .In case window is not provided in lavatory, it shall be ensured that the stale air is exhausted out of the car.

5.27.2 The hopper window is designed in such away so that the opening part must be hinged. The system allows two fixed positions for the opening part of the lavatory windows i.e. fixed and opened at approximately 30 º angles.

5.27.3 The hopper part is fitted with handle which has integrated locking device.

5.27.4 The lavatory windows shall be translucent.

5.27.5 It is possible to change the both glasses of lavatory from inside of the car.

5.27.6 Glazing strength shall meet the requirements of UIC 564-1/ UIC 566 or Equivalent international Standard.

5.27.7 Glazing of windows shall resist to an act of vandalism and shall be high enough to prevent easy breakage.

5.27.8 Window seals shall be designed to prevent ingress of water to the inside. The sealing material shall be so selected that it lasts at least the mid life interval overhauls of car body.

5.28 Partition Frames

5.28.1 Partitions walls shall be aesthetic pleasant and have sufficiently good wear and tear properties and shall be of made with light weight material.

5.28.2 Partitions pillars shall be aesthetic pleasant and have sufficiently good wear and tear properties and shall be of made with aluminium alloy.

5.28.3 Both the transverse and longitudinal side partition walls of AC railcars shall be provided up to ceiling height.

5.29 Other Passenger Amenities

5.29.1 Each cabin of sleeper cars shall have provision of Mirror, Bottle Holder, Magazine Bag, Coat Hook and Snack table.

5.29.2 The Mirror, Bottle Holder, Magazine Bag , Coat Hook and Snack table shall be of injury free design and aesthetically pleasant.

5.30 Foot Step

5.30.1 Foot Step shall be provided at all body side doors in all the railcars.

5.30.2 The design of the foot step shall be skid free.

5.30.3 These shall be designed so that it is possible to board the train from the platforms (as defined in Clause 3.6 hereunder). Occasionally it is necessary for passengers to board the train from track level and the steps shall be designed to allow this.

5.31 Brake System

5.31.1 ~~Cars shall be provided with Graduated Release Twin Pipe Air Brakes~~. The brake system shall be twin pipe graduated release type and its performance shall conform to the latest revision of UIC specification 540 & 547. Disc Brake system upgradable to EP assist shall be provided in accordance to UIC 541-5. The Brake system shall be of UIC approved type and shall meet all UIC requirements for Air Brakes on passenger cars with twin pipe feature as an extra requirement over the above what has been laid down by UIC. ~~Anti skid device shall be provided~~ Brake system should be of the proven design which had worked successfully in India or International Railway passenger trains. Necessary proof in this regard shall be submitted by the firm.

5.31.2 Apart from above following specifications may be referred:

i. UIC specification no.540
ii. UIC specification no.541-1
iii. UIC specification no.541-3
iv. UIC specification no.541-5
v. UIC specification no.542
vi. UIC specification no.543
vii. UIC specification no.544-1
viii. UIC specification no.545
ix. UIC specification no.546
x. UIC specification no.547

xi. UIC specification no.831 R
xii. Relevant DIN, EN & ISO standards as applicable

5.31.3 Air brake system shall be designed in such a way that they can be retrofitted with EP assist brake system in accordance to UIC541-5.

5.31.4 Wheel Slide Protection device, preferably should be one of the UIC approved and conforms to the conditions mentioned in UIC 541-05 & should perform satisfactorily in Indian Railway service conditions.

5.31.5 Brake Accelerator Valve to be provided as per UIC 544-1.

~~5.31.6 Adequate redundancy shall be provided to ensure that the EP assist brakes do not become non functional in case of failure of power supplies, failure of control electronics and pressure transducers etc. In case of isolation of any EP valve due to any defect, the brake electronics shall take adequate corrective action with least system isolation. The system shall provide enough redundancy in the brake electronics and controls so that the isolation of traction equipment does not lead to non-functioning of EP assist brakes of the affected railcar.~~

5.31.7 Graduated application release of brakes on application of emergency brake from coaches shall be so designed as to cause minimum coupler forces in a train.

5.31.8 The brake system must allow safe running of the train down the longest & steepest gradient (i.e. of 1% and 250m in length) and it shall be possible to control the speed at operating speed levels permitted on this gradient.

5.31.9 The brake system shall have ability to stop the train in emergency (quick acting) and full service application without affecting stability of the train during braking.

5.31.10 The disc brake equipment's shall be designed and constructed in such a way that in normal conditions of use & vibrations to which it may be subjected to should not cause its premature failure or in a way effect the functional efficiency.

5.31.11 It shall be possible to operate the train satisfactory with EP assist feature non operative with all types of single/multiple locomotive units over IR.

5.31.12 In case of bogie vehicles, it shall be possible to replace the discs without dismantling the wheels.

5.31.13 Emergency braking distance on level tangent track for a loco hauled train/train set of full rake length at a speed of 160 kmph should not exceed 1200m.

5.31.14 Brake system shall be provided with automatic slack adjusters either built in to cylinders or provided separately.

5.31.15 Friction pad shall be non-asbestos material. The maximum thermal heating of disc and pad shall in no case exceed the permissible values of chosen materials.

5.31.16 Brake rigging arrangement shall be light and as simple as possible, with a minimum number of levers and fulcrum points permitting easy access to brake disc and other wearing parts.

5.31.17 Air brake equipments shall be mounted on brake panels suitably located on the underframe or adequate cabinet inside the cars. These brake panels shall be protected against track-stone hitting, dust, rain, salt water influence and shall be have minimum wear & tear in conjunction to easy accessibility for maintenance.

5.31.18 All pins in the proposed brake system shall be with bushes, which will have long life.

5.31.19 Hand brake/parking brake shall be provided in gaurd's cabin of AC Generator car cum Luggage & Brake van, which shall be of latest proven design and shall be capable of holding train on steepest & longest down gradient (i.e. of 1% and 250m in length) of IR.

5.31.20 The brake system shall be compatible with existing locomotive brake systems of IR.

5.31.21 Disc brake indication system shall be provided in accordance to UIC.

5.31.22 Blocking/Dummying of EP assist system on any car shall not affect the brake operation on complete train as well as on that car.

5.31.23 The system shall give satisfactory performance under wet conditions also.

5.31.24 ~~Working of brake system shall be ensured ensured~~ Brake system should work smoothly and properly without realising abnormal shocks to the passengers and vehicle.

5.31.25 The brake system shall have adequate stopping ability from the operating speed to stand still after continuous braking for prolonged time during downhill travel.

5.31.26 Friction characteristics in dry and wet conditions of the brake pad material shall be supplied by the partner. Also value of odour and smoke in various running conditions shall be supplied by the partner.

5.31.27 Brake alarm pull handles shall be provided in the compartment and lavatories of all variants of car, as per IR requirement.

5.31.28 Following technical documents/details for Disc Brake system shall be submitted:

i. Schematic diagram for the pneumatic systems.
ii. Descriptive literature explaining the systems.
iii. Descriptive literature explaining the individual equipment used in the system.
iv. Layout dispositions of all the components/equipments on bogie, underframe and body.
v. Operation and maintenance manual and instructions, maintenance schedule of all individual items.
vi. The complete set of drawings in A1/A2 size for each item of disc brake equipment which shall contain details regarding material specification, dimensions, estimated weight, testing parameters, reference to manufacturing / original collaborator's drawing etc.
vii. Electrical wiring diagram.
viii. Electrical power requirement i.e. voltage, current (AC/DC) for WSP.
ix. Thermal loading details and calculations with the use of disc brakes.
x. Instantaneous/ average co-efficient of friction for disc pads for a speed up to 200 kmph under different brake pad pressures (should be as per relevant UIC).

5.32 Requirements of Restaurant car

5.32.1 General

5.32.1.1 Restaurant car shall be Railway passenger car that serves meals in the manner of a full-service, sit-down restaurant. The design and facilities of Restaurant car shall enhance the familiar restaurant experience.

5.32.1.2 Restaurant car shall have mainly Dinning area, Bar/ Service area, Kitchen area along with the wash basin.

5.32.1.3 Interior fittings of Restaurant car should be aesthetically pleasing. Colours used should be soothing. The shades & samples of all items should be got approved before manufacturing of the car.

5.32.1.4 Interior panelling (with hidden screw) of plywood & veneered decorative ply with approved shade & colour by IR shall be provided on sidewall, partition frames, endwall & roof ceiling of dining area, bar/service counter, wash room, outside washbasin arrangement, kitchen area and vertical bar counter. Water proof laminates / PVC tiles or phenolic resin with pavement shall be used in sink area of kitchen.

5.32.1.5 Provision of polyester fabric of approved brand with pelmet having round corners with minimum protrusion from sidewall to be made in AC area. Two- curtain arrangement system will be provided for curtains. Inner curtain will be of thin cloth and lighter in colour as compared to colour of outer curtain. There should be provision of securing curtains in open position with suitable ties. Also the width of the curtain should be enough to cover complete window preventing leakage of even iota of light. Curtain should not make noise during train movement.

5.32.1.6 General layout showing Dining area, Bar/ Service area, Kitchen area, wash room etc. along with other drawings of interior furnishing of various area shall be got approved from RDSO.

5.32.1.7 The partner shall have to submit the technical details of furnishing and other fittings proposed to be used in restaurant car and got approved from RDSO.

5.32.1.8 Workmanship shall be of very high standard and screws, any gap, uneven surfaces, unwanted spots etc should not be visible.

5.32.1.9 All the interior furnishing shall suiting to circulation of conditioned air requirement and there should be no sharp corners in the furnishing materials.

5.32.1.10 AC diffusers of elegant look for conditioned air to be provided at suitable locations in ceiling.

5.32.1.11 All plumbing pipes & fittings used in restaurant car should be concealed and all the joints shall be leak proof & maintenance free.

5.32.1.12 Adequate no. of call bells, power points, telephone socket & mobile charging points at suitable locations shall be provided in dining area & bar/service area. Call bells switch, power points, telephone socket & mobile charging points should be easily approachable.

5.32.1.13 Proper shrouding of electric switches matching with interiors décor should be done.

5.32.1.14 Proper label marking should be done on electric switches, mobile charger points, telephone etc.

5.32.1.15 Fire extinguishers of portable size shall be provided in bar/service area, dining area and in kitchen (02 Nos.). The location and securing of fire extinguishers should be such that it improves the aesthetics of interior furnishing & are easily accessible.

5.32.1.16 The partner should get the proto type coach approved from IR before execution of work in all other restaurant cars. IR reserves right to demand for any type of change required in prototype car.

5.32.1.17 The requirements specified for restaurant car include only minimum requirements. Any other requirement, if not covered for interior furnishing will be in the scope of the partner.

5.32.1.18 Each restaurant car shall be provided with two audio – visual entertainment panels, inside the car.

5.32.2 **Bar/Service Area**

5.32.2.1 The counter of the bar/service area should be of same quality as used in 5 star hotels equipped with all latest accessories and required fittings.

5.32.2.2 Hinged flap type arrangement matching with service counter top to enter in service area of counter shall be provided.

5.32.2.3 Adequate no. of elegant 'adjustable height revolving hot seat type chairs with leg support shall be provided in front of the bar/service counter.

5.32.2.4 Stools of appropriate height for sitting in service area shall be provided.

5.32.2.5 Carpet of matching colour with interiors shall be provided in Bar/Service area.

5.32.2.6 Adequate no. of good quality paintings/ sceneries of suitable size approved by the IR are to be provided on sidewall in front of bar/service counter.

5.32.2.7 Painting /sceneries should be secured properly to avoid rattling after mounting.

5.32.2.8 Adequate no. of racks, shelves, drawer etc. shall be provided to cater to the needs of passenger.

5.32.2.9 Sink along drip tray arrangement & suitable drain pipe and water tap shall be provided.

5.32.3 **Dining Area**

5.32.3.1 Dining area shall be provided in restaurant car for consuming food by passengers.

5.32.3.2 Complete dining arrangement for min 30 passengers shall be provided however dining capacity may differ while finalization of the layout of Restaurant car. These arrangements shall include dining chairs, table, table cloth, carpet etc.

5.32.3.3 Ergonomically designed good quality and elegant finish cushioned chairs and tables shall be provided in dining area.

5.32.3.4 Carpet shall be provided in dining area. The colour shade of carpet should match with interior panelling of the coach.

5.32.3.5 Table cloth shall be provided for all the tables of dining area.

5.32.3.6 Call bell on sidewall near each dining table shall be provided.

~~5.32.3.7 Automatic spray arrangement (stand alone type) for sprinkling of freshner at preset time intervals (can be changed) shall be provided.~~

5.32.3.8 Adequate no. of good quality paintings/ sceneries of suitable size approved by the IR are to be provided.

5.32.4 **Kitchen area**

5.32.4.1 Kitchen area shall be provided for cooking and food preparation .

5.32.4.2 Service table with granite top or any other service proven material shall be provided at cooking and food preparation area.

5.32.4.3 Kitchen area shall be typically equipped with a cooking range, sink with hot and cold running water, Refrigerator Microwave oven ,Hot case, Hot water boiler of suitable capacity.

5.32.4.4 Chimney arrangement suiting to heating range shall be provided.

5.32.4.5 Pull out multipurpose baskets (telescopic slides) shall be provided and there should be proper cup board for pull out baskets suiting to interior decor of the kitchen.

5.32.4.6 Adequate no. of cupboards and racks shall be provided to suit kitchen requirements.

5.32.4.7 There should be provision for keeping detergent powder/ liquid, soap & scrapper etc. required for washing utensils.

5.32.4.8 Dish rack with drip tray adjacent to the sink shall be provided. Proper cupboard has to be provided to cover the dish rack to give a flush look.

~~5.32.5 **Wash room**~~

- ~~Wash room fitting in general will include:-~~
- ~~Towel rack~~
- ~~Suitable shelf for towel stacking at corners in the shower area.~~
- ~~Coat hooks~~
- ~~Grab handles~~
- ~~Mirror~~
- ~~Wash basin~~
- ~~Soap dish~~
- ~~Wash room engaged / free indication light~~

~~5.32.5.1 Wash room shall have vinyl curtain arrangement in place of doors.~~

~~5.32.5.2 Flooring of lavatory will be with ceramic tiles. It has to ensured that floor and wall tiles of matt finish, anti skid type. Joints of the tiles should be properly white cemented & colour compatible to the tiles colour.~~

~~5.32.5.3 On the partition and sidewall of wash room, small size tiles matching with floor tiles will be provided. Small border of different colour on upper most tile in wall/PF in uniform pattern of tiles to improve the aesthetics can be provided. Proper care should be taken while providing slope. The drains at suitable location with mesh of stainless steel flushed with floor should be provided.~~

~~5.32.5.4 Besides, other standard wash room fittings, not covered above, will be provided.~~

5.32.6 **Outside wash basin arrangement**

Wash basin shall be provided outside the wash room and fittings of outside wash basin in general will include:-

- Wash basin & drain pipe
- Towel holder, liquid soap dispenser and soap stand
- Decorative mirror with bevelled edged and etched lining near border. The size should be compatible with wash basin. There should not be any distortion even of mild nature in mirror's view.

- Decorative Mirror lights with sufficient illumination level with etched glass cover.
- Covering of wash basin drain pipe with built-in type dust bin.

5.32.7 Besides, other standard fittings, not covered above, will be provided. The arrangement should be aesthetically pleasing matching with interior decor of the restaurant car.

5.33 Exterior Painting

5.33.1 **General**

5.33.1.1 The exterior colour scheme of different variants of the cars listed in clause 2.4.1 shall be got approved from IR.

5.33.1.2 The paint coating shall be tested in accordance with relevant latest international standards.

5.33.1.3 Anti graffiti clear coating shall be provide on exterior painting of passenger railcars.

5.33.2 **Surface preparation**

Either of the following two surface preparation methods may be adopted followed by the application of primer, surfacer and finish for car body shell made up of aluminium alloy :-

i. Blasting with non-abrasive blasting media (for a profile of 20-40 microns)

Or

ii. Cleaning, degreasing and application of suitable Etch primer (for a profile of 15-20 micron)

5.33.3 **Exterior Primer**

5.33.3.1 Exterior primer paint having anti-corrosive property designed for use on aluminium structures, plate and extrusions shall be applied.

5.33.3.2 The material shall have good adhesion on the substrate and shall have good compatibility with subsequent coats of two pack unsaturated polyester based putty, two pack polyurethane based under coat paint and two pack polyurethane based top coat paint.

5.33.3.3 Primer shall be applied with airless spray equipments immediately after surface primer.

5.33.3.4 The primer shall be suitable for spray application and it may also be suitable for application by brush for touching up smaller areas.

~~5.33.4 **Putty**~~

~~5.33.4.1 Twin pack unsaturated polyester base knifing putty intended to be used for levelling up the surface imperfections of the exteriors of railcars.~~

~~5.33.4.2 The consistency of the putty shall be smooth, uniform and suitable for knife application.~~

~~5.33.4.3 Putty shall be applied on all spots and seam welding joints and there should not be any sign of sagging, cracking or shrinkage. It shall have good rubbing properties and shall not show defects like roughness, scratches, crack and pinholes after rubbing.~~

~~5.33.4.4 It shall have good adhesion and compatibility with primer on which it is to be applied also with surfacer, which is to be used as a subsequent coat. It shall finish with uniform gloss and colour.~~

~~5.33.5 **Grinding**~~

~~Rubbing of the putty shall be done to even out the surface and to remove the excess putty.~~

5.33.6 **Undercoat/ Surfacer**

5.33.6.1 Twin pack Polyurethane surfacer shall be used and shall be mixed in the ratio recommended by the manufacturer of the paint. The consistency of the surfacer shall be smooth, uniform and suitable for spray application.

5.33.6.2 Polyurethane surfacer is to be used over primed/putty applied surfaces for protection of exterior of railcars. The material is used with the object of getting smooth, uniform and non absorbent base for PU top coat paint. The material shall have good compatibility with two pack PU top coat paint, polyester based putty and epoxy zinc phosphate primer.

5.33.6.3 Undercoat/Surfacer shall be provided for getting better surface adhesion. This undercoat should be applied using airless spray equipments.

5.33.6.4 The spray gun shall be thoroughly cleaned before use. The pressure ratio of air cylinder to hydraulic cylinder shall be adjusted in accordance with the viscosity of the material to be sprayed. The material shall be sprayed carefully so as to obtain an even and uniform coat having a dry film thickness of 30 microns minimum per coat. The mixed paint shall allow good spraying properties on vertical panels and the film when dry shall be free from sags, runs, streaks and any defects.

5.33.7 **Top Coat**

5.33.7.1 Twin pack polyurethane enamel shall be used and shall be mixed in the ratio recommended by the manufacturer of the paint. The consistency of the polyurethane enamel shall be smooth, uniform and suitable for spray application.

5.33.7.2 The spray gun shall be thoroughly cleaned before use. The pressure ratio of air cylinder to hydraulic cylinder shall be adjusted in accordance with the viscosity of the material to be sprayed. The material shall be sprayed carefully so as to obtain an even and uniform coat having a dry film thickness of 40 microns minimum per coat. The mixed paint shall allow good spraying properties on vertical panels and the film when dry shall be free from sags, runs, streaks and any defects.

5.33.7.3 02 nos. top coats shall be applied using airless spray equipments and multiple top coatings shall be done as required.

5.33.7.4 Polyurethane enamel used shall have good spraying properties on vertical parts. The film when dry shall be free from sags, runs, streaks, and any other film defects.

5.33.7.5 The colour of the top coat shall be as per exterior colour scheme, which has been got approved from IR.

5.33.7.6 The finish of the top coat shall be smooth, uniform and glossy.

5.33.7.7 Dry film thickness shall be of 40 microns minimum per coat and there should be no visible damage or detachment of film.

5.33.7.8 Minimum gloss value at 60º angle of incidence shall be 85.

5.34 Marking

The railcar number shall be applied on both sides of each railcar, both externally and internally to be easily visible to the IR maintenance personnel. Location, other information like car type, car code, and logo of Indian Railway etc shall be finalized in consultation with IR and approval shall be taken on final design.

5.35 Safety measures

5.35.1 General

5.35.1.1 All exterior components including under slung equipments shall be attached with use of secondary restraints, redundant fixings or secondary latches as appropriate to ensure that no single point failure shall cause equipment to either physically detach or protrude out of gauge.

5.35.1.2 Standard protective systems shall be provided, in accordance with the Good Industry Practice, for protection of the electrical equipments against abnormal currents, excessive voltages, etc., with indicating facilities, so as to ensure safe and correct operations. All equipments shall be adequately earthed, insulated, screened or enclosed and provided with essential interlocks and keys as may be appropriate to ensure the protection of the equipments and safety of those concerned with its operation and maintenance.

5.35.1.3 A sensitive and reliable protection arrangement against earth fault shall be provided in each circuit group.

5.35.1.4 All electrical circuits shall be fully insulated from the superstructure on both the positive and negative sides and the super-structure shall not be used as a part of any earth return circuit.

5.35.1.5 Relevant provisions stipulated in Indian Electricity Rule 1956 shall strictly be followed in the interest of safety of passengers/staff as well as for equipments/instruments provided in the railcars.

5.35.2 Fire Safety

5.35.2.1 The railcars shall be designed to minimize the risk of any fire.

5.35.2.2 Materials used in the manufacture of railcars shall be selected to reduce the heat load, rate of heat release, propensity to ignite, rate of flame spread, smoke emission and toxicity of combustion gases.

5.35.2.3 The railcars shall comply with all relevant parts of BS EN 45545 applicable to rail vehicles.

5.35.3 **Fire Detection and Suppression System**

5.35.3.1 The railcars shall have a world class fire detection system and shall be capable of detecting a fire in railcars specified in clause 2.4.1.

5.35.3.2 Fire detection system should also capable of dealing both with electrical and non electrical fires.

5.35.3.3 Fire detection systems should be reliable and should activate consistently in all modes of operation and under all operating conditions. They should not initiate a significant number of false alarms.

5.35.3.4 Fire suppression systems may be either fixed or portable. A fixed system may be manual or automatic discharge, a portable system is, by definition manual discharge only.

5.35.3.5 The medium used in fire suppression system should not present a hazard to train crew, passengers or staff.

5.35.3.6 A minimum of one passenger communication devices should be fitted to every passenger/crew carrying vehicle. These devices should allow a spoken two way exchange of information with staff and should be clearly marked and readily identifiable.

5.35.3.7 Wherever a fixed fire suppression system is required then an associated automatic fire detection and audible alarm system should also be fitted. The alarm should be capable of informing crew and/ or staff remotely, as to which vehicle has been affected, and where relevant, which zone with in the vehicle.

5.35.3.8 A suitable portable fire suppression system should be present in all vehicles that may contain people under normal or engineering operation.

5.35.3.9 Portable fire suppression or a fixed fire protection system should be available for any area of the vehicle that contains equipments which uses combustion of fuel as a source of fire.

5.35.3.10 Fire detection and suppression systems should be fitted to any area or vehicle which has the potential to present an increased risk. This should incorporate, as a minimum, automatic detection and audible warning, and portable extinguishing agents.

5.35.3.11 Fire detectors should be provided in each sleeping compartment, in each general area which forms a separate fire compartment and within the air conditioning or ventilation ducting.

5.35.3.12 Fire detection system should be such that, on detection of fire, an audible alarm sounds in all areas of affected vehicle and a signal is sent to warn the responsible crew or staff member. The system should also activate the process which inhibit or control the movement of smoke within the vehicle and through the ventilation or air conditioning duct.

5.35.4 **Fire Extinguishers**

Each railcar shall be provided with two dry powder type or other appropriate fire extinguishers located at each end of each car. These shall be in a niche so as not to cause injury or obstruction to people.

5.36 Train Control and Management System (for mechanical sub-systems)

5.36.1 The railcars shall be fitted with a computerized Train Control and Management System (TCMS) that as a minimum is capable of the following functions:-

- Receiving status and fault information from railcar's sub-systems generally including brake system, roller bearing , water level indicator and door closing system etc. however list of parameters to be monitored shall be got approved from IR,
- Providing the above status information to the Train Driver/ Guard/Power car maintenance staff.
- Providing fault information to the Train Driver/ Guard/Power Car Maintenance Staff, faults shall be suitably prioritised and filtered so that the Driver / Guard and maintenance staff receive information appropriate to their roles,
- Recording all fault information and status indications as necessary to assist maintenance staff,
- Supporting maintenance staff by identifying repair work required or defective equipment,
- TCMS shall have provision to provide location, fault and status information to a central server without any extra Hardware/ software.

5.36.2 The TCMS (and where appropriate the monitoring functions in sub-systems) shall differentiate between a fault in the monitoring equipment and the equipment being monitored.

5.36.3 The TCMS shall be interfaced with the brake system.

5.36.4 The TCMS (and where appropriate the monitoring functions in sub-systems) shall enable fault finding to be carried out at module or card level as appropriate.

5.36.5 For each fault, the following data shall be recorded:

- Details of the fault itself;
- Location of fault (e.g. vehicle, subsystem, module, etc.);
- Any background data necessary to allow subsequent investigation;
- The time and date that the fault occurred; and
- The GPS location of the train.

5.36.6 The TCMS shall provide the facility to capture post trigger and pre-trigger background information on the occurrence of specific faults.

5.36.7 The TCMS shall store all faults recorded for a minimum of 100 days in non-volatile storage.

5.36.8 The TCMS shall provide on-line, context sensitive trouble shooting assistance to the Train Driver/ Guard in case of any fault, through the Train Driver/ Guard's display. The fault display to Train Driver/ Guard shall also accompany the standard trouble shooting instructions in simple English language.

5.36.9 In the event the fault identified by the TCMS has occurred as a consequence of the actions of the Train Driver/ Guard, this shall be identified and logged.

5.36.10 Where possible and appropriate, train control systems shall be integrated into the TCMS so as to reduce hardware and cables. Where control functions are integrated into the TCMS, the requirements of EN: 50126 and EN: 50128 shall be applied. In particular the risks associated with the integration of any control function shall be assessed and the design of the TCMS (e.g. the SIL according to EN: 50128) shall reflect the level of risk identified.

5.36.11 Features of self-check, calibration and plausibility checks shall be incorporated in the design of the TCMS so as to aid the identification of faults.

5.36.12 The TCMS shall include a communications interface which shall (providing the communications channel is available) provide the following data to a central server (provided by the Company) via GSM or GSM-R:

- The train's location (determined by GPS) at pre-configured intervals. It shall be possible to configure this interval from once per day to once per minute in suitable steps;

- immediate indication that a critical fault has occurred; and
- Details of all faults recorded.

5.36.13 The Train Driver/ Guard shall be provided with a user interface to the TCMS in the Loco / Guard cabin.

5.36.14 The TCMS user interface shall include a suitable high resolution coloured graphics display incorporating the following features:

- Suitable illumination to achieve clear visibility in all lighting conditions without causing a distraction to the Train operator at night;
- a wide viewing angle so that it can be readily observed by anyone in the Driving Cab;
- Protection against vandalism, impact, rough handling and damage; and
- Protected to IP 54 as a minimum.

5.36.15 There shall be a suitable means of input to the TCMS. This shall be designed so that it is protected against vandalism, impact, rough handling and damage and shall be protected to IP54 as a minimum.

5.36.16 It shall be possible to access all the processors of propulsion equipments of all the railcar(s) in a train, from the Loco / Guard's cabin, over wired train bus (WTB).

5.36.17 Loco / Guard's cabin shall include an interface so as to allow fault data to be downloaded to a standard USB pen drive, without the installation of any special hardware or software.

5.36.18 Where data is held in connected subsystems (e.g. pre and post trigger background data), it shall be possible to download this data through the interface described above and visualize it by means of the application software described below.

5.36.19 Application software shall be provided to facilitate the fault diagnosis and the analysis of equipment failures. The steps required for investigation to be done, shall be displayed in simple language along with background information. Such software shall be compatible for working on commercially available operating systems.

5.36.20 Access shall be provided to allow configuration parameters of TCMS and connected subsystems to be modified. This shall be possible either through use of the TCMS display or by means of a laptop connected via the interface specified above. All configuration parameters shall be protected against unauthorized modification by means of a password.

Chapter 6
Technical Requirements (Electrical)

6.1 Scope of supply

6.1.1 Scope of supply has been defined in chapter 2 of the specification. The scope shall also include the followings:

a) The supply of complete documentation for approval of design, relevant drawings and calculations to the satisfaction of IR and RDSO and support documentation associated with the operation and maintenance of the equipment supplied against this specification.

b) Partner shall submit list of equipment and facilities required for maintenance and overhaul of equipment offered. Partner shall also interact with the consultant appointed by the IR for finalizing the layout design of construction/ modification of the existing facilities in respect of maintenance sheds/ work shop.

c) Software packages for scrutinizing the design calculations, equipment ratings, performance evaluation & making simulation studies shall be supplied. In case the software package can only run on customized hardware, the same shall also be supplied. The package shall be complete in all respect so as to enable the RDSO to simulate all performance and operational related variables in India.

6.2 Eligibility Criteria

Eligibility criteria for major equipment of electric supply / cables / air conditioning system, manufacturer is intended to use only proven system of reputed manufacturing for each major equipment / assembly / sub-assembly etc. The regular source as per RDSO specification shall be considered as proven source / equipments. For other sources criteria as mentioned in Chapter-2 of this specification shall be followed.

6.3 Partner's Responsibilities

The partner's responsibilities will extend to the followings:-

6.3.1 The partner shall supply detailed instructions, drawings & relevant specifications for proper installation of the equipment in the cars to Railways& RDSO. For this purpose, the partner shall depute a team of engineers to Railways during installation and pre-commissioning of the equipment in the different type of cars.

6.3.2 The partner shall entirely responsible for the execution of the contract in accordance with the requirements of this specification. The partner shall comply with the provisions of the general conditions and the special conditions of the contract in scheduling executing and obtaining the RDSO's approval of the design.

6.3.3 The partner shall submit a technical plan to IR and RDSO giving details of overall system design. This document will be prepared for approval within one month of the contract awarded to freeze the overall the system design.

6.3.4 Complete information on equipment testing and commissioning at site/ on train, their interface and complete system testing shall also be provided. The relevant customize hardware, if any, required for the purpose as above shall also be supplied to RDSO.

6.3.5 Supply of drawings, operating manuals, maintenance manual and software manuals regarding all aspect of the supplied equipments.

6.3.6 Planning and provision of comprehensive training to IR staff regarding design, system engineering, assembly / testing / trouble shooting commissioning of electrical system.

6.4 Clause by Clause Comments of specification and schedule of technical requirement (STR)

6.4.1 The bidder shall furnish clause by clause comments on compliance or otherwise of each clause of this specification & Schedule of technical requirement (STR). The bidder shall indicate deviations in their offers clearly against the respective clauses and also furnish lists of deviations as per the bid. Complete details as required vide the respective clauses shall be furnished by the Bidder.

6.4.2 The comments like 'noted' against the respective clauses shall be considered as 'not complied' for the specific clause. Therefore, the bidder shall clearly indicate the compliance or otherwise by writing 'complied' or 'not complied'.

6.5 Approval of Design

6.5.1 The design shall be developed based on the requirements given in this specification and sound engineering practices with specific consideration to the specified passenger loading condition and environmental conditions. The entire design shall be supplied by the partner with required technical data and

calculations to RDSO for approval. The manufacturing will commence after the approval of the design by RDSO.

Any calculation which is evaluated on the basis of software simulations shall be supported with sample calculations.

6.5.2 After the contract is signed, the partner shall furnish to RDSO and the IR the detailed schedule programme for submission of design documents for approval which shall be suitably staggered, to enable RDSO to plan for expeditious clearance.

6.5.3 The partner shall deliver all necessary data, designs, calculations, drawings and specifications referred in their drawings or design documents in English language as required by RDSO for examination and shall provide explanation and clarification of the drawings for which approval is sought. Approval or decision by RDSO shall normally be given within 3 weeks of submission of all clarifications by the partner to the satisfaction of the RDSO. For this purpose, the partner shall depute his technical experts to RDSO for design discussions and finalization. After the final design is approved the partner shall furnish complete set of applicable specifications as mentioned in the approved drawings & documents and shall also submit the list of equivalent Indian Standards wherever applicable.

6.5.4 Partner shall submit the basic design, functional specifications, software specifications, block diagrams. Schematic drawings, loading calculations, circuits, wiring diagrams, control equipment and panels etc. drawings and ratings of all sub-supplier's deliveries. Details of tonnes capacity calculations, components rating calculated under the ambient conditions as specified etc. shall be got approved from RDSO. Partner shall supply / furnish complete technical details with respect to their system and equipment design and to the satisfaction of RDSO at the time of design approval.

The design shall be developed in SI Units.

6.5.5 **Approval of design means approval of general design features:** Notwithstanding the approval, the partner shall wholly and completely be responsible for the performance of the complete system and equipment supplied by him. RDSO will not be responsible for the correctness of the dimensions indicated on the drawings, the materials used or the strength of parts. The partner shall, when submitting proposal or designs for approval of RDSO draw specific attention to any deviation or departure from the specification involved in his proposal or designs.

6.5.6 Bidder shall enclose details of their system design, weight particulars and its disposition, covering all major items viz. transformer, battery, air conditioning unit and duct etc. Bidder shall submit detailed document on step-wise calculations of equipment rating.

6.5.7 The partner shall be responsible for carrying out improvements and modifications at his own expense on all the equipment supplied, provided such modifications/improvements are decided to be necessary jointly between partner and RDSO for meeting the requirements of reliability, performance & safety etc.

6.5.8 For the purpose of technical decisions on improvements / modifications etc. on equipment, the final authority from the IR's side will be RDSO.

6.6 Maintenance manual, spare parts catalogue & material specification:-

6.6.1 The detailed maintenance and service manual shall be prepared for the various equipment and 40 copies of the same shall be supplied free of charge. The draft contents of the manuals shall be submitted for approval of the RDSO.

6.6.2 Detailed spares parts catalogue listing all components manufactured or purchased by the partner along with their rating, source & schematic position etc. (40 copies) each shall also be supplied free of charge. Partner shall furnish purchases specification of the bought items as well.

6.6.3 The documentation shall be provided on compact discs and floppies along with relevant software and complete arrangements to read them or edit them in future to take prints in colour.

6.7 Size of drawings

The drawings of the equipment parts shall be of full sizes. The dimensions, weight, capacity, etc. shall be in SI units. All drawings shall be submitted in CDs in latest Auto CAD format along with the complete setup for reading editing and taking the prints. This would include supply of relevant software and customized hardware, if any.

6.8 Method of filling of drawings

The facilitate filling of drawings, it is essential that each drawing submitted for approval is marked so that it can be identified. The partner is, therefore, required to

ensure that all prints are marked legibly at the right hand bottom corner. The following information is required in respect to each drawing:-

a) Partner's drawing number.
b) Partner's name and date of submission.
c) Contact number given by the IR.
d) Description of drawings.
e) Relevant specifications and material specifications.

6.9 Photographs

While the equipment's is under manufacture, photographs shall be taken of the various assemblies and subassemblies in various stages of production. Photographs shall not be less than 380 x 255 mm in size and shall be taken on non-curl films. The negative and three prints of each shall be furnished to IR. The print should be mounted on sheets to form complete sets. Photographs on digital media and videos shall also be furnished.

6.10 Binding

Each set of tracings together with a set of photographs shall be suitably bound within a cover of superior quality durable material with the title block printed on the outside of the cover.

6.11 Marking of equipment

All main assemblies of the equipment shall bear serial number for identification and initials of the IR. Where the sub-assemblies / components of the main assemblies are not inter-changeable the sub-assemblies shall also be marked with the serial number of the main assembly of which they form a part.

6.12 Rating plate

All equipment / cubicle shall contain rating plates of anodized aluminium with embossed letters. The rating plate will give detailed rating specification and identification of equipment. The details of rating plate of each equipment shall be approved by RDSO.

6.13 Change of manufacturing unit

i. The change of manufacturing unit shall be restricted to only those items which are explicitly mentioned in the bid-document and agreed to in the contract.
ii. All such items permitted for change of source and agreed so in the contract shall be Re-type tested.
iii. The manufacturing unit where these items are proposed to be manufactured shall be approved by OEM of that item for the adequacy of manufacturing and testing facilities, Quality Assurance Plans (QAP) and processes for manufacturing of the series supply. The quality of final series product shall be certified by the OEM.
iv. Not more than one manufacturing unit shall be used for manufacture of one equipment in addition to that of OEM.

6.14 General Design Requirements

6.14.1 Notwithstanding the contents of this specification, the partner shall ensure that the equipment supplied by them is complete in all respect so as to enable the desired operation of the coaches fitted with their equipment.

6.14.2 The equipment design shall incorporate all essential features necessary to yield high passenger loading, low maintenance requirements, easy maintainability, high reliability in operation and high efficiency with low power consumption with a justification that how it is energy efficient.

6.14.3 The specification has been prepared for the general guidance of the partner. Deviation from this specification may be proposed if it intends to improve the performance, utility and efficiency of the system as a whole or part thereof as options with cost of withdrawal of deviation. All such deviations shall be accompanied with complete technical details and justification for the proposed deviation.

6.14.4 The entire equipments shall be designed to ensure satisfactory and safe operation under the running conditions and especially under sudden variations of passenger loading, faulty operation and short circuits etc. The design shall also facilitate erection, inspection, maintenance and replacement of the components of the system.

6.14.5 All components of control electronics, and PCBs shall be suitably covered to keep them free from moisture and dust. The protection level shall be furnished by the partner during design approval.

6.14.6 All the electrical equipments shall comply with the latest addition of IEC specifications unless otherwise specified. The temperature rise shall be measured according to the procedure stipulated by IEC and shall comply with the limits specified and the ambient conditions defined in this specification.

6.14.7 All equipments shall be adequately earthed, insulated, screened or enclosed. They shall be provided with essential interlocks and keys as may be adequate to ensure the protection of the equipment and the safety of those concerned with its operation and maintenance.

6.14.8 The design shall also facilitate easy erection by means of suitable tools and equipment, inspection, maintenance and replacement of the various units comprising the equipment.

6.14.9 Major equipment in EOG AC type coaches like Switch Board cabinet, Transformer, Batteries, Regulated Battery Charger (RBC), Mono-block pump etc shall be under slung. All under slung equipment shall be IP: 65 protected or better.

6.14.10 The equipments are mounted under-slung / roof mounted, while designing the equipment the vibration level evaluated during the trial shall be considered.

6.14.11 All electrical equipment shall be designed to give full rated output from minimum supply voltage to maximum supply voltage of system being offered.

6.14.12 All power equipment and control devices shall be IGBT based.

6.14.13 Research Designs & Standards Organization (RDSO) shall be assigned the responsibility for technical evaluation of bid, approval of design and test specification. RDSO shall also be responsible for carrying out prototype test, approval of modifications, any changes in design and layout of electrical equipment of coach.

6.15 Danger plate

Danger plate shall be provided as per IS: 2551 at all electrical equipment's where operating voltage is more than 230 V.

6.16 Reliability

6.16.1 In addition to meeting the performance requirements, the equipment, shall incorporate high standards of reliability to ensure that operating cost and operation performance are optimized.

6.16.2 The partner shall provide the achieved quantitative reliability data of major sub-system / equipment, expressed in Mean Time Between Failures (MTBF) and / or Mean Distance Between Failures(MDBF), based on operations of proven coaches fitted with similar equipment for a minimum of 3 years and 4,50,000 Kilometres per coach in revenue service, for IR's evaluation. The MTBF shall be submitted for the ambient temperatures of 45º C, 50º C & 55º C.

6.16.3 Failure is defined as "A coach in service should be considered to have failed, when through some electrical defect in the stock":-

a) Either coach is unable to complete its booked working in its nominated rake.

Or

b) A delay of not less than 15 minutes is caused to any train included in the booked working of the day. Failures of all coaches, whether employed on traffic or departmental service, are to be included.

6.17 Power supply system for EOG coaches

Power supply requirements for Ventilation, Air conditioning and lighting / Fans load henceforth referred, as hotel load on these cars shall be fed from Generator car cum luggage Brake-van. The train line system voltage is of 750V, AC, 3-Phase, 4-wire, 50 Hz. The power supply voltage is 415 V AC / 110 V AC.

6.18 Generator cum Luggage & Brake Van

6.18.1 A power generating equipment of suitable capacity in the Generating van will be provided by the manufacturer viz. :

a. Power generation equipment with diesel engine and alternator of proven design, etc. including base rails and anti-vibration mountings.
b. Engine fuel system
c. Generator control panel including associated wirings.
d. Engine cooling and ventilation system includes air intake filters of the engine, air system and silencers.

e. The functional guarantee of the power generation equipment.
f. Power and control for DG set containing necessary instrumentation with suitable rating.
g. Fuel tank should be of 2 x 3000 litres capacity so as to run 26 coach trains in longest route in India.
h. DG set should confirm the latest norms of pollution issued by Central Pollution Control Board.
i. Dry Chemical Powder (DCP) type firefighting equipment shall be provided with instruction in generator cum brake van.
j. Latest revisions of RDSO specifications of power car and control panel shall be followed.

6.18.2 The generator-cum brake van including all other equipment to which belong the air conditioning equipment and furnishing of the crew and guards compartment (for 6 persons including guard) ventilation system with body side filters for the power room, fuel tank with necessary pipe line, service tank in the generator-cum brake van 60 KVA step down transformers (750V / 415V, 3 phase 4 wire) for feeding the electrical equipment of the generator-cum-brake van and the necessary wiring will be provided by the partner.

6.18.3 **Noise Reduction Features:**

DA set layout shall be in such a way that minimum noise is transmitted outside the power car in the plate form area. Firm shall reorient / redesign radiator motor, ventilation system, provide acoustic panel and use residential silencer to achieve noise reduction. Noise reduction measures should not increase the weight of complete system. Acoustic material used shall be fire retardant. Technical details of complete noise reduction scheme should be submitted to RCF and RDSO. Noise level shall be measured as method prescribed in ISO: 8528 Part-10 figure-4 (Latest version).

6.18.4 Relevant electricity rules / act shall be followed while electrical installation, transmission & distribution system of electrical power.

6.18.5 The general arrangement of power car shall be generally confirm to RDSO specification no. ELPS/SPEC./EOG/01 for “Specification and Code of Practice for Wiring in 750 Volt End –On –Generation (EOG) system” issued in March, 1994 and ELPS/SPEC./EOG/02 for “Specification for BG High Capacity Power Car for 750 V. End-On –Generation System” for study and reference purpose.

6.18.6 At present RDSO Specification no.RDSO/ PE/ SPEC./ AC/ 0084-2008 (REV. "1") for " Specification for 336 KW Diesel–Alternator set for Power car" currently used for LHB Rajdhani 19 coach rake formation.

6.18.7 RDSO approved RCF Specification no. EDTS: 350 for "Specification for 450 KW High Capacity Diesel–Alternator set along with Control Panel for power car" shall be followed for LHB Rajdhani 24 coach rake formation.

6.18.8 RDSO approved RCF Specification no. EDTS: 351 for "Specification for Switch Board Cabinet for Power & Control Panel of 2 X 450 KW High Capacity Diesel–Alternator set for LHB type Generator car "shall be followed.

6.19 Mains Supply and Electrical Equipment:-

AC 750V Mains

Two alternating current mains (feeders) runs through the rake with 750V, AC, 3-Phase, 4-wire, 50 Hz voltage take over the power supply of the passenger cars. This voltage is provided by two generators (Diesel–Alternator set) of suitable rating inside the Generator cum Luggage & Brake Van.

6.20 Hotel load

6.20.1 **From Generator car**

6.20.1.1 The Hotel load of the rake will be fed from the Generator-Cum-Brake- Van provided at end(s) of the rake. The Generator-Cum-Brake- Van will be equipped with two diesel engine driven alternator sets including its cooling and ventilation system for generating a train line system voltage 750 Volts AC, 3 phase, 4-wire system, 50 Hz.

6.20.2 **From Electric loco/ Diesel loco**

6.20.2.1 The coupler arrangement shall be suitable for receiving 3-phase 750 V AC supply from Electric loco / Diesel loco for meeting the hotel load requirement. The arrangement shall be suitably brought to control panel with protection scheme for distribution.

6.20.2.2 Provision of fitment of suitable capacity of Diesel-Alternator set shall be made as per required (24 nos. cars) composition of the train along with fuel tank in Generator-Cum-Brake-Van.

6.20.2.3 For making the EOG coaches compatible to Head On Generation (HOG) system, the implementation of modification sheet no. RDSO/ PE/ MS/ AC/ 0051-2011 (REV."0") for "Provision of Head–On-Generation (HOG) power supply system in LHB design power car and coaches" issued by RDSO shall be incorporated in the specification of the coaches and power cars, during manufacturing stage.

6.20.2.4 In order to avoid disruption of supply in neutral section, complete lighting, fannage and control supply shall be of 110 V DC.

6.20.2.5 For making HOG power car RDSO specification no. . RDSO/ PE/ SPEC./ EMU/ 0072-2008 (REV. "1") or latest shall be followed.

6.21 Fuel capacity of Generator -Cum-Brake-Van

The Generator-Cum-Brake- Van shall be provided with fuel tank(s) of minimum capacity (6000 litre), which is adequate for Minimum 44 hours of continuous operation at 75% of its rated output.

6.22 Power supply to cars

6.22.1 The output from the Generator-Cum-Brake-Van will be according to the train line voltage system as per clause no. 6.20. The train line is the electrical feeder transmitting power from Generator-Cum-Brake-Van to each car for meeting its hotel load.

6.22.2 All the air-conditioning equipment shall work on 415 V, 3-phase ac., 50 Hz. Lights and Fans work on single phase 110 V AC/DC. Step down transformer of 60 KVA, 750/415V, 3 phase 4 wire shall be required on each car to feed hotel load equipment at 415 V. Similarly, suitable lighting transformer shall be provided to get 110 V. AC 1-phase for light and fan load.

6.22.3 The equipment shall be of modular construction and would facilitate easy handling during installation and replacement for repairs. It shall also facilitate easy trouble shooting and repair in position in case of any defects.

6.23 Air conditioning

6.23.1 Air conditioning plant should be roof mounted package type. The control system for the AC units should be microprocessor based preferably with remote control. There should be at least two package units in each coach. Both the unit shall be controlled by single microprocessor unit.

6.23.2 The cars shall be provided with Reverse cycle Refrigeration system using R 407C refrigerant, which is ozone and eco-friendly or any other eco-friendly HFC refrigerant having zero ozone depletion potential and A1 safety category as per ASHRAE standard.

6.23.3 The cars shall be designed to meet the following conditions inside the compartments:-

Summer conditions	**Dry Bulb**	**Wet Bulb**	**%RH**
Outside (dry summer)	50ºC	25ºC	---
Outside (wet summer)	40ºC	28ºC	---
Inside (dry & wet summer)	23ºC-25ºC	---	40-60
Outside	4ºC	---	
Inside	19ºC-21ºC	---	----

6.23.4 All the equipment shall be capable of continuous operations without detriment to the operation of cut-outs, circuit breaker, or overload in ambient temperatures between 0º C and 55º C and relative humidity up to 100 %.
For AC 1st class sleeper it is preferable to have temperature control in individual cabin.

6.23.5 Each railcar shall be provided with two nos. of Roof Mounted AC Package Units (RMPU). The structure of RMPU shall be preferably made of corrosion resistant Aluminium or aluminium alloy having sufficient strength which can meet the shock and vibration of minimum 3g in each direction. The cooling capacity of each unit shall not be less than 8.0 TR under specified condition mentioned in clause No. 6.23.3 of this specification.

6.23.6 The Roof Mounted Package unit shall have reverse cycle feature (heat pump). There shall be two independent refrigerant circuits in each RMPU. Resistive type of heating during winter may not be acceptable. During heating both the compressors of the RMPU shall be in operation alternatively to avoid ice formation on outside heat exchanger.

6.23.7 The conditioning system shall achieve an interior temperature of 25º C (DB) and 16º C (WB) at an external ambient temperature of 50º C with full passenger loading.

6.23.8 The relative humidity inside the railcar shall not be more than 60%.

6.23.9 The air conditioning system shall deliver an air quality inside the railcar as per ASHRAE norms or EN norms.

6.23.10 The air conditioning system shall use a refrigerant which is eco-friendly (R-407C refrigerant) for next 30 years as per Montreal protocol.

6.23.11 In the event of leakage of refrigerant in air-conditioning unit/units, harmful quantities of the refrigerant shall not be released inside the compartment and there shall be an arrangement for forced ventilation of the railcars.

6.23.12 The air conditioning system shall provide a high rate of renewed air, maintenance of constant temperature and take into account, frequent door opening and high user density. The units shall be compact, roof mounted and low power consumption.

6.23.13 In the event of power failure to all air-conditioning units exceeding 2 (two) minutes, a minimum of 3600 cubic meter per hour of fresh air shall be introduced to railcar and distributed evenly through the passenger areas. For this application an inverter of suitable rating will be provided inside the RMPU unit and it should be easily accessible for maintenance point of view.

6.23.14 The design of the ventilation unit shall be such that CO2 level inside the railcars, with payload shall not exceed the permissible threshold limit of the order of 700 PPM above the CO2 concentration in air outside the railcar.

6.23.15 The general requirement of roof mounted package unit & testing for air conditioning shall generally conformed to RDSO spec no. **RDSO/ PE/ SPEC/ AC/ 0061-2005 (rev. 1)** or latest and RDSO spec no. **RDSO/ PE/ SPEC/ AC/ 0139-2009 rev.1** for micro controller of RMPU or latest or EN standards.

6.24 Microcontroller for operation of air-conditioning units:

A microprocessor based microcontroller for operation of RMPU units of coach shall be use as per RDSO spec. no. RDSO/ PE/ SPEC/ AC/ 0139-2009 rev.1 or latest. There shall be one microcontroller per coach mounted in the switch Board Cabinet and shall have feature for operation of reverse cycle RMPU.

6.25 Switch Board Cabinet AC cars

There shall be one switch board cabinet per car for power supply to both RMPU unit and coach lighting. The switch board cabinet shall generally conform to RDSO approved RCF spec no. EDTS: 073 Rev 'D' amndt.-6 or latest. Modification sheet no. RDSO/ PE/ MS/ AC/ 0056-2008 (Rev.1) also issued in this regard.

6.26 Emergency lighting and ventilation

6.26.1 Emergency Light Unit (ELU) for disaster management shall be provided as per ICF specification no. ICF / ELEC / 917 for "Emergency lighting unit in rolling stock "and modification sheet no. RDSO / PE / MS / 0047 (Rev. "0") -2009 for "Checking function of Emergency Light Unit (ELU)."

6.26.2 Arrangement should be made on the cars so that a part of light constituting essential lights and fresh air ventilation shall work without an interruption for 4 to 6 hours. This provision will also cater for short time taken to start stand by supply from Generator-Cum-Brake-Van.

6.27 Fire Loading

6.27.1 The total fire load of potentially flammable materials on a vehicle should be minimized as far as in practicable and the calculated figures be submitted for approval. The fire load of the vehicle should not exceed that of similar vehicles already in service in similar operating environments.

6.27.2 All the electrical material to be provided in AC coach shall have fire retardant properties and shall meet the requirement V0 UL-94. While manufacturing the coach, UIC: 564-2 shall be followed for fire protection and fire fighting measures.

6.27.3 Code of practice for prevention of fire in AC Coach no.RDSO/ PE/ O/ 0008-2005 (Rev.0) shall be followed. The manufacturer however may propose improved scheme also with justification.

6.27.4 "Code of Practice for prevention of fire on Power cars "no.EL/ E-M/1-79 issued in August, 1979 no. and RDSO letter no. EL/0.6.2/ Test dated 16-08-2011 "Prevention of fire in power cars" shall be followed. In addition to above the instructions issued by RDSO time to time shall also be followed.

6.28 Inter Vehicular Couplers Electrical

6.28.1 Each car shall have two feeders and two set of IV couplers, and dummy sockets. Feeder selector arrangement with indication and interlocks shall be provided.

6.28.2 For train line supply of 750 V 3-Ph, 50 Hz both the coupler and feeders provided on each end of car shall carry full hotel load of the train. One coupler / Feeder will be standby.

6.28.3 The inter-vehicular coupler arrangement for both power and control system shall be proven and shall conform to international standards and compatible with the existing coaches.

6.28.4 Coupler shall also carry control circuit C-1 & C-2 pilot wires.

6.28.5 The IV couplers in between the Generator-Cum-Brake-Van and cars and also between different cars shall be minimum rating of 500 Amp. at 50° Ambient temperature.

6.28.6 The coupler will also carry earth wires for earthing of power equipment on car, which are to be finally taken to the cars through Generator-Cum-Brake-Van. The Generator-Cum-Brake-Van will be provided with earthing brush to provide effective earthing of the earth wires running with the train line.

6.28.7 IV coupler shall be capable of making all necessary electrical connections between adjacent railcars in a train. On minimum radius curves, the covers shall not exceed the allowable clearance envelope of the railcar. Sufficient spare contacts (at least 15 %) shall be provided for catering to future needs of the partner.

6.28.8 The outer cover of the electrical coupler shall be additionally strengthened to protect the coupler against ballast or external hitting. The coupler plug shall be of water proof in construction.

6.28.9 The complete coupler assembly shall have IP 67 protection as per IEC: 60529 in vibration condition.

6.28.10 The insulating material shall have the fire / flame retardant property of V0 grade when tested as per UL: 94.

6.28.11 A heat shrinkable, fire retardant polyamide sleeve shall be provided covering some portion of lugs and cables.

6.28.12 Cable shall be crimped at minimum 4 points in plug pins & socket tubes, so that possibilities of loosening of cable & presence of air may be eliminated during service. If required stainless steel fastener as per SS: 304 grade shall be provided to prevent from corrosion & rusting.

6.28.13 In order to secure the cables from external hitting, the cables connected with the coupler shall not hang lower than the lower most face of the coupler and shall be suitably secured to arrest dangling.

6.28.14 The design shall cater for relative movements between the railcars. It shall be that there is no disruption and sparking due to vehicle behavior under worst conditions of operation.

6.28.15 Couplers shall function satisfactorily with difference in head stock heights of adjoining railcars up to 75 mm. It shall be ensured that the jumper cable assemblies do not touch / rub the couplers under any circumstances.

6.28.16 Coupling of the electrical couplers between railcars shall be capable of being accomplished by one person and shall be practicable with longitudinal axis misalignment between railcars of eight degrees and 100 millimeters difference in height.

6.28.17 Any inter vehicular electrical connections carrying voltages in excess of 750 V AC shall be located above cant rail height.

6.28.18 Electric couplers shall use a configuration so that any end of the standard unit can couple to any end of any other standard unit. Contacts shall be spring loaded, of silver surfaced alloy, shall have surface capacity, shape and positive action to prevent fouling in coupling, shall maintain positive contact under all specified operating conditions and shall be capable to work even with the impacts to which the car coupler may be subjected in service.

6.28.19 The design shall cater for relative movements between the coaches. It shall be that there is no disruption and sparking due to vehicle behavior under worst conditions of operation.

6.28.20 Couplers shall allow coupled coaches to negotiate curves of radius 152.4 meters and shall be capable of passage in either direction over standard 1 in 8½ turn outs and shall function satisfactorily with difference in head stock heights of adjacent coach's up to 75 mm.

6.28.21 Coupling shall be practicable with longitudinal axes misalignment between cars of eight degrees and 100 mm different in height.

6.28.22 All train lines and inter vehicular couplers shall be so designed that they are not susceptible to any damage due to vandalism and external hitting during the run. Further adequate safety measures shall be taken to safeguard against ballast hitting, vandalism, rains and flood water. The layout shall be such that they are accessible to maintenance staff only. Adequate measures shall be taken to reduce the number of train lines to bare minimum. Details of the arrangement shall be furnished.

6.28.23 All weather proof coupler conforming to international standard and EMI / EMC compliance shall only be used.

6.29 Special Safety Provisions For High Voltage Equipment:

6.29.1 High voltage equipment and cables shall be adequately protected to eliminate any possibility of development of dangerous voltages due to leakages etc to parts of equipment etc., which are directly accessible to passengers and maintenance staff.

6.29.2 Proper interlocks shall also be provided for ensuring that high voltage equipment cannot be opened and charged conductors cannot be exposed. It should be possible to open and attend to this equipment only after supply has been disconnected and required safety measures have been taken.

6.29.3 Relevant clause of Indian Electricity rule shall be followed, keeping in mind the statutory and regulatory requirement.

6.29.4 All equipment working at voltage higher than 110 V shall be earthed on the car to earth wire and fail safe protection scheme shall be provided to isolate the equipment with poor insulation, which may be dangerous for passengers.

6.29.5 Earthing symbol shall be provided at all locations.

6.30 Utilization Voltage & Load Distribution On Cars

Generated voltage of DG set of Generator car shall be 750V AC. Electrical power shall transmitted to coaches, Hot buffet car & Dinning Car through 750V feeder cables & Inter vehicular coupler. In each car there shall be provision of 60KVA step down transformer for step down the 750V to 415V. The ventilation, air – conditioning and heating equipment on the cars shall work on 3-phase 415V, 50 cycles supply available on each car. The lighting circuit shall works on 110V DC/AC.

6.31 Electrical Apparatus, Wiring and Components

6.31.1 The car wiring shall be concealed in rigid PMA 6.6 conduits with their associated accessories (halogen free fire retardant) suitably laid for attention and trouble shooting in course of service without need for opening of body side and ceiling board panels on the car. Electrical junction box and distribution boards will be provided with suitable inspection covers away from passenger area.

6.31.2 The car wiring shall also be protected against short circuits, overloads and excessive leakage. The cables used for wiring shall be fire retardant. Shielded e-beam halogen free cable shall be used in wiring in order to minimize the EMI with suitable earthing.

6.31.3 The cables for wiring in the railcars and equipment shall use high grade electrolytic copper stranded conductors tinned in accordance with Good Industry Practice.

6.31.4 Electron beam irradiated / chemically cross linked, thin walled, halogen free, low smoke and less toxic cables as per RDSO specification no. ELRS / SPEC. / 0019 (REV. '2') according to relevant international standards and the Good Industry Practice for rolling stock application, shall be used. The insulation/sheathing material shall be EPDM / EVA and shall be fire survival type according to EN: 50264. At locations in the railcars where high temperatures are likely to be encountered, special cables shall be used. Crimping sockets for the termination of the cables shall be as RCF specification No. EDTS 200 & 201.

6.31.5 The layout of the cables shall be such that there is no contamination by oil. Length of power cables shall be kept to minimum. Cables and connections carrying different types of voltages shall be physically segregated from each other. For vital circuits, adequate numbers of spare control wires shall be provided with clear identification. Cable layout shall be according to EN: 50343.

6.31.6 Loading of power cables shall be such that in no case conductor temperature shall exceed maximum temperature according to data sheet minus 10 degree Celsius. The power cable layout shall ensure equal sharing of current in all power cables. Derating of cables due to bunching effect and cable layout shall be taken into account during design

6.31.7 All connections shall be terminated on terminal bars manufactured in accordance with Good Industry Practice. The terminals and wire cable ends shall be suitably marked to facilitate correct connections.

6.31.8 Plugs / couplers and sockets shall be used to connect pre-assembled units to facilitate maintenance and ensure a better layout.

6.31.9 No cable having a conductor size of less than 2.5 sq. mm shall be used except for multi core cables where 1.0 sq. mm cable is permitted. Smaller size cables for internal wiring of panels, control cubicles, consistent with the mechanical and electrical requirements, may be adopted.

6.31.10 Cables are properly secured and routed in the suitable Polyamide alleys/ trays/ ducts whenever the cable shall cross the door/ passage are, the cable shall be self extinguished and halogen free Polyamide jack braiding / Nylon jacket (Polyamide 6.6) as per RDSO/ PE/ SPEC/ AC- 0138-2009 (Rev-1) for Specification of Poly amide conduit system for cable management.

6.31.11 Equipment cases should be tropicalized and assembled in a dust and damp protecting enclosure manufactured in accordance with IEC 60529. Electronic equipment should be designed, constructed and tested in accordance ELRS/ SPEC/ SI/ 0015. The number of different types of electrical equipment and components should be minimized.

6.31.12 The maximum recorded temperature under worst loading condition shall be corrected for 55° C and compared with maximum permissible temperature (for power devices at junction). The thermal margin available shall be compared with safety margin declared by the manufacturer under worst loading condition even at lowest power factor the corresponding temperature of power devices shall have a margin of minimum 10° C.

6.31.13 Temperature of inductors/ transformers shall not exceed 155° C when corrected to 55° C for H class insulation. The inverter shall also be subjected for short time rating after continuous loading to ensure temperature rise is within the permissible limit.

6.31.14 The maximum temperature rise of electronic devices on the PCB should not exceed approximately 20° C for industrial grade components suitable for 85° C environment, when measured at half inch away from identified critical components. In case it is exceeding this limit use of MIL grade component shall be considered.

6.31.15 With the exception of jumper cables, all under body cables should be installed in fixed cable ducts or conduits. Cable ducts should include removable covers to provide access to the cables. Cables contained within the ducting should be clamped securely along the length of the cable runs to prevent chafing of cables. Cables should be securely clamped in strain relief cable glands at the entry and exit point of ducts and conduits. Ducts and conduits should be designed to prevent the entering of the water.

6.31.16 The cable shall be derated to take care of the adverse ambient conditions. All derating factors shall be applied, together with the maximum permissible conductor continuous temperatures for the particular exceed 90° C. The maximum short circuit temperature shall not exceed 250° C. The cable insulation shall be capable of withstanding these temperatures.

6.31.17 All cables should be manufactured with halogen free, flame retardant and low smoke emission insulation in accordance with an approved international standard. All cables should be firmly and adequately supported with cable supports for its entire length. Un- armored cables should be protected by means of turcking, conduit or other suitable means in all areas where physical damage may occur.

6.31.18 The following operation and environmental factor will specially kept in view while selecting the cable:-

- Excessive vibrations that are experienced because of prevalent track maintenance conditions in India.
- Prevalence of high temperature and humidity for the most part of the year.
- Operation of the coaches over a humid and salty terrain in which the climate varies from high rainfall for 4-5 months and extremely dusty atmosphere during rest of the year.

6.31.19 Smaller size cable for internal wiring of panels, control cubicles, consistent with the mechanical and electrical requirements may be adopted. The layout of the cable will be such that contamination by oil is avoided. Loading of power cables will not be more than 75 % of its capacity. Cables for terminal connections will have only crimped joints.

6.31.20 The sum of the cross-section is of cable, carried in any cable duct, conduits or any other enclosed area of the enclosure. Cables used for control circuits and all multi-core cables should be provided with cable identification sleeves at their points of connection.

6.31.21 Lightning, emergency lighting circuit, communication / control cables and halogen free, low smoke, low toxicity and flame retardant fire survival copper conductor cable. The power cable shall be chemically / e-beam crossed linked cable as per RDSO specification / IEC / DIN Standard.

6.31.22 Cable layout should be such that removal of any defective cable is easily possible. Every circuit in the car wiring should be protected against excessive current by a protective device fitted at the origin of the circuit. The protective devices should be provided on the positive end of each such circuit. All wiring circuits running on the

car superstructure are also required to be protected in addition on negative side. The wiring originating from the control panel should be protected by HRC fuses of MCBs. A reliable smoke / fire detection system should also be provided to detect fire in electrical equipments.

6.31.23 In each car at least four LED emergency light units shall be provided which will work even after failure of coach battery / DG set supply. The emergency light shall provide illumination level in steps for period of 12 hours & minimum lux load shall be maintained as 20 lux.

6.31.24 Freedom from dust and protection from surges will be ensured modular construction will be adopted wherever considered possible. The converter / inverter system and transformer will be capable of withstanding the maximum short circuit current under fault conditions and these will be established as well. As such in case of any dead short circuit across the outgoing terminals of converter/inverter systems, the system shall provide adequate protection so that no damage is reflected on the converter / inverter system.

6.32 Insulation system

6.32.1 The insulation system to be employed will be particularly designed to withstand the adverse environmental conditions. The materials comprising this system and the system itself will have been proved to be of the highest6 reliability in traction application. Imperviousness to moisture will be a special requirement.

6.32.2 The evaluation of the insulation system for thermal endur5ance will be made with fabricated test models by way of accelerated aging test as per the test programme drawn up in accordance with the norms specified in IEC 60505 / 1999. Various aging parameters, such as heat, vibration, mechanical/compressive stresses, special environmental effects of humidity, dust, metallic dust from brake shoes, etc. will be incorporated to simulate the actual working conditions as closely as possible.

6.32.3 Evaluation of the insulation system for sealing against moisture will be done in accordance with IEEE: 429. The temperature index of the insulation system corresponding to the extrapolated life of 20,000 hours shall be established.

6.32.4 The control equipments, relays and switches, and such other devices shall represent the latest and proven technology established under the most severe operating conditions defined in this specification with particular regard to reliability. Wherever considered necessary, the contacts should be duplicated to provide redundancy. The use of relays and contactors shall be to bare minimum. All relays and contactor4s shall be provided in dust proof enclosures.

6.32.5 The input voltage shall be 90 –140 V DC. The output shall be 3-phase sinusoidal output 415± 5%, 50 Hz, AC. The inverter shall meet the requirements of IEC: 61287& the control electronic and PCBs shall conform to IEC: 60571 including compliance to the optional tests. However, due to higher ambient temperature in India, the temperature for dry heat test shall be 80° C. The electronic control equipments should be protected against unavoidable EMI in the machine compartment. The vibration and shock tests and endurance tests shall preferably be done as per IEC: 61373.

6.32.6 The temperature rise limits for rotating machines will be reduced compared to IEC limits to take care of the higher ambient in India. Only insulation system of class H and higher will be acceptable. The permitted temperature rise for different classes will be:-

Class H	180 ° C
Class C	100° C

6.32.7 Vacuum pressure impregnation of the stator winding must be done using solvent less varnish having thermal index above 200° C.

6.32.8 In the case of squirrel cage motors, aluminum alloy die cast rotor construction will be preferred.

6.32.9 L-10 life of bearings will not be generally less than 1, 00,000 working hours when calculated as ISO recommendation R-281. The bearing design will be such that no greasing or any intermediate attention may be required to be done for at least one and half year after each greasing/adopting maintenance schedule as recommended by manufacturer.

6.32.10 All auxiliary motors separately & combined equipment like motor blower sets will be subjected to prototype tests as per relevant IEC specification. If the operating conditions of the auxiliary machines differ from the specified test conditions in relevant IEC publications additional tests will be carried out.

6.32.11 Modular based cable sealing system with multi diameter technology EPDM cross linked halogen free rubber compound) shall be followed which shall be capable of preventing propagation of fire also.

6.33 Requirements of AC Hot Buffet Car and AC Restaurant Car

6.33.1 Pantry equipment's like Freezer, Deep Freezer, Bottle Cooler, Hot Case, Induction heating based cooking range, Hot water Boiler, Refrigerator, Electric Chimney etc. similar to existing pantry equipment's provided in LHB Hot Buffet car. The equipment shall be provided as per RCF specification no. EDTS 118 (Rev.C). Switch board cabinet for Hot buffet Car shall be provided as per RCF specification no. EDTS 134 (Rev.D).The capacity of the equipment's shall not be less than existing equipment's provided in LHB Hot Buffet car.

6.33.1.1 Pantry shall be equipped with Modern Induction hating based cooking system and service tables.

6.33.1.2 Adequate no. of sink and insect killer shall be provided in pantry area.

6.33.1.3 Pantry shall fulfill the ergonomical and Hygienic requirements.

6.33.1.4 Environmental requirements with respect to temperature, humidity and corrosions shall be taken into consideration.

6.33.1.5 Cut-outs for smoke emission through Electric Chimney shall be provided in the side wall of each cooking range / Induction hating based cooking range as provided in conventional Rajdhani Express trains.

6.33.2 AC Restaurant car:

6.33.2.1 AC Restaurant car shall have two numbers of LHB design roof mounted AC package unit (RMPU) and shall have one fridge, one micro wave, one hot case and one coffee dispensing machine of suitable capacity. The layout of the AC Restaurant car shall be as per the requirement of Indian Railway.

6.33.2.2 AC Restaurant car lighting shall as per clause no. 6.43 of this specification.

6.34 Mini Pantry (for all AC sleeper Cars)

6.34.1 Mini Pantry with equipment like freezer, Deep freezer, Bottle Cooler, hot case etc. similar to existing mini pantry provided in LHB type coaches shall be provided in all versions of AC sleeper cars mentioned in clause 2.4.1.

6.34.2 Mini pantry shall fulfill the ergonomical and Hygienic requirements.

6.34.3 Environmental requirements with respect to temperature, humidity and corrosions shall be taken into consideration.

6.35 Electrical Interfaces

For sub assemblies mentioned below the components of the current supply are to be delivered by the partner of the electrical equipment. The electrical wiring and electrical connection of these subassemblies will be affected by the mechanical part. The diagrams of the circuits, the wiring and connection will be provided by the partner of these subassemblies.

(i) Air conditioning system
(ii) Pantry equipment
(iii) Mini pantry
(iv) Water supply
(v) WC system
(vi) EP Assist brake
(vii) (Destination board
(viii) Lighting equipment

6.36 750/415 V, Step down Transformer 60 / 15 / 9 KVA, 3-Phase, 4-wire:

One number 750 / 415 V, minimum 60 KVA rating step down under-slung transformer shall be provided in each AC EOG coaches, two numbers in Hot Buffet cars and three numbers in Generator van respectively as per RDSO Specification No. RDSO/ PE/ SPEC/ AC/ 0080-2007 (Rev. '0') or latest.

6.37 AC 415 / 240 V Mains

750V, AC, 3- Phase 4 wire supply shall be reduced to 415 / 240 / 110 V, 3- phase, 4- wire, 50 Hz by 60 KVA transformer and feeds the coach loads. The 240 / 415V mains serve the following main car components:

(i) Air Conditioning.
(ii) Regulated Battery Charger (RBC).
(iii) Pantry / Mini Pantry.
(iv) Car Illumination.
(v) Mobile / Laptop charging sockets.
(vi) Water raising equipment (Mono-block pump)

6.38 110V, DC Mains Supply

The DC, Voltage mains is fed from the coach battery to serve the electrical equipment like emergency Lighting (DC part) and other control equipments.

6.39 Back-up Battery

6.39.1 Each passenger car shall be equipped with 120AH sealed maintenance-free (VRLA) or low maintenance lead-acid cells / battery having a nominal voltage of 2 volt (system voltage 110 V).The sealed maintenance-free shall be kept in MS tray. The battery (VRLA) shall be rated and tested in accordance with the requirements

as per RDSO specification no. RDSO/ PE/ SPEC/ AC/0009-2008 (Rev. '1') with amendment no. 1 & 2 or latest.

6.39.2 The backup battery shall utilize a sufficient number of cells to ensure that it is capable to supply emergency load for at least 45 minutes in case of failure of battery charger or its supply with the battery charged to 80% of its full capacity, before the voltage level at any device falls below 90 V, d.c. Non-essential load shall be shed after 30 seconds of failure of battery charge supply. This feature shall be demonstrated during testing.

6.39.3 The proposed list of equipment of the emergency systems shall be able to run minimum 45 minutes in emergency condition:-

(i) Emergency lighting.
(ii) All exterior lights.
(iii) Ventilation fans, but not air conditioning.
(iv) Communication systems including public address, passenger emergency alarm, surveillance system and train radio.
(v) Brake controls
(vi) Door controls
(vii) TMS
(viii) HVAC controls

6.39.4 The design and control of the battery shall ensure that there is sufficient capacity left under all conditions to operate current collector's control system. Adequate circuit protection shall be provided to ensure the battery load shall be disconnected when the battery voltage has dropped below 80% of the nominal voltage and when the auxiliary load is re-connected, the initial battery load shall not cause the battery output to oscillate.

6.39.5 The battery shall be on float charge by the voltage 128.5 ± 0.5 V d.c. output of the auxiliary power supply of which the output voltage shall have fine adjustments and good stability to avoid over or undercharging of the battery.

6.39.6 The control elements taking power from the battery shall be capable of operating between 90 V and 138 V, d.c. The instantaneous battery voltage shall be monitored and recorded through TMS.

6.39.7 The battery shall be adequately protected using fuse. These shall be mounted as close to the battery as possible. The status of fuse and circuit breakers shall be monitored by TMS.

6.40 Regulated Battery charger

Regulated battery charger of suitable capacity for charging the 120 AH, 110 V, VRLA battery shall be provided.

6.41 Battery Protection and Isolation:-

(i) Protection of the battery shall be provided, with adequately rated fuses placed in both the positive and negative poles.
(ii) Battery fuses shall be fitted in a separate box located adjacent to one of the battery boxes and shall enable easy access from track level.
(iii) Back connected fuse holders shall be provided and the battery fuse enclosure shall be sealed to IP: 65 in accordance with IEC: 60529.
(iv) A low voltage earth bar shall be provided and located close to the negative fuse

6.42 24 V, DC Mains Supply

The DC, Voltage mains is fed from the DC/ DC converter to serve the electrical equipment like wheel slide protection system, PA system, toilet control etc.

6.43 Saloon Illumination

6.43.1 Eco friendly Energy efficient modern state of the art 110 V DC(+- 30%) LED based lighting, in luminaries meeting flame, smoke and toxicity requirements shall be recessed into the ceiling panelling. The light fittings shall be simple, and arranged not to trap dirt, moisture and insects. Suitable sealing protection shall be incorporated to prevent ingress of dust etc from AC ducts.

6.43.2 Modern state of the art lighting shall be arranged in such a way that it extends along the saloon ceiling.

6.43.3 The lighting fittings shall be of an accepted robust construction, with the access to components. This shall be in a manner which does not significantly increase heat input to the saloon.

6.43.4 Each lighting fixture module shall have a translucent diffuser. The diffuser shall be protected against ultra-violet radiation degradation and discolouration and shall be fully sealed, at their periphery to exclude water, dirt, and dust ingress to the inner surfaces. The entire arrangement shall be free from rattling.

6.43.5 The lighting fittings shall be of an accepted robust construction, and preferably hinged for access to components mounted on the back. This shall be in a manner which does not significantly increase heat input to the saloon. The numbers and spacing of the lighting shall be such as to achieve a minimum lighting level of 300 Lux over the whole saloon area, measured at a height of 1.20m above floor level. The difference of lighting level in any place at 1.20 m height level from the railcars floor level shall not exceed 50 Lux.

6.43.6 The lighting system shall be designed so that it is resistant to vandalism; in particular it shall not be possible to damage or remove any light source without the use of special tools to dismantle a protective cover.

6.43.7 The lighting output shall be a warm white light. Light sources shall not dazzle passengers, nor limit horizontal vision, particularly at night (observation on the outside).

6.43.8 Light fittings shall be provided along the entire length of the saloon. The no. of light fittings for normal and emergency lighting in saloon cars shall be same.

6.43.9 Emergency lights shall be provided in each railcar to be fed by battery in case of total failure of supplies. These emergency lights shall have inbuilt rechargeable battery along with battery charger so that these shall continue to operate even in the event that railcars become separated from each other.

6.43.10 LED used in the luminare shall have minimum life of 5000 burning hours at 125° C junction temperature.

6.43.11 The size and number of light fittings shall be sufficient to provide a sensibly constant level of illumination of 300 lux at a height of 1.20 m above floor level, along the entire length of saloon/railcar.

6.43.12 Two separately protected lighting circuits shall be used, such that in the event of one tripping, the others provide evenly distributed lighting throughout the saloon.

6.43.13 Separately protected lighting circuits shall be used, such that in the event of one tripping, the others provide evenly distributed lighting throughout the railcar.

6.43.14 The partner shall submit documents related to service life of luminaries during the design stage which shall be as per the best international practices.

6.43.15 The partner shall submit layout of fittings and control circuit for review by the IR.

6.44 Laptop / Mobile charging Sockets

6.44.1 110V AC Electrical sockets for charging batteries of portable electronic devices or for powering a laptop computer / Mobile charging as per clause no. 3.7 “ESS ESS KAY model no NV-200 for switch, NV-219 for socket and NV-262 for cover frame with plate of signature NV series or similar models of MK (Honeywell) / Crabtree make shall be used” of RDSO spec no. RDSO/ PE/ SPEC/ TL/ 0142 - 2010 (Rev “0”) shall be provided, distributed throughout in each passenger compartment of the railcars as per latest railway board directives. The step down transformer (415 / 110V) required for above shall be of suitable capacity and mounted in switch board cabinet of the coach.

6.44.2 At present 3 KVA, 415 / 190V, 3-phase transformer is installed in the AC panel of the EOG coaches for coach lighting and laptop/ mobile charging socket each bay. For providing laptop / mobile charging points to every passenger, 9 KVA transformer is required as per RDSO Specification No. RDSO/ PE/ SPEC/ AC/ 0080-2007 (Rev. '0') or latest, which can be fitted in under-frame of the coach.

6.45 Carriage Fan

Adequate number (one number in each cabin) of BLDC fan shall be provided in AC Cars. The BLDC fan generally conform to RDSO spec. no. RDSO/PE/spec/TL/0021 rev(2) or latest.

6.46 Passenger Information System (PIS)

6.46.1 Passenger information system (PIS) as per RDSO specification No.RDSO / PE / SPEC / AC/ 0087-2008 (Rev "1") or latest shall be provided. This shall use GPS based data to determine the Train location and shall provide automatic announcements and the display of destination information on displays throughout the Train. Facilities to allow manual announcements to be made shall also be provided.

6.46.2 The PIS shall include provision for the announcements to be made remotely by train controllers should suitable communication facilities are provided.

6.46.3 All elements of the PIS installation shall be designed so as to resist damage and vandalism. Loudspeakers shall be flush mounted and suitably protected by grills. Information displays shall be protected by transparent covers so as to protect against damage.

6.46.4 The PIS system shall be designed to provide audible announcements and information displays in Hindi, English and regional languages throughout each journey.

6.46.5 Each railcar shall be provided with two LCD based passenger information display boards inside the railcar. These displays shall show current location of the Train, next station, remaining distance and time to next station, welcome & farewell messages, passenger related safety information and any other important information.

6.46.6 Each railcar shall be provided with two LED based destination boards on the outside of the railcar (one on each side) as per RDSO latest specification. These displays shall show the originating and destination station.

6.46.7 Unless otherwise stated above, it shall be possible for someone of normal vision to read any display from a distance of 10 metres under all lighting conditions.

6.47 Passenger Alarm Chain Indication Light (PACIL)

6.47.1 Passenger Alarm Chain Indication Light (PACIL) shall be provided as per type "J" luminaire of RDSO specification no. RDSO/ PE/ SPEC./ TL/ D/ 0091 (REV. "0")-2008 AMDT-2, in the compartments and outside toilets of the railcars.

6.47.2 Provision shall also be made for a warning signal to be given to the Train Driver and/or guard in the event of passenger alarm being pulled in any railcar. The operation of the alarm pull by a passenger shall not act directly on the train brakes but the brake operation shall be left to the decision of the Train Driver /guard. An audio visual indication shall be provided to identify the railcar and the location inside the railcar from where the alarm pull has been operated.

6.48 Reservation chart illumination light

Reservation chart illumination light shall be provided as per luminaire of RDSO specification no. RDSO/ PE/ SPEC./ TL/ D/ 0091 (REV. "0")-2008 AMDT-2, in the compartments and outside toilets of the railcars.

6.49 Tail Lamp

6.49.1 A tail lamp shall be provided, generally confirm in accordance with Indian Railways practice i.e. as per RDSO specification no. RDSO/ PE/ SPEC./ TL/ 0119 -2008 (REV. "0").

6.49.2 The tail lamp shall be red in colour.

6.49.3 The tail lamp shall flash at a rate of 55-65 flashes per minute in operation.

6.49.4 The tail lamp shall be provided in suitable water proof enclosures conforming to IP 68 standard with Poly Carbonate front glass.

6.50 Train Control and Management System (for electrical sub-systems)

6.50.1 The railcars shall be fitted with a computerized Train Control and Management System (TCMS) that as a minimum is capable of the following functions:-

- Receiving status and fault information from railcar's sub-systems generally including, ,power supply system, lighting system, ventilation and air circulation system etc. however list of parameters to be monitored shall be got approved from IR.
- Providing the above status information to the Train Driver/ Guard/Power car maintenance staff.

- Providing fault information to the Train Driver/ Guard/Power Car Maintenance Staff, faults shall be suitably prioritised and filtered so that the Driver/ Guard and maintenance staff receive information appropriate to their roles;
- Recording all fault information and status indications as necessary to assist maintenance staff;
- Supporting maintenance staff by identifying repair work required or defective equipment.
- TMS shall have provision to provide location, fault and status information to a central server without any extra Hardware/ software.

6.50.2 The TCMS (and where appropriate the monitoring functions in sub-systems) shall differentiate between a fault in the monitoring equipment and the equipment being monitored.

6.50.3 The TCMS shall be interfaced with the brake system. The Automatic flasher operation (in case of train parting) and vigilance control functionality shall also be implemented in TCMS.

6.50.4 The TCMS (and where appropriate the monitoring functions in sub-systems) shall enable fault finding to be carried out at module or card level as appropriate.

6.50.5 For each fault, the following data shall be recorded:

- Details of the fault itself;
- Location of fault (e.g. vehicle, subsystem, module, etc.);
- Any background data necessary to allow subsequent investigation;
- The time and date that the fault occurred; and
- The GPS location of the train.

6.50.6 The TCMS shall provide the facility to capture post trigger and pre-trigger background information on the occurrence of specific faults.

6.50.7 The TCMS shall store all faults recorded for a minimum of 100 days in non-volatile storage.

6.50.8 The TCMS shall provide on-line, context sensitive trouble shooting assistance to the Train Driver/ Guard in case of any fault, through the Train Driver/ Guard's display. The fault display to Train Driver/ Guard shall also accompany the standard trouble shooting instructions in simple English language.

6.50.9 In the event the fault identified by the TCMS has occurred as a consequence of the actions of the Train Driver/ Guard, this shall be identified and logged.

6.50.10 Where possible and appropriate, train control systems shall be integrated into the TCMS so as to reduce hardware and cables. Where control functions are

integrated into the TCMS, the requirements of EN: 50126 and EN: 50128 shall be applied. In particular the risks associated with the integration of any control function shall be assessed and the design of the TCMS (e.g. the SIL according to EN: 50128) shall reflect the level of risk identified.

6.50.11 Features of self-check, calibration and plausibility checks shall be incorporated in the design of the TCMS so as to aid the identification of faults.

6.50.12 The TCMS shall include a communications interface which shall (providing the communications channel is available) provide the following data to a central server (provided by the Company) via GSM or GSM-R:

- The train's location (determined by GPS) at pre-configured intervals. It shall be possible to configure this interval from once per day to once per minute in suitable steps;
- immediate indication that a critical fault has occurred; and
- Details of all faults recorded.

6.50.13 The Train Driver/ Guard shall be provided with a user interface to the TCMS in the Loco / Guard cabin.

6.50.14 The TCMS user interface shall include a suitable high resolution coloured graphics display incorporating the following features:

- Suitable illumination to achieve clear visibility in all lighting conditions without causing a distraction to the Train Operator at night;
- a wide viewing angle so that it can be readily observed by anyone in the Driving Cab;
- Protection against vandalism, impact, rough handling and damage; and
- Protected to IP 54 as a minimum.

6.50.15 There shall be a suitable means of input to the TCMS. This shall be designed so that it is protected against vandalism, impact, rough handling and damage and shall be protected to IP54 as a minimum.

6.50.16 It shall be possible to access all the processors of propulsion equipments of all the railcar(s) in a train, from the Loco / Guard's cabin, over wired train bus (WTB).

6.50.17 Loco / Guard's cabin shall include an interface so as to allow fault data to be downloaded to a standard USB pen drive, without the installation of any special hardware or software.

6.50.18 Where data is held in connected subsystems (e.g. pre and post trigger background data), it shall be possible to download this data through the interface described above and visualize it by means of the application software described below.

6.50.19 Application software shall be provided to facilitate the fault diagnosis and the analysis of equipment failures. The steps required for investigation to be done, shall be displayed in simple language along with background information. Such software shall be compatible for working on commercially available operating systems.

6.50.20 Access shall be provided to allow configuration parameters of TCMS and connected subsystems to be modified. This shall be possible either through use of the TCMS display or by means of a laptop connected via the interface specified above. All configuration parameters shall be protected against un authorized modification by means of a password.

6.51 Control Equipment

6.51.1 All control equipment, including Train driver / Guard's controls and indications for electrical, pneumatic, air pressure, brake and other circuits shall be provided. Necessary operational, protective and safety devices in the form of relays, contactors, switches as may be required by the circuit design shall also be incorporated for proper functioning of the power and auxiliary equipments and brakes etc.

6.51.2 The control equipments, relays and switches, and such other devices shall be in accordance with the Good Industry Practice.

6.51.3 All vital contacts for operation of the railcars shall be duplicated to provide redundancy where necessary.

6.51.4 Interlocks and auxiliary contacts of relays of protective, operation, control, auxiliary and safety circuits shall be housed in dustproof enclosures either by providing the complete equipment in dust-proof cabinets and/or pressuring the cabinets or by covering the contacts only by dust-proof covers.

6.51.5 The working of all relays and contactors shall be in the range –30 % / +25 % of nominal battery voltage when the operating coils are at their rated temperature and the contacts are subjected to normal pressure.

6.51.6 Rubber components, such as pistons, 'O' rings etc. wherever employed in the control gear, brake system and their controls shall be suitable for the specified humid and environmentally severe conditions. The life of rubber components shall not be less than six years.

6.51.7 Surge suppression circuits shall be incorporated to eliminate surges, wherever required.

6.51.8 All tests including endurance tests, both mechanical and electrical, shall be in accordance with latest RDSO specifications / International standards.

6.51.9 It shall be possible for the IR to execute parametric changes in the software viz: modifying some of the permissible parameters like current and voltage sensor settings, temperature sensor setting, pressure sensor setting, ,wheel diameter, main reservoir pressure setting for loading and unloading of compressor and vigilance control timer settings etc., for adjusting the characteristic within permissible range, changing preset values, limits, characteristics etc. and behavior of the railcars in general, and add/alter the protection features, if so required in the future in order to improve the operation of railcars.

6.52 General Safety measures

6.52.1 All exterior components including under slung equipment's shall be attached with use of secondary restraints, redundant fixings or secondary latches as appropriate to ensure that no single point failure shall cause equipment to either physically detach or protrude out of gauge.

6.52.2 Standard protective systems shall be provided, in accordance with the Good Industry Practice, for protection of the electrical equipment's against abnormal currents, excessive voltages, etc., with indicating facilities, so as to ensure safe and correct operations. All equipment's shall be adequately earthed, insulated, screened or enclosed and provided with essential interlocks and keys as may be appropriate to ensure the protection of the equipment's and safety of those concerned with its operation and maintenance.

6.52.3 A sensitive and reliable protection arrangement against earth fault shall be provided in each circuit group.

6.52.4 All electrical circuits shall be fully insulated from the superstructure on both the positive and negative sides and the super-structure shall not be used as a part of any earth return circuit.

6.52.5 Relevant provisions stipulated in Indian Electricity Rule 1956 shall strictly be followed in the interest of safety of passengers/staff as well as for equipment's / instruments provided in the railcars.

6.52.6 All the material of electrical equipment and wiring of coaches shall be fire retardant as per UL-94 V-0 or higher grade as specified in concern specification.

6.52.7 Positive and negative supply wire of coach shall be segregated in different conduit as per code of practice of RDSO to avoid any short circuit.

6.53 Fire Safety

The fire and safety requirements shall be as per clause 5.35.2 of chapter-5 of this specification" i.e. "The railcars shall comply with all electrical relevant parts of BS EN: 45545 applicable to rail vehicles" or BS:6853-1999 or latest "code of practice for fire precautions in the design and construction of passenger carrying trains".

6.54 Fire Extinguishers

6.54.1 Each railcar shall be provided with two dry powder type or other appropriate fire extinguishers located at each end of each car. These shall be in a niche so as not to cause injury or obstruction to people.

6.54.2 Any deviation from this specification proposed by the tenderer, aimed to improve upon the performance, utility and reliability/efficiency of the equipment will be given due consideration, provided full particulars of the deviations along with technical justifications are furnished.

Chapter 7
Inspection, Test and Trials

7.1 General

7.1.1 The partner shall furnish inspection, testing and trial plan and programs as prescribed in the Specification.

7.1.2 All the tests shall be carried out at the partner's cost, wherever performed, in the presence of and to the satisfaction of the IR, who reserves the right to witness any or all of the tests and to require submission of any or all test specifications and reports.

7.1.3 Wherever any equipment, system or sub-system is not specifically covered by an internationally recognized specification or test procedure, or where the type and routine tests prescribed by other international standard do not adequately cover the requirement, tests which are acceptable both to the partner and to the IR, shall be devised.

7.1.4 Type tests for certain equipment may be waived if these were carried out earlier for a reputed passenger car project and accepted by them. The partner shall submit a proposal along with a copy of type test report in this regard to the IR for review.

7.1.5 The IR reserves the right to reasonably call for additional tests as are considered necessary, including the quality of welds particularly in highly stressed areas, by non destructive testing methods.

7.1.6 The results of all tests shall be submitted to the IR, who will record his conclusions as to whether or not the equipment being tested has passed satisfactorily.

7.1.7 Repeated rejections, at either the partner's or their sub-contractors' facilities, shall be cause for the IR to suspend inspection. In such case, the work in question shall also be suspended until satisfactory corrective action is taken by the partner.

7.1.8 The partner shall not be released from any liability or obligation under the contract by reason of any such inspection, testing or witnessing, nor by submission of reports of inspection or testing to the IR.

7.2 Test Procedure

7.2.1 The partner shall submit detailed test procedures for each of the equipment/sub system/system for the review of the IR as part of design submissions. The plan test procedures shall include the following information:

I. Relevant specification applicable to each of the tests.
II. Type, routine and special tests to be carried out.

III. Description of the tests, scheduled dates, and locations of the tests.
IV. Test parameters to be measured.
V. Constraints to be applied during the test.
VI. Defined pass/fail criteria.
VII. Facilities, equipment, and test and measurement tools.

7.2.2 Test procedures shall be amended, as required throughout the duration of the contract, to reflect changes in system design or the identification of additional testing requirements.

7.3 Type Tests on Prototype Sub-Systems

The individual sub-systems of prototype cars listed in Clause 2.4.1 shall be tested accordance with good industry practice to determine their compliance with specification. Such test may include laboratory and field tests for validating the design of mechanical components like underframe, bogie, Suspension system etc. and optional tests in accordance with relevant specifications for various sub-systems.

7.4 Vehicle Body Shell Tests

7.4.1 Squeeze load test shall be carried out in accordance with EN 12663, P2. Car types having similar type Body shell can be exempted from the squeeze load test in consultation with IR. It will be the sole discretion of the IR that among all which type of cars shall be selected for squeeze load test.

7.4.2 Crashworthiness shall be proved by submission of detailed calculations and demonstration by means of finite element analysis and simulations.

7.4.3 The strength of the railcar side wall windows and of those in the doors shall be performed in accordance with UIC 566, as a type test.

7.4.4 The strength testing over a reasonable time frame of couplers and draft gear shall be carried out in accordance with international practice, also as a type test.

7.4.5 The car body shall also be subjected to a vertical deflection test. All side doors on one side of the car shall be installed, complete with drive mechanisms, and all sealing and weather-stripping.

7.4.6 At each increment of test load the doors shall be opened and closed by means of the door controls. Any failure to operate at the prescribed speed profile, or any indication of binding, shall require corrective action to be taken by the partner, to the car structure, to the door arrangement, or both.

7.5 Bogie Frame Stress and Fatigue Testing

Prototype Bogie frame shall be used for the bogie fatigue load tests and shall be performed as per UIC-515-4 and 615-4. Fatigue test shall be performed in the

presence of RDSO official for witnessing the test. After the test this frame shall not be used in any case and shall be discarded or destroyed.

7.6 Body side Entrance Plug type Door, Type Tests

7.6.1 The body side doors shall be tested for strength as required in chapter 5, for relevant parameters which are required to be met.

7.6.2 The following type test shall be carried out on a complete leaf door and operating assembly equipment with its control gear.

(i) **Endurance** -One million operations shall be performed. A record of the velocity profile shall be taken at the beginning and the end of the test. It should also be demonstrated that no undue wear or compression of seals has occurred.

(ii) **Vibration Tests**-Vibration test shall be carried out as per EN61337 standard.

7.7 Brake Equipment Type Tests

A. Disc brake; Following Tests shall be carried out:

(i) Functional checks such as working stroke, slack adjuster operation and hand/parking brake action.
(ii) Recording of the relationship of disc brake pad force to cylinder pressure over the full working range.
(iii) Plotting of brake force against pressure curves in all conditions of operation of brake cylinder and hand/parking brake.
(iv) Vibration test as defined in IEC 61373.
(v) Air leakage test

B. Brake Blocks/Pads:

The contractor shall carry out testing of brake lining in respect of coefficient of friction with respect to the disc under dry and wet condition, maximum temperature attained during braking, rate of wear. The brake blocks/pads shall comply to UIC-541-4/UIC-541-3.

7.8 Complete Brake System, Type Tests

7.8.1 A complete set of brake equipment comprising all items of equipment forming the Brake System shall be assembled.

7.8.2 The partner may submit a proposal to combine the test of individual items with the system test if agreed by for review and acceptance of the IR.

7.8.3 Instrumented tests shall be carried out at train level both in tare and loaded condition, to establish designed performance of braking. Similarly emergency braking distance tests shall be carried out in tare and loaded condition under dry and wet rail conditions. Wheel Slide Protection system shall be tested under and wet rail conditions.

7.8.4 The prototype train shall be used for carrying out emergency braking distance trials under tare and loaded conditions of the train as per IEC 61133.

7.9 Complete Brake System, Routine Tests

All reservoirs shall be tested to an appropriate international pressure vessel standard and necessary test certificates shall be provided from a recognized test agency.

7.10 Body side Entrance Plug type Door, Routine Tests

These will comprise functional test to verify that performance is consistent with accepted type test results, and shall include tests to relevant specifications for the electrical portion.

7.11 Interior Doors (Saloon Compartment Door, Vestibule Door and Lavatory Door) Type tests

The Prototype Saloon Compartment Door, Vestibule Door and Lavatory Door shall be subjected to an endurance test of one hundred thousand (100,000) operations, during which it shall be demonstrated that no component fails.

7.12 Seats/Berths& Chairs

The Seat/Berths assembly shall withstand without permanent deformation with type test strength requirements based on international recognized standards, subjected to mutual agreement (UIC 566 and TS Para 5.16).

7.13 Luggage Racks

The Luggage Rack assembly shall withstand without permanent deformation with type test strength requirements based on international recognized standards, subjected to mutual agreement (UIC 566 and TS Para 5.17).

7.14 Water Tank

Testing of the water tank shall be done in the same condition as fixed in the cars. Following test shall be applied to water tanks:

i. Dimensional Checking.
ii. Water Tightness.
iii. Air tightness with a air pressure of 50000Pa for underslung water tanks.
iv. Strength requirement according to Para 2.1.4 of UIC566 or equivalent standard.
v. Complete weight of the entire tank types and suspension.

7.15 Noise and Vibration, Verification

The partner shall perform noise and vibration type tests on all type cars to demonstrate compliance to this document. All test procedures, data and results shall be submitted to the IR for acceptance.

7.16 Fire Performance Verification

Type tests according to the relevant standards shall be undertaken to establish fire ratings for all materials proposed. However, test certificates from any Testing Agency of international repute may be accepted in lieu by the IR at his sole discretion.

7.17 Car Weight

The partner shall weigh each complete car and the weight of each car shall not differ by more than 5% of design load. In addition, bogies of cars shall be weighed separately. Certified weight shall be submitted to the IR and copies thereof included in the car history book.

7.18 Service Trials

7.18.1 The passenger cars listed in clause 2.4.1 shall be subjected to pre-revenue service trials. Service trials are intended to prove not only the satisfactory running performance of the cars, but also to enable practical evaluation of their reliability in service, ease of maintenance and operation, in parallel with the work of other designated contractors, and adequacy of the cars and equipment for all performance requirements envisaged in the specification.

7.18.2 The proto passenger train consists of passenger cars as per clause 2.4.1, shall be evaluated by the Indian railways during operation for the first 45,000Kms after induction into revenue service.

7.18.3 Before initiating service trials, the proto type railcars will be subjected to certain pre revenue service trials, mainly to satisfy the Indian Railways regarding operational performance, capability and safety. The following trials shall be conducted in this connection on proto type railcars of a particular design.

a) Oscillation Trial

Oscillation trial shall be carried out to prove the stability and riding performances of the proto type passenger train consists of passenger cars as per clause 2.4.1. The Proto type passenger train shall be subjected to trials on Indian Railways to determine its compliance with these specifications, at speed up to 10% above the maximum permissible speed as specified in clause 4.2 of this specification in four configurations, namely, instrumented bogie leading and trailing with original and condemning wheel profile. The following criteria shall be adopted for clearing the stock for regular operations:

i. evaluation shall also be done in terms of ride index which shall not be greater than 2.75 in both horizontal and vertical directions;
ii. The value of acceleration, recorded as near as possible to the bogie pivot, shall be limited to 0.3g (g is gravitational force) both in vertical and lateral mode. However ,a peak value of up to 0.35g shall be permitted, if the trial do not indicate a resonant tendency in the region of the peak value; and
iii. a general indication of stable running, characteristic of the prototype passenger train consists of passenger cars (as per clause 2.4.1), as evidenced by the movement of the bogie on straight and curved track ,shall be based on the recorded acceleration reading and instantaneous wheel load variation/spring deflections.

b) Emergency braking distance trials (EBD)

The measurements shall be recorded in accordance with the test scheme prepared by RDSO.

c) Coupler Force Trial

The measurements shall be recorded in accordance with the test scheme prepared by RDSO.

d) Confirmatory Oscillograph car Runs Trial (COCR)

The measurements shall be recorded in accordance with RDSO Testing Directorate procedure.

7.18.4 Passenger cars shall be inducted into revenue service only after service trials to ensure that functions and operations of various systems are satisfactorily integrated and permit all the technical systems to stabilize.

7.18.5 Upon completion of service trials the partner shall submit a statement confirming that the rolling stock is safe and ready for commencement of revenue service.

7.19 Electrical Equipment Tests

7.19.1 **Roof Mounted Package Unit Type and Routine Tests:**

Type test plan and Routine test plan as specified in RDSO specification no. RDSO/ PE/ SPEC./ AC/ 0061-2005 (rev. "1") or latest shall be followed.

7.19.2 **I.V. Coupler Type & Routine test:**

Type test plan and Routine test plan as specified in RDSO specification no. RDSO/ PE/ SPEC/ AC/ 0177 (Rev.0) -2012 or latest shall be followed.

7.19.3 **LED based tail lamp Type and Routine test:**

Tasting of Led based tail lamp in SLR & power car as specified in RDSO specification no. . RDSO/ PE/ SPEC./ TL/ 0119 -2008(REV. "0") or latest shall be followed.

7.19.4 **Passenger Alarm Chain Indication Light (PACIL) type "J" luminaire Type and Routine test:**

Tasting of passenger Alarm Chain Indication Light (PACIL) type "J" luminaire as specified in RDSO specification no. RDSO/ PE/ SPEC./ TL/ D/ 0091 (REV. "0")-2008 AMDT -2 or latest shall be followed.

7.19.5 **750 / 415 V, 60 KVA step down Transformer Type and Routine test:**

Testing of 60 KVA transformer as per RDSO Specification No. RDSO/ PE/ SPEC/ AC/ 0080-2007 (Rev. '0') or latest shall be followed.

7.19.6 **15 / 9 KVA Step down Transformer Type and Routine test:**

Testing of "15 KVA, 750/ 415/ 190 V and 9 KVA,750 / 415/ 190 V, transformer as per RDSO Specification No. RDSO/ PE/ SPEC/ TL/ 0080-2010 (Rev.'0') or latest shall be followed.

7.19.7 **Low maintenance Lead –Acid batteries Type and Routine test:**

Testing of Low maintenance Lead –Acid batteries as per RDSO Specification No. RDSO/ PE/ SPEC/ AC/ 0058-2005(Rev."0'') or latest shall be followed.

7.19.8 **Valve Regulated Lead –Acid (VRLA) batteries Type and Routine test:**
Testing of Valve Regulated Lead –Acid (VRLA) batteries as per RDSO Specification no. RDSO/ PE/ SPEC/ AC/0009-2008 (Rev. '1') with amendment no. 1 & 2 or latest shall be followed.

7.19.9 **450 KW High Capacity Diesel –Alternator set for power car Type and Routine test:**

Testing of 450 KW High Capacity Diesel –Alternator set for power car Type and Routine test as per RDSO approved RCF Specification No. EDTS: 350 REV. "0" with Ammendment no. -1 or latest shall be followed.

7.19.10 **Switch Board Cabinet for Power & Control Panel of 2 X 450 KW High Capacity Diesel –Alternator set for LHB type Generator car Type and Routine test:**

Testing of Switch Board Cabinet for Power & Control Panel of 2 X 450 KW High Capacity Diesel –Alternator set for LHB type Generator car Type and Routine test as per RDSO approved RCF Specification No. EDTS: 351 REV. "0" or latest shall be followed.

7.19.11 **Passenger information system**

Testing of PIS shall be as per RDSO specification No .RDSO/ PE/ SPEC/ AC/ 0087-2008(Rev-1) or latest.

7.19.12 **Microcontroller of RMPU**

Testing of microcontroller of RMPU shall be as per RDSO specification no RDSO/PE/SPEC/AC/0139-2009(Rev-1) or latest.

7.19.13 **Railway carriage fan (BLDC)**

Testing of Railway carriage fan shall be as per RDSO spec. No.RDSO/PE//TL/021(Rev 2) or latest.

7.19.14 **Poly amide conduit**

Testing of poly amide conduit as per RDSO/ PE/ SPEC/ AC- 0138-2009 (Rev-1) or latest for Specification of Poly amide conduit system for cable management.

7.20 Emergency lighting and ventilation

Testing of Emergency Light Unit (ELU) for disaster management shall be as per ICF specification no. ICF / ELEC / 917 for "Emergency lighting unit in rolling stock "and modification sheet no. RDSO / PE / MS / 0047 (Rev. "0") -2009 for "Checking function of Emergency Light Unit (ELU)."

Appendix- A. List of Designs and Drawings

1.1. **Mechanical Designs and Drawings:** The partner shall provide the Design and Drawings in English language and SI units of the following:

1.1.1 **Basic Design: The design shall include:**

i. Basic configuration of cars
ii. Weight Distribution
iii. Calculation of lateral and longitudinal balance
iv. Tare weight
v. Gross weight

1.1.2 **Shell of Railcars: The Design shall include:**

i. Construction of shell along with material
ii. Designed end load of the shell
iii. Anti Telescopic features incorporated in shell
iv. Vestibule arrangement with calculation showing minimum passage width on sharpest curves
v. Fatigue life evaluation of railcar body
vi. Floor Construction

1.1.3 **Weights:** The Design Shall includes the weight of complete fully furnished railcar of each type along with detail of breakup of the following components:

i. Bare Shell
ii. Bogie frame and other Bogie components
iii. Axle boxes
iv. Ventilators
v. Suspension (both primary and Secondary)
vi. Wheel and Axle assembly (Including Roller bearings)
vii. Brake Equipment
viii. Piping
ix. Draw and Buffing Gear (Including draft gear)
x. Ceiling and paneling material
xi. Furnishing
xii. Electrical Equipments

1.1.4 **Furnishing Materials:** The design shall include the installation detail including Vertical and longitudinal positioning of draw and buffing gear and accessories.

1.1.5 **Brake System: The design shall include:**

i. Brake system details of EP assist brake system
ii. Schematic diagram of brake system
iii. Brake power of railcars as percentage of tare weight
iv. Safety Integrity Level
v. Details of passenger Alarm System

1.1.6 **Bogie Frame including Brake Rigging and Suspension: The design shall include:**

i. Unsprung mass
ii. Primary and Secondary Suspension
iii. Bolster Arrangement if any
iv. Axle floating arrangement
v. Details of Shock Absorbers/Damping Arrangement
vi. Vogel Layout for 100 curve and 1 in 8 ½turnout for negotiability of Bogies
vii. Throw over the at headstock coupler
viii. Movement of bogie parts with details of clearances
ix. Estimation of flange forces on curve and turn outs
x. Bogie frame section views
xi. Arrangement of suspension system
xii. Connection between Bogie and Body

1.1.7 **Wheel Set: The design shall include:**

i. Heat capacity
ii. Details of Bearing and Lubrication
iii. Design calculations of Wheel, Axles and Roller Bearings including maximum stress under fatigue loading conditions and anticipated service life conditions and anticipated service life
iv. Weight distribution indicating Lateral and Longitudinal balance
v. Method of adjustment of Wheel and Axle load
vi. Wheel base of Bogie
vii. Diameter of Wheels when new and fully worn
viii. Details of wheel profile

1.1.8 **Axle: The design shall include:**

i. Stress calculation
ii. Static and dynamic load rating
iii. Safety factor in loading

1.1.9 **Axle Box: The design shall include:**

i. Details of bearing and lubrication
ii. Bearing life calculation

1.1.10 **Draw and Buffing Gear:** The design shall include the installation detail including vertical and longitudinal positioning of draw and buffing gear and accessories.

1.1.11 **Other Designs:** The partner shall provide the following details of design of railcars.

i. Calculation for strength and vibration analysis of the body shell under static and dynamic loading conditions using FEM
ii. Crashworthiness and collision protection analysis of the body shell.
iii. Compressed fluid dynamics (CFD) analysis for air flow inside the car
iv. Calculations of stability and riding performances of railcars with parameters of suspension system and dimensional details adopted for track standard.
v. Calculations of weight and center of gravity of each equipment together with calculations for lateral and longitudinal equipment balancing
vi. Calculations of stress in underframe, Bogie frame/bolster suspension springs, axles other components and fatigue life of these components.
vii. Deflection calculation of underframe under different loading conditions
viii. Design calculations for wheel and axle etc. giving maximum permissible stress under fatigue loading calculations, anticipated service life etc.
ix. Calculation of heat transmission through railcars
x. Calculation of equipment rating and performance requirements
xi. Calculations of Primary and Secondary suspension
xii. Calculation of air supply by compressor and consumption by air equipments.
xiii. Maximum moving dimension calculations
xiv. Reliability calculations, predictions, and mitigations including redundancy provisions
xv. Hazard identification, safety assessments and mitigations
xvi. Center buffing force calculations

1.1.12 **Drawings: The partner shall provide the following Drawings:**

i. Outline diagram of railcars having front and side elevations and at least on longitudinal and transverse section
ii. General Layout of each type railcar with major equipments, Seats/Berths, electrical fittings , bogie ,MMD etc
iii. General arrangement drawing along with mounting arrangement for other equipments or assemblies used by partner
iv. Diagram showing alignment of railcars on sharpest curve and 1 in 8 ½ turnout. This diagram shall also show that the profile of the railcar body is within the moving dimensions including extra clearance permitted on curves when the railcar is negotiating sharpest curve
v. Piping arrangement
vi. Brake system diagram
vii. Arrangement of wheel slip detection and correction system
viii. Gang way arrangement
ix. Air Brake system drawings
x. Maximum moving dimension drawing showing extreme cases including curve overthrows
xi. Earthing and bonding arrangement

2.1 Electrical Designs and Drawings:

Details of Designs and Drawings pertains to electrical items shall be as per clauses given in chapter-6.

Appendix- B. Standards/Specifications

1.1 General

1.1.1 A list of Standards used and applied to the material and workmanship to be supplied will be prepared and updated during the design stage and this list will be mutually agreed.

1.1.2 During the design phase, the partner shall provide original copies of the standards used.

1.1.3 The standards shall preferably be provided in electronic format (soft copy). However, in case the same is not available, with the consent of IR, original printed copy can be provided.

1.1.4 Standards are set out of the Standards Organization (in English) in tables B1 to B15.

1.1.5 Where international or national standards are quoted and specified in the specification, the partner may propose to work to equivalent internationally or nationally recognized standards. Not systematically, but if necessary, the IR can require the partner to prove the equivalence between the European and other standards. Submission for Approval are to be supported by a copy of the proposed standards, a detailed comparison of the quoted and proposed standards and, where applicable, an English translation of the proposed standard.

1.1.6 Latest version of standards/specifications shall be used.

Table B.1 Indian Standards

Standard Organization	Standard Reference Number	Title or Description of the Standard
IS	875 (Part-III)	Indian standard codes of practice for design loads (other than earthquake) for building and structures
IS	2553(Part-II)	Safety Glass Specification
IS	6680 1992	Specification for Railway carriage Fan
IS	10000-1980 Pt. 9 or latest	Methods of tests for internal combustion engine (Endurance test).
IS	4722-2001 or latest	Specification for rotating electrical machines.
IS	7132-1973 or latest	Guide for testing synchronous machines.
IS	7306-1974 or latest	Methods for determining synchronous machine quantities from tests.

IS	4889-1968 or latest	Methods of determination of efficiency of rotating electrical machines.
IS	1460-2005 or latest	Automotive Diesel fuels.
IS	13730 Part -13 1994 or latest	Particular types of winding wires Part 13 Polyester or polyesterimide over coated with polyamide-imide enameled round copper wire, class 200.
IS	13947-1993 Pt. 1 or latest	Specification for low voltage switchgear & control gear – Pt. 1, General requirements
IS	13778-1993 Part 1 to 6 or latest	Method of test for winding wires-thermal properties.
IS	1239 Part-2-1982 Or Latest	Mild Steel tubes,tubler and other wrought steel fittingf,part-2 mild steel tubular and other wrought steel pipe fittings

~~**Table B.2 Indian Railway Standards**~~

~~**Standard Organization**~~	~~**Standard Reference Number**~~	~~**Title or Description of the Standard**~~
~~IRS~~	~~R-19/93 (Part II)~~	~~Indian Railways standard specification for solid forged steel wheels for Carriage, Wagon and EMU stock~~
~~IRS~~	~~R-16/95~~	~~Indian Railways standard specification for steel Axles for Carriage and Wagon~~

Table B.3 RDSO Specifications, Code of practice &Schedule of technical Requirement (STR)

Standard Organization	Specifications Reference Number	Title or Description of the Specification
RDSO	ELPS/SPEC./EOG/01	Specification and Code of Practice for Wiring in 750 Volt End –On –Generation (EOG) system issued in March, 1994
RDSO	ELPS/SPEC./EOG/02	Specification for BG High Capacity Power Car for 750 V. End-On –Generation System.
RDSO	EL/E-M/1-79	Code of practice for prevention of fire in Power cars
RDSO	RDSO/ PE/ SPEC./ AC/ 0084-2008 (REV. “1”)	Specification for 336 KW Diesel – Alternator set for Power car.
RDSO	RDSO/ PE/ SPEC./ AC/ 0009-2010(Rev. ‘1’) with amendment no. 1 & 2 or latest.	Specification for valve Regulated Lead-Acid Batteries for 110 v. T.L., AC and LHB coaches.
RDSO	RDSO specification no.RDSO/ PE/ SPEC/ AC/ 0058-2005(Rev.“0‘’)	Specification for Low maintenance lead-acid batteries for 110V. T.L. & AC SG coaches
RDSO	RDSO specification no. ELRS / SPEC. / 0019 (REV. ‘2’)	Specification for e-beam Thin walled copper cable
RDSO	RDSO/ PE/ SPEC./ TL/ 0119 -2008(REV. “0”).	Led based tail lamp in SLR and power car
RDSO	RDSO/ PE/ SPEC./ TL/ D/ 0091 (REV. “0”)-2008 AMDT -2	Passenger Alarm Chain Indication Light (PACIL) type “J” luminaire
RDSO	RDSO/ PE/ SPEC./ AC/ 0061-2005 (rev. “1”)	Specification for RMPU
RDSO	RDSO/PE/SPEC/AC/0139 -2009(Rev.1).	Specification for micro processor controller of RMPU
RDSO	RDSO/PE//TL/021 (Rev 2)(revised in Dec -2005) or latest.	Specification for Railway carriage (BLDC) fan
RDSO	RDSO/ PE/ O/ 0008-2005 (Rev.0)	Code of practice for prevention of fire in AC Coach.
RDSO	RDSO/PE/SPEC/AC/0177 (Rev.0) -2012	Specification for high capacity inter vehicular coupler unit (500 amps. Rating) for eog type ac coaches/ power cars

RDSO	RDSO/ PE/ SPEC/ AC/ 0080-2007 (Rev. '0')	"Specification for 60 KVA, 750 V, 3-Phase, Dry Type Power distribution Transformer for LHB type AC coaches (EOG)/ Power car.
RDSO	RDSO/ PE/ SPEC/ TL/ 0158-2010 (Rev.'0')	Specification No. "15 KVA, 750/ 415/ 190 V and 9 KVA,750 / 415/ 190 V, 3-Phase dry- type distribution transformers for LHB type NON-AC EOG coaches " respectively for Second Class 3-tire sleeper and Second Class.
RDSO	RDSO/ PE/ SPEC./ EMU/ 0072-2008 (REV. "1")	Specification for Head –On –Generation (HOG) system in power cars and locomotives.
RDSO	RDSO/ PE/ MS/ AC/ 0051-2011 (REV."0")	Provision of Head–On-Generation (HOG) power supply system in LHB design power car and coaches
RDSO	Schedule RDSO/ PE/ STR./ AC/ 0037-2012 (REV. "0")	Schedule of technical requirement (STR) for Diesel –alternator set for power car.
RDSO	RDSO/ PE/ SPEC/ AC-0138-2009 (Rev-1)	Specification of conduit system for cable management
RDSO	STR no. RDSO/ 2008 /EL/ STR/ 0048 (Rev. 0) April' 2010	STR for Auxilliary Motor for RMPU
RDSO	STR no. RDSO/ PE/ STR/ TL/ 0014-2010 (Rev.1) Amd 1	Battery for train lighting/120 Ah (VRLA)
RDSO	STR no. RDSO/ PE/ STR/ AC/ TL/ 0013 (Rev. '0')	Regulated Battery Charger
RDSO	STR no. RDSO/ PE/ STR/ TL/ 0016-2005 (Rev. '0')	Specification for BLDC fan
RDSO	STR no. RDSO/ PE/ STR/ AC/ 0035-2011 (Rev. '0')	Conduit system for cable management
RDSO	STR no. STR no. RDSO/ PE/ STR/ AC/ 0034-2012 (Rev. 0) [An I, IIA & E, III]	Emergency Lighting System for LHB EOG Coaches
RDSO	STR no. STR no. RDSO/ PE/ STR/ AC/ 0034-2012 (Rev. 0) [An I, IIA & E, III]	Micro Processor Control Panel/ panel for air conditioned
RDSO	STR no. RDSO/ PE/ STR/ AC/ 0033-2011 (Rev-0)	ZS coupling 400 A 750 V
RDSO	STR no. RDSO/ PE/ STR/ AC/ 0027-2009 (Rev.0)	Switch Board Cabinet for AC Coaches
RDSO	STR no. RDSO/ PE/ STR/	Switch Board Cabinet for LHB AC Hot

	AC/ 0027-2009 (Rev.0)	buffer Coaches
RDSO	STR no. RDSO/ PE/ STR/ AC/ 0008 - 2003 (Rev. 2)	AC Control panel for roof mounted AC package units
RDSO	STR no. RDSO/ PE/ STR/ AC/ 0032-2011 (Rev '0')	Passenger Information system
RDSO	STR no. RDSO/ PE/ STR/ AC/ 0034-2012 (Rev ' 0') (An. I, IIA, IIC,III)	Microprocessor cotroller for roof mounted AC package Unit For LHB design
RDSO	RDSO / PE / MS / 0047 (Rev. "0") -2009	Checking function of Emergency Light Unit (ELU)

Note:

1. All above RDSO specifications are only for study and reference purpose.
2. Detailed list of IS, ISO, IEC, BS, IEC, UIC, VDE, RDSO, ICF / RCF and other relevant specifications are already mentioned in their concern specifications.

Table B.4 RCF / ICF Specifications

Standard Organization	Specifications Reference Number	Title or Description of the Specification
RCF	EDTS 073 (Rev.D) Amendment .6	Specification for Switch Board Cabinet of EOG AC coaches.
RCF	EDTS: 200 REV. "	Specification for Tubler crimping sockets for e-beam cables
RCF	EDTS: 201 REV. "A" with Amnd no. -1	Specification for Ring tongue type crimping sockets for e-beam cables
RCF	EDTS 118 (Rev.D)	Technical specification for modular integrated pantry unit for LHB type hot buffet or EOG coaches
RCF	EDTS 134 (Rev.D)	Specification for switch board cabinet to be used in LHB hot buffet coaches
RCF	EDTS: 350 REV. "0" with Amnd no. -1	Specification for 450 KW High Capacity Diesel –Alternator set along with Control Panel for power car
RCF	EDTS: 351 REV. "0"	Specification for Switch Board Cabinet for Power & Control Panel of 2 X 450 KW High Capacity Diesel –Alternator set for LHB type Generator car
RCF	EDTS 355 REV. "0"	Specification for set of panels for LHB EOG Non-AC coaches

ICF	ICF/ELEC/917	Emergency lighting unit in rolling stock

Note:

1. All above specifications are only for study and reference purpose.
2. Detailed list of IS, ISO, IEC, BS, IEC, UIC, VDE, RDSO, ICF / RCF and other relevant specifications are already mentioned in their concern specifications.

Table B.5 British Standards Institution

Standard Organization the Standard	Standard Reference Number	Title or Description of
BS	1006	Methods of test for colour fastness of textiles and leather
BS	5514 part 1 -1996 and ISO 3046 -1 : 1995 or latest	Reciprocating Internal Combustion Engine performance Part-1 Standard reference conditions, de-rations of power , fuel and lubricating oil consumption and test methods
BS	5514 part 3 -1990 and ISO 3046 -3 : 1989 or latest	Reciprocating Internal Combustion Engine performance Part-3 Specification for test measurements
BS	5514 part 4 -1997 and ISO 3046 -4 : 1997 or latest	Reciprocating Internal Combustion Engines Part-4 speed governing
BS	5514 part 5 -1979 and ISO 3046 -v : 1978 or latest	Reciprocating Internal Combustion Engine performance Part-5 Torsional vibrations
BS	5514 part 6 -1992 and ISO 3046 -6 : 1990 or latest	Reciprocating Internal Combustion Engine performance Part- 6 Specification for over speed protection.
BS	5514 part 7 -1996 and ISO 3046 -7 : 1995 or latest	Reciprocating Internal Combustion Engine performance Part- 7 Code for engine power
BS	6853	Code of Practice for Fire Precautions in the Design and Construction of Railway Passenger Rolling Stock. Gives advice on the choice and testing of materials for use in the interiors of Passenger rolling stock, includes advice on the provision of fire barriers, and on the means of achieving safe evacuation from a train on fire.

Table B.6 German Standards / DeutshesInstitut fur Normung

Standard Organisation	Standard Reference Number	Title or Description of the Standard
DIN	5510 1/2/4/5/6	Preventive fire protection in Railway vehicles

Table B.7 Euro Norms

Standard Organisation	Standard Reference Number	Title or Description of the Standard
EN	485-2	Aluminium and aluminium alloys. Sheet, strip and plate-part-2:Mechanical properties
EN	755-2	Aluminium and Aluminium alloys. Extruded rod/bar, tube and profiles. Mechanical properties
EN	12663	Structural requirements for Railway Vehicle Bodies“.
EN	13103	Railway applications - wheel sets and bogies - non-powered axles - design method
EN	13452-1	Railway applications - braking - mass transit brake systems – Performance requirement
EN	13452-2	Railway applications - braking - mass transit brake systems - methods of test
EN	13260	Railway applications. Wheel sets and bogies. Wheel sets. Product requirements
EN	13261	Railway applications - wheel sets and bogies - axles - product requirements
EN	13262	Railway applications - wheel sets and bogies - wheels - product requirement
EN	13272	Railway applications - electrical lighting for rolling stock in public transport systems
EN	13298	Railway applications. Suspension components
BS EN	13749	Railway applications. Methods of specifying structural requirements of bogie frames
EN	14750-1	Railway applications - air conditioning for urban and suburban rolling stock - part 1: comfort parameters
EN	13979-1	Railway applications - wheel sets and

		bogies – Monobloc wheels – Technical approval procedure
EN	14752	Railway applications – Body side entrance systems
EN	15227	Railway applications — Crashworthiness requirements for Railway vehicle bodies
EN ISO	4892-2	Plastics - methods of exposure to laboratory light sources - part 2: xenon-arc lamps
EN	50121 (1/2/3/3.1/3.2/4/5)	Railway Application – Electro-Magnetic Compatibility – Rolling Stock
BS EN	45545-1	Railway Applications – Fire protection on Railway vehicles-part 1 : General
BS EN	45545-2	Railway Applications – Fire protection on Railway vehicles-part 2: Requirements for the fire behavior of materials and components.
BS EN	45545-3	Railway Applications – Fire protection on Railway vehicles-part 3: Fire resistance requirements for the fire barrier.
BS EN	45545-4	Railway Applications – Fire protection on Railway vehicles-part 4: Fire safety requirements for Railway rolling stock design.
BS EN	45545-5	Railway Applications – Fire protection on Railway vehicles-part 5: Fire safety requirements for electrical equipment, including that of trolleybuses, track-guided buses and magnetic levitation vehicles.
BS EN	45545-6	Railway Applications – Fire protection on Railway vehicles-part 6: Fire Control and management systems.
BS EN	45545-7	Railway Applications – Fire protection on Railway vehicles-part 7: Fire safety requirements for flammable liquid and flammable gas installations
EN	50126-1	Railway Application – The specification and demonstration of reliability, availability, maintainability and safety (RAMS) Part 1: Basic requirement and generic process
EN	50128	Railway applications — Communications, signalling and processing systems — Software for railway control and protection systems.

EN	50264	Railway Application- Railway Rolling Stock cables having special fire performance
EN	50343	Railway applications – Railway rolling stocks –Rules for Installation of cabling
EN	61337	Filters using waveguide type dielectric resonators. Generic specification

Table B.8 International Electro-technical Commission

Standard Organisation	Standard Reference Number	Title or Description of the Standard
IEC	77	Rules for electric traction equipment
IEC	101	Rules for auxiliary machines on motor vehicles
IEC	60349-2	Electric traction - rotating electrical machines for rail and road vehicles - part 2: electronic converter-fed alternating current motors
IEC	60077-1	Railway applications - electric equipment for rolling stock - part 1 - general service conditions and general rules
IEC	60077-2	Railway applications - electric equipment for rolling stock - part 2: electro technical components - general rules
IEC	60529	Degrees of protection provided by enclosures (IP code
IEC	60571-1998	Rules for electronic equipment used on the rail vehicles
IEC	60623	secondary cells and batteries containing alkaline or other non-acid electrolytes - vented nickel-cadmium prismatic rechargeable single cells
IEC	60993	electrolyte for vented nickel-cadmium cells
IEC	61133	Electrical traction-Rolling stock - testing of rolling stock on completion of construction and before entry into service
IEC	61373	Railway applications - rolling stock equipment - shock and vibration tests
IEC	61000 series	Electromagnetic compatibility (EMC) Pt.-4, Testing and measurement technique-section-4, Electrical test transient / burst

		immunity test.

Table B.9 International Standards Organisation

Standard Organisation	Standard Reference Number	Title or Description of the Standard
ISO	281/1	Specification for rolling bearings - dynamic load ratings and rating life. Calculation methods
ISO	3095	Railway applications - acoustics - measurement of noise emitted by rail-bound vehicles
ISO	3381	Railway applications - acoustics - measurement of noise inside rail-bound vehicles
ISO	8573	Certification of Air compressors for Contaminants and air purity classification
ISO	8528 part-10 figure-4 or IS: 4729	Reciprocating internal combustion engine driven alternating current generating sets - - Part 10: Measurement of airborne noise by the enveloping surface method

Table B.10 French Standards (Normes Françaises)

Standard Organisation	Standard Reference Number	Title or Description of the Standard
NF-F	16-103	Fire protection and fire-fighting - design arrangements

Table B.11 Research and Study Organisation (ORE)

Standard Organisation	Standard Reference Number	Title or Description of the Standard
ORE	C116/RP8	DB WZ Ride Index : Frequency Weighting Curves

Table B.12 International Railway Union

Signature			
Name & Designation	Prepared By	Checked By	Approved By

Standard Organisation	Standard Reference Number	Title or Description of the Standard
UIC	505 -1	Railway transport stock rolling stock construction gauge.
UIC	515 -4	Passenger Rolling Stock - Trailer Bogies - Running Gear - Bogie Frame Structure Strength Tests.
UIC	541 -5	Brakes - Electropneumatic brake (ep brake) - Electropneumatic emergency brake override (EBO)
UIC	564-1	Coaches window made from safety glass.
UIC	564-2	Regulations Relating to Fire Protection and Fire Fighting Measures in Passenger Carrying Railway Vehicles.
UIC	566	Loadings of coach bodies and their components.
UIC	565-3	Indications for the layout of coaches suitable for conveying disabled passengers in their wheelchairs.
UIC	615-4	Motive power units - bogies and running gear - bogie frame structure strength tests.
UIC	811-1	Technical Specification for the Supply of Axles for Tractive and Trailing Stock
UIC	812-2	Solid Wheels for Tractive and Trailing Stock Tolerances (1)
UIC	854 R	Technical specification for the supply of Alkaline and lead –acid starter Batteries

Table B.13

VDE VERBAND DER ELEKTROTECHNIK ELEKTRONIK INFORMATIONSTECHNIK
(Association for Electrical, Electronic & Information Technologies)

Standard Organisation	Standard Reference Number	Title or Description of the Standard
VDE	0100	Regulations for equipping power current plants up to 1000 V.

Table B.14 Underwriters Laboratories

Standard Organisation	Standard Reference Number	Title or Description of the Standard
UL	UL: 94	Code for fire retardant material.

Table B.15

Institute of Electrical and Electronics Engineers Standards Association

Standard Organisation	Standard Reference Number	Title or Description of the Standard
IEEE	429	IEEE Recommended Practice for Thermal Evaluation of Sealed Insulation Systems for AC Electric Machinery Employing Form-Wound Preinsulated Stator Coils for Machines Rated 6900 V and Below.

Appendix- C

Details of existing LHB variant Cars

Signature			
Name & Designation	Prepared By	Checked By	Approved By

Table-1

S.N	Parameter	Dimensions (in mm)
1.	Length over body	23540
2.	Length over Buffers	24000
3.	Width	3240
4.	Over all height from rail level	4039
5.	Floor height from rail level	1320

Table-2

S.N	Type Of LHB AC (EOG) Cars of Rajdhani rake & Shatabdi rake	Weight (in tons)			
		Tare	Gross	Body Shell	Bogie
1.	AC 2ndclass Chair Car	42.27	50.27	9.99	6.65
2.	AC Executive class Chair Car	42.27	48.51	10.2	6.65
3.	AC First class sleeper Car	40.87	43.34	10.0	6.65
4.	AC 2-Tier Sleeper Car	41.60	46.72	10.5	6.65
5.	AC 3-Tier Sleeper Car	43.00	48.80	10.5	6.65
6.	AC Hot Buffet Car	42.20	48.20	10.0	6.65
7.	AC Generator Car cum Luggage cum Brake van	52.12	56.78	11.0	6.65

Table-3

S.N	Type Of LHB AC (EOG) Cars of Rajdhani rake	Seating/sleeping capacity (Passenger/Crew)
1.	AC 2nd class Chair Car	78
2.	AC Executive class Chair Car	56
3.	AC First class sleeper Car	24
4.	AC 2-Tier Sleeper Car	52
5.	AC 3-Tier Sleeper Car	72
6.	AC Hot Buffet Car	18
7.	AC Generator Car cum Luggage cum Brake van	5 (04 Crew +01Guard)