

Chapter - I

GENERAL CONDITIONS

1.1 Explanatory:

- 1.2 The Research, Designs & Standards Organisation, Ministry of Railways, Manak Nagar, Lucknow 226011, India is hereafter referred to as RDSO.
- 1.3 8-Wheeler Overhead Equipment Inspection car is hereafter referred to as ‘car’ only.

1.4 Scope:

- 1.4.1 The specification covers the design, construction, supply and commissioning of 8-Wheeler Inspection and Maintenance cars for operation on broad gauge (1676mm) electrified (25 kV a.c.) routes of Indian Railways.
- 1.4.2 The car shall be self-propelled 4-axle vehicle and is used for periodical inspection, patrolling and maintenance of traction overhead equipment(OHE). It shall also be used for attending sites of break-down, restoration of damaged OHE. It is also required to erect small lengths of catenary and contact wire for repairs of damaged OHE.
- 1.4.3 Shall there be any point of difference between the specification and/ or exhibited drawings that this specification fails to clarify, the tenderer shall submit each such item to RDSO for immediate clarification.

1.5 CLIMATIC CONDITIONS

- 1.5.1 The OHE CAR power equipment shall be in continuous operation under the following atmospheric and climatic conditions: -

Altitude	Sea level to 600 m above MSL
Humidity	40% - 100%
Ambient temperature	0° C to 55° C

- 1.5.2 The rain-fall is fairly heavy and during dry weather the atmosphere is very dusty. The car should be able to negotiate water logged tracks with water level about 100 mm above the rail top for which the equipment shall be suitably designed.
- 15.3 The car and its principal assemblies shall be of such design and manufacture, which have proved satisfactory performance in tropical climate similar to that of India.

1.6 Examination of the Tender Offer:

- 1.6.1 To facilitate examination of the tender offer, the tenderer is required to furnish comments clause by clause of this specification either confirming acceptance of the clause and elaborating its details, where necessary, or indicating deviation

therefrom. A comprehensive specification of the car offered shall also be submitted along with the above commentary.

1.6.2 In the event of the tenderer being unable to conform to any part of the requirements of this specification, it must be stated specifically that variation therefrom is desired by the tenderer. Full particulars of the deviations, including technical details, cost implications and past service performance, if any shall be given for ease of evaluation. The tender will be evaluated strictly as per the condition of this specification.

1.6.3 The evaluation of bids shall inter alia take into consideration the fuel efficiency of the diesel engine. For this purpose the bids shall be loaded by capitalized cost of additional fuel-oil and lubricating oil consumption over and above the base consumption at 75% of rated output of the diesel engine. The lowest values of fuel-oil and lubricating oil consumption quoted by the technically suitable bidder will form the basis for purpose of comparison and shall be taken as base consumption. The bidders shall indicate fuel-oil consumption and lubricating oil consumption in litres per hour at 75% of rated output of the diesel engine.

The fixed parameters for evaluating the capitalized cost shall be as under :-

1. Life of the diesel engine	18years
2. Annual operating period	2000 hrs.
3. Cost of fuel-oil per litre	} Prevalent on the
4. Cost of lubricating oil per litre	
5. Rate of interest	12%

1.7 **Design Development :**

1.7.1 The contractor shall develop the design based on the details given in this specification and sound engineering practice. The entire design data shall be submitted with technical data and calculation to RDSO for approval before commencing construction of car or placing orders on sub-contractors.

1.7.2 The design shall be developed in the S.I.Units.

1.7.3 From the exhibited drawings and from this specification and from the instructions of the RDSO, the supplier shall prepare at his own expense, a full set of working drawings in standard size complete in every respect and submit the same for approval of the RDSO.

1.7.4 When submitting drawings of a particular detail, other details depending on it shall be shown in juxtaposition. Sufficient drawings of surrounding details are to be submitted to enable the design to be judged.

1.7.5 Material specifications, manufacturing tolerances and other details, which are necessary for manufacture for each component shall be indicated on the relevant drawing and copies (in English) of such specifications shall be supplied to RDSO.

1.8 **Approval of Drawings:**

1.8.1 "Approval" to the drawing means the approval to the general adoptability of the design features. The RDSO will not be responsible for the correctness of dimensions on the drawings, the materials used, the strength or performance of the components for all of which the contractor will be wholly and completely

- responsible. The contractor when submitting proposals or designs for approval of the RDSO shall draw specific attention to any deviation or departure from the specification involved in his proposals or drawings.
- 1.8.2 To facilitate filing of drawings in RDSO it is essential that each drawing submitted for approval be marked so that it can be identified. The contractor, is therefore, requested to ensure that all prints submitted are marked legibly at the right hand bottom corner in a similar manner. The following information is required in respect of each drawing submitted:
1. Contractor's drawing number.
 2. Contractor's name and date of submission.
 3. Contract number given by the Railway Board.
 4. Nomenclature of the car.
 5. Description of drawing.
- 1.8.3 Drawing shall be submitted in standard size (s) and triplicate alongwith main calculation details in triplicate which are necessary for checking the design of major components.
- 1.8.4 **Prints:**In order to facilitate subsequent maintenance and service three complete sets of CD/DVDs and three complete sets of tracings shall be supplied by the successful Tenderer to the Purchaser together with the equipment delivered. The tracings shall be on transparent linen of durable quality as approved by the Purchaser and shall show the whole of the equipment as actually made and shall include fully dimensioned drawings of all parts, including proprietary fittings. Exploded views in schematic forms shall be furnished in case of complicated assemblies to make them, clear. Drawings on Auto CAD CD shall also be provided.
- 1.8.5 At least one of the “ As made” tracing sets shall be hand made, the others being mechanical copies on linen with such writings which cannot be erased by soft India rubber. Drawing on Auto CAD CD shall also be provided.
- 1.8.6 All tracings shall be of standard size as per IS:696. The tracings shall be in a rolled form over its entire length so that it lies flat on a table when spread.
- 1.8.7 Each set of tracings shall form a complete set of working drawings the first sheet being the index and the following sheets being arranged properly to show the various assemblies, sub- assemblies and components of complete works in the following sequence:
- (a) Diagram sheets show the overall dimensions of the equipment, weights and the relation of overall dimensions to the space in the car.
 - (b) Lists of all parts grouped in to major assembly with details of numbers per set, weight, specification material and drawing reference against each item.
 - (c) General arrangement drawings of complete equipment sets. Diagram of lubrication points indication type of lubricant. Sub-assembly arrangement, drawing and proper and logical sequence.
- 1.8.8 The “As Made” tracing sets shall be dispatched with first consignment of car and the supply shall not be considered complete until the tracing sets are delivered. Should the tracing set not be completely furnished at the time of delivery of the first car, the contractor shall supply at his own expense at the time of the first

shipment, a set of prints giving sufficient information to enable the car to be put in to service. Drawing on Auto CAD CD shall also be provided

- 1.8.9 Twelve copies each of photographs of full broad side view and $\frac{3}{4}$ front view of approximate size of 380 x 280mm and photographs of front and rear end of the car of approximate size of 250mm shall be supplied.

(d) Detailed drawings:- On detailed drawing sheets, each part shall be identified by an alphabetic letter and the list of all parts forming the sub-assembly shall be tabulated just above the title block on the same sheet giving details against each alphabetic letter.

1.9 Contractor's responsibility:

- 1.9.1 The contractor shall be entirely responsible for the execution of the contract strictly in accordance with the terms of this specification and the conditions of contract, notwithstanding any approval which RDSO or the Inspecting officer may have given:

- (a) of the detailed drawing prepared by the contractor.
- (b) of the sub-contractors for materials.
- (c) of other parts of the work involved by the contractor.
- (d) of the tests carried out either by the contractor or by the RDSO or the Inspecting Officer.

1.10 Guarantee:

- 1.10.1 Any part of the car failing or proving unsatisfactory in service due to defective design, material or workmanship within 30 months from the date of delivery in India or twenty four months from the date of placing in service, whichever is earlier, shall be replaced by the contractor at his own expense. Further, should any design of material modification be made in any part of the equipment offered or as a result of any defect/lacuna/fault/short-coming in the original design features or material the period of 24 months would commence from the date modified part is commissioned in service.

- 1.10.2 Exhibited Drawings and standard Specifications:

- 1.10.3 "Exhibited Drawings" means the drawings which are exhibited or provided by RDSO for the guidance of the contractor.

- 1.10.4 The exhibited drawings, illustrative of a range of standardized dimensions and fittings, are listed in Appendix 'A'. The design of the car must comply with the dimensions, and fittings included in the exhibited drawings as far as possible. Any deviation therefore shall be clearly mentioned in the form of a table on the drawing.

- 1.10.5 The drawings exhibited are not guaranteed to be free from discrepancies. The contractor in preparing his working drawings, shall ensure that drawings prepared by him are free from discrepancies noticed and shall incorporate all modifications required by this specification or those desired by the RDSO subsequently without

prejudice to the date of delivery or contracted price, except as provided for under the conditions of contract.

- 1.10.6 The contractor is warned that from time to time modifications and corrections are made in specification and drawings. The contractor must, therefore, satisfy himself that the drawings or specifications, used by him, include all the up-to-date modifications or corrections.
- 1.10.7 The Contractor shall provide himself at his own expense with copies of all the drawings and specifications required for the manufacture of the car.
- 1.10.8 Copies of drawing referred to in this specification and given in Appendix 'A' may be obtained on payment from RDSO.
- 1.10.9 Copies of Indian Railways standard (IRS) specifications and schedules of Maximum and Minimum Dimensions may be obtained on payment from the Manager, Government of India Publications, Civil Lines, Delhi 110 006(INDIA).
- 1.10.10 Copies of Indian Standard Specification are available from Bureau of Indian Standards, 9 Bahadur Shah Zafar Marg, Delhi 11 002.

1.11 **Materials:**

- 1.11.1 Materials used in the construction of the car shall comply with the relevant IRS specification or Indian Standard Specification (ISS). Alternative materials can only be used with the prior approval of RDSO. Where IRS or ISS do not exist for specification components, the contractor shall submit his proposed material specification for approval of RDSO.

1.12 **Service Engineers:**

- 1.12.1 The Contractor shall arrange for the supervision of commissioning of the car immediately after their receipt at ultimate destination. Adequate number of teams of technical experts will be made available so that the commissioning delays are eliminated. The contractor or his agent will be required to inspect the car at the consignee's end and carry out a joint check of the receipt of components to avoid subsequent complaints regarding short shipment or transit damages.
- 1.12.2 The contractor or his agent shall ensure commissioning of the car within 30 days from the date of intimation by the consignee.
- 1.12.3 The performance of car shall be demonstrated by the contractor or his agent after its successful commissioning at the consignee's works.
- 1.12.4 The contractor shall provide and ensure servicing facilities in India throughout the warranty period. After the Warranty period is over, the contractor should on call give, if required, service support for troubleshooting and for obtaining spare parts.

1.13 **Training:**

- 1.13.1 The Contractor shall arrange to provide training facilities at their manufacturing works for four persons for a period of two weeks. The charges for providing these

facilities (excluding travel, boarding and lodging) should be indicated separately. The charges for travel, boarding and lodging shall be borne by the Railways.

1.13.2 Technical experts of the manufacturer during commissioning of car will fully and adequately train operators/ maintenance staff nominated by the consignee.

1.14 Service Manuals and Spare Parts Catalogues:

1.14.1 Detailed maintenance and service manuals shall be specially prepared for the car and at least three copies of the same shall be supplied free of charge per car to the consignee. The draft Manuals shall be submitted for approval of RDSO.

Three copies per car of detailed spare parts catalogues shall also be supplied to the consignee.

In addition, one copy each of the maintenance and service manuals and spare parts catalogue for Carriage Directorate, T.I. Directorate and M.P. Directorate shall be dispatched to the address of the Director General, Carriage Directorate /T.I., Directorate/M.P. Directorate, Research Designs & Standards Organisation, Govt. of India, Ministry of Railway, Manak Nagar, Lucknow 226 011, India.

1.15 Electric Arc Welding:

1.15.1 Indian Railways Standard Code of Practice for Electrical Arc Welding shall be followed. If the contractor desires to follow any other code of practice, it shall first be submitted for approval of RDSO.

1.15.2 Welding symbols are to be in accordance with Indian Standard Specification No. :813. Drawings on which such symbols appear, are to bear a note on the bottom left hand corner, "WELDING SYMBOLS ISI SPECIFICATION NO. 183".

1.16 Railway Initial Letters:

1.16.1 Where parts are required to be marked with Railway initial letters, they shall be 'I.R.'

1.17 Sublet Orders for Materials

1.17.1 Complete instructions regarding submission of proposed sub-contractor's names for approval, and furnishing copies of sublet orders may be obtained from RDSO.

1.18 Spare Parts:

1.18.1 The tenderer shall submit the list of spare parts and special tools as explained below. The name and address of the manufacturer/ supplier of spare parts should also be indicated. However final decision to buy the spares will rest with the buyer'

1.18.1.1 The prices for the spares (stand by units) shall be quoted separately. These spares shall be for every set of 10 cars or part thereof. The prices for the following spares shall be quoted separately.

- | | | | |
|-------|---|---|--------|
| i) | Diesel Engine (complete) | - | 1 unit |
| ii) | Power Transmission Unit
alongwith flexible coupling/
engine connection (complete) | - | 1 set |
| iii) | Air compressor (complete) | - | 1 unit |
| iv) | Power bogie (complete) | - | 1 set |
| v) | Trailer Bogie | - | 1 set |
| vi) | Air brake equipment excluding
air compressor and the items
forming parts of bogies | - | 1 set |
| vii) | Generator for charging of
starter batteries | - | 1 unit |
| viii) | Equipment for measurement
of OHE parameters (complete)
stagger, contact force and height
(optional). | - | 1 set |

Price for optional items to be quoted separately. Decision of buying optional items shall be with purhaser and.

1.18.1.2 Recommendatory Spares:

List of recommendatory spare parts including special maintenance tools required for three years normal maintenance to cover the complete range of Mechanical Hydraulic and Electrical equipment should be separately quoted.

1.18.1.3 The list of spare parts shall be accompanied with the tender. The Tenderer shall indicate what facility exists or is proposed to ensure ready availability of spare parts in India other than those which those, which are already being manufactured in India.

1.18.1.4 The tenderer shall be responsible to ensure subsequent availability of the spare parts for the normal life of the respective equipment.

1.19 Tools:

1.19.1 List of tools required for maintenance and overhaul with tenders shall be submitted by the tenderer in accordance with Clause 6.1 of this specification.

1.20 Training Kit:

1.20.1 Tenderer will submit a complete list of equipment required for purposes of training the Indian Railways maintenance, operational and executive staff, along with his tender.

1.21 Testing Kit:

1.21.1 The supply shall include testing equipment required for ensuring optimum performance and trouble-free service of the car as well as their major assemblies and sub-assemblies. Details of this testing equipment shall be submitted by the tenderer with complete quotations.

1.22 Collaboration:

1.22.1 Indian Railways contemplate indigenous manufacture of cars at a later stage. The manufacturer shall indicate his terms and conditions for entering into a technical collaboration either with the Indian Railways or any collaboration either with the Indian Railways or an Indian Company for manufacture of cars. In any case, the tenderer shall furnish all the manufacturing and design drawings in sufficient details so that it should be possible for the Indian Railways to take up the manufacture of the car or its components in their own workshop or get them manufactured for their own use from trade.

Chapter -II

DIMENSIONAL OPERATING AND OTHER REQUIREMENTS FOR CAR

2.1 The car shall conform generally to maximum moving dimensions to diagram 1D of Indian railways schedule of dimension 1676 mm gauge (BG) revised 2004. The purchaser may at his option revise the layout so as to provide for an arrangement for front opening on one side to load and unload collapsible ladders from the trackside. Tenderer may offer alternative proposals with full details of the advantage of the proposed arrangement.

2.2 The car shall be designed to conform to the principal dimensions/requirements specified hereunder:-

1	Track gauge	1676
2.	Minimum radius of curve	175 m. It should also be capable of negotiating. 1.9 a radius of 213m in case of 1 in 8-1/2 BG turnout with 6.4m over-riding switch. 1.10 175 m radius in case of 1 in 8-1/2 scissors crossing.
3.	Maximum super elevation	185 mm
4.	Maximum Super - elevation deficiency	100mm
5	Maximum wind pressure	200 kg/m ²
6	Maximum moving Dimensions	Maximum moving dimensions shall Conform to diagram 1D of Indian Railway Schedule of dimension 1676 mm gauge (BG) revised 2004 with the pantograph and platform in lowered condition infringement, if unavoidable and fully justified, may be considered, if within the limits shown in SOD 1676 mm gauge(BG) revised2004 .
7.	Maximum permissible wheel base length of the car, over hang beyond bogie center, buffer height draw bar height	These shall conform to Indian railway, schedule of dimension 1676 mm gauge (BG). revised 2004. Adequate clearance shall be allowed so that no component of the car shall infringe a minimum of 102 mm above rail level with wheels in fully worn conditions, full deflection of springs and effect of dynamics.
8.	Axle load	16 t
9.	Maximum speed	Maximum speed: 110 Km/h

10	Performance capabilities:-	i) Pay load (excluding Power equipment and hydraulic platform)	Approx.12 t
		ii) Period of continuous running at 110 km/h on generally tangent track followed by frequent to and fro movement at walking pace for 1-1/2 h)	5-1/2h total (4h+1-1/2h)
		iii) Period of continuous running at 40 km/h up or down gradient of 1 in 60 to be followed by frequent to and fro movement at 5 km/h for 1-1/2 h on same gradient.	5-1/2h total (4h+1-1/2h)
		iv) Performance in monsoon and Squally conditions.	Un- restricted
		v) The car shall be capable of running at a speed of 26 km/h on 1/33 up gradient	
		vi) The car shall be capable of starting and hauling a loaded bogie flat rail wagon weighing 60 t on up gradient of 1 in 60. Maximum operating speed of the car for level and 1 in 60 up gradients shall be indicated with the offer.	
		vii) With the swiveling platform in raised condition the car shall run at a maximum speed of 10 km/h.	

2.3 The car shall be an 8-wheeler vehicle. The disposition of equipment storage space shall be such as to ensure equal axle loads. Design shall be such as to afford easy inspection and maintenance. Guiding principle in selection of assemblies should be the easy availability of wearing components.

2.4. Provision shall be made for the following in the car:

2.4.1 **Driving Cabs:**

- i) Two driving cabs, one at each end, with complete operating & driving control with dash boards so that the car may be worked from either cab. Driver's seat shall be on the left side. Adequate leg space shall be provided for the driver when he is seated.
- ii) Sitting space in each of the driving cabs for 4 persons in addition to the driver. For this purpose a foldable cushion sheet shall be provided.

- iii) All controls, brake handle, hand brake, Deadman's device, footswitch for horn and indication lamps/meters shall be within easy access and view of the driver.
 - iv) Inter-communication equipment between cabs, Inspection compartment, working platform through handfree sets with its own battery.
 - v) 2 numbers, 24 V sockets for hand signals in each cab.
 - vi) Flasher lights search lights and marker lights at both ends of the cab.
 - vii) OHE voltage sensing device in both the cabs.
 - viii) Full width, splinter proof glass wind shield protected with expanded metal or BRC (having least obstruction to visibility). The wind shield shall extend upto the ceiling level so as give clear view of overhead equipment.
 - ix) Provision of wind screen viper arm and blade assembly to be provided as per RDSO specification no.C-K306 (latest revision).
- 2.4.2 It is proposed to keep drums of contact wire and catenary wire, duly mounted on the stand, for erection during the restoration of breakdowns. Stands shall be provided with hand brakes to control the tension in the wires during the laying out process. It shall be possible to lay-out wires in either direction and therefore these drum shall preferably be in the middle of the car. The drums be loaded from a sliding door of adequate size on both sides. The laying out of the wire shall be from two of openings of suitable size in the roof vertically above each of the drums. These openings shall normally be covered so as to prevent water falling into the car.
- 2.4.3 The principal details of the conductor drums are-
- | | |
|-----------------------|---------------|
| (a) Diameter | 1900mm |
| (b) Width | 950mm |
| (c) Bore for mounting | 105mm x 105mm |
- on the stand.
- 2.4.4 The facilities to be provided in the car shall be as described briefly in the following clauses (from Clause 2.4.4 to Clause 2.4.8). In case it is necessary to curtail or eliminate any of the facilities to accommodate the diesel generating set or such other equipment, the specific reasons for doing so shall be clearly indicated.
- 2.4.5 **Material Cabin:**
The material cabin shall be provided adjoining one of the driving cabs having adequate space and proper locking arrangement for the storage of costly equipments and fittings. A reasonable number of cup-boards having sufficient number of pigeon holes shall be provided inside the material cabin for storage of non-ferrous fittings, tools and tackles, lighting equipment and other fragile spares. Suitable shelves/racks shall also be provided for storage of about 50 MS tubes of upto 47mm dia and upto 4m long.
- 2.4.6 **Workshop:**
A well-ventilated workshop shall be provided in the middle equipped with exhaust fans, ceiling fans and windows, with a room for 4 persons to stand and

work. On one side a workbench of size 2500mm x 900mm shall be provided. It shall be fitted with two vices to under take minor repair work along with one drilling machine. On the side opposite the workbench, racks/cup board shall be provided for tools and plant. Design drawing of voices to access its capability to be furnished for approval.

2.4.7 **Storage space:**

Adequate space shall be provided for installation and storage of equipment such as batteries, battery charger, emergency lighting equipment and other items supplied with the car.

2.4.8 **Staff Cabins:**

Two separate cabins for staff, one with two berths and the other with six berths, each cabin with a toilet and separate overhead tank shall be provided. The cabins shall have separate entry. The cabins shall preferably be not over the wheels and made sound proof as far as possible. Sink of stainless steel, drinking water tank of stainless steel (overhead), exhaust fan, windows on both sides are to be provided. Provision for mobile charging point to be made in each staff cabin.

2.4.9 **Kitchenette:**

A shall kitchenette, approx. 1500mm x 2000mm, shall be provided. Provision for keeping gas stove along with gas bottle to be made. An exhaust fan shall be fitted on one of the windows to expel out the smokes etc. from the kitchenette. Windows for cross-ventilation shall also be provided.

2.4.10 **Communicating doors:**

Each driving cab shall have independent entry from both sides. The car lobby shall have entry from each cab. Through communication inside the car shall be provided. It shall be possible to isolate the cabins using sliding doors with locking arrangements.

2.4.11 **Facilities on roof:**

- i) The car shall be provided with a pantograph similar to AM-12 FAIVELEY type with foot insulators and actuating mechanism complete on one bogie center. Pantograph shall be graduated to enable manual measurement of stagger.
- ii) For illumination of roof for night inspection plug points shall be provided for fixing portable lights.
- iii) **Observation dome:**
An observation dome shall be provided in the roof near the pantograph so as to observe interaction between the contact wire of the OHE and the pantograph. Two persons shall be able to sit conveniently in the observation dome. The upper portion of the dome shall be insulated for 25 KV. The arrangement shall be such that an unobstructed view of the contact between contact wire and pantograph is obtained by the persons in the observation dome without any strain. Adequate ventilation shall be

provided in the observation dome, while at the same time ensuring that it is leak proof.

- iv) A, lifting and swiveling platform with hydraulically operated mechanized adjustment for height and rotation with under-noted features shall be provided over the fixed platform. The swiveling platform shall conform to principle dimensions/ requirements specified hereunder:

(a) Length	5700 mm
(b) Width	1600 mm
(c) Platform upper surface level above rail when elevated.	6150 mm
(d) Lifting time	45 s
(e) Rotation range of platform towards sides.	90 ⁰
(f) Side shifting reach of platform.	4200 mm
(g) Full height of collapsible railing above swiveling platform floor.	800 mm
(h) Time of rotation from 0 ⁰ position to 90 ⁰	36 s

NOTE: Control for lifting, lowering and swiveling shall be provided on the platform. The raising and swiveling of the platform shall be gradual and not sudden or too fast.

- v) Two searchlights with halogen lamp 250 W on platform shall be provided for inspection of the overhead equipment while on the run. Searchlight shall provide a high intensity illumination beam and be capable of swiveling on universal joints type support.
- vi) Except space for pantograph and observation dome the remaining roof shall be covered with a 2325mm wide fixed working platform at maximum possible height but within the maximum moving dimensions. This fixed platform shall be provided with four approach ladders, two on each side to climb on to the platform from the ground.

2.4.12 Provision shall be made to carry 3 OHE masts (steel) and 1 mast of 12 m length is suitably strung or slung or strapped near the headstock. The mast is 9500mm long and may either rolled I beam of 150mm x 200mm size or fabricated structure of 250mm x 300mm.

2.4.13 Suitable safety measures including interlocks between various equipments, access doors and line equipment shall be provided to ensure.

- (i) Safety of man working and
(ii) Stability of the car while in operation. The tenderer shall indicate the interlocking and safety aspects he proposes to incorporate.

2.4.14 The entire car including bogies, superstructure alongwith equipment is to be effectively earthed as per standard practice for rolling stock.

2.4.15 The equipment fixed to the under frame shall be able to perform efficiently under cast iron dust from brake blocks.

2.4.16 The equipments and their arrangement shall withstand satisfactorily, the vibration and shocks normally encountered in service as indicated below:

- (a) Maximum vertical acceleration 3.0g
- (b) Maximum longitudinal acceleration 5.0g
- (c) Maximum train acceleration 2.0g (g being acceleration due to
Gravity)

Chapter - III

MECHANICAL DESIGN

3.1 Superstructure:

3.1.1 **General:** The car shall be of welded light weight construction, generally to maximum moving dimensions to diagram 1D of Indian railways schedule of dimension 1676 mm gauge(BG) revised 2004 with pantograph and platform in lowered condition. Infringements, if unavoidable and fully justified, may be considered, if within limits shown in the SOD 1676 mm gauge (BG) revised 2004. The weight of the car shall be kept as low as possible consistent with adequate strength. The structure shall withstand end load of 200t (divided equally between the two buffers) applied in conjunction with full payload. Under such loading no permanent deformation should occur and stresses should remain below the yield point. The design shall be sufficiently rigid to withstand stresses imposed by lifting with overhead or breakdown cranes or by jacks applied to the headstocks. The superstructure shall be designed as a tubular girder for the purpose of withstanding vertical loading, but the inner sheeting of the roof and walls shall not be stress- bearing members.

3.2 **Body shell:**

3.2.1 The body shell shall be of corrosion resistant low alloy high tensile steel.

3.3 **Door Openings:**

3.3.1 All door openings shall be true to specified dimensions and perfectly square. The openings shall be tested for size and squareness with templates so that doors open and close freely and when closed shall be reasonably weather proof and dust proof. Single leaf inward opening hinged or sliding doors with locking arrangement shall be provided in driver's compartment and shall have a clear opening of 535mm. Other doors on sidewalls shall preferably be of sliding type with a clear opening of 1100mm. The door leaves shall slide on roller bearing carriers suspended from top rail and shall work in retaining guides on the doorsills. Each leaf shall have a window opening. Since the tenderer is expected to develop his own layout, location of doors may be decide in the most suitable manner. (See Clause 2.1 and 2.4.2).

3.3.2 Catches shall be fitted on all doors so as to secure them from inside in the closed position.

3.3.3 Where hinged doors are provided on the side walls, they shall be of inward opening type and will give an opening of 750mm approx.

3.4 **Door Footsteps:**

3.4.1 The door footstep assembly shall be of mild steel and shall have compreg board to RDSO spec. No. C-9407 (latest Revision). The edges shall be protected with metallic treads. Any other suitable arrangement can also be considered

- 3.4.2 **Door hand holds**: Door hand holds of stainless steel tubes or chromium plated steel tube, with malleable cast iron brackets shall be provided on either side of all body side doors and shall be so fitted as to clear the side walls sufficiently to prevent injury to knuckles. Hand holds shall also be within the car profile so that mechanized car washing is not hindered.
- 3.4.3 **Door locks** : All doors shall be fitted with reliable locks to be operated from outside and inside. Hasps for external padlocking shall also be provided on all doors opening out of the car.
- 3.5 **Windows**:
- (i) The window guides, and sills shall be of FRP, and shall be as per RDSO Schedule of Technical Requirement (STR), C- 9502 (Latest Revision)
 - (ii) Glass window frames and louvers shutters shall be of FRP as per RDSO STR C- 9403(Latest Revision).
 - (ii) Frames, guides and sills should be manufactured from sheet molding compound (SMC) to RDSO spec. C-8409 (Latest Revision)
- 3.5.1 All window and door glasses shall be of the shatterproof type plate glass set in sun heat resistant synthetic rubber section. The front windows shall be of hinged type.
- 3.5.2 All window openings shall be true to dimensions square and of uniform width. The window opening shall not at any point exceed 2mm over or under the specified dimensions and shall not be out of square by more than 2mm.
- 3.5.3 The windowsills of the body side windows shall have an outward slope of approximately 5⁰.
- 3.5.4 The body side windows shall have two shutters, one louver on the outside and a glass on the inside.
- 3.5.5 The glass used for windows/shutters shall be either of toughened quality or safety laminated quality to IS:2553, weighing not less than 9.76 kg/m². Gravity safety catches of approved design shall be provided at two intermediate positions to arrest the glass and louver shutters from falling down. The shutters should be balanced by balancers of suitable design.
- 3.5.6 The louver shutters shall consist of a light alloy framing of robust design fitted with louver panel or pressed light alloy, designed as to exclude water, but permit air freely. The louver shutters shall be provided with shoot bolt type safety catches to secure the shutters firmly in closed and open position.
- 3.6 Roof**
- 3.6.1 The roof shall be designed to form a satisfactory chord to the superstructure considered as a girder, and to take a concentrated load of 4 men standing, close together at any point. The structure shall consist generally of two main longitudinal members running from end to end of the car, braced at frequent intervals along their lower flanges, and rigidly connected to the arch bars, and to the grab pillars by rigid transverse members. At partition and semi bulkheads, the sills shall be attached to vertical pillars within or forming part of the partitions or

- semi-bulk-heads. The construction through out shall be absolutely watertight and shall permit easy renewal of corroded sheets.
- 3.6.2 Four openings shall be provided in the roof for erection of catenary and contact wires in either direction. The openings shall be of suitable size to permit paying out of the conductors in any direction, when the car is moving slowly at 5-10 km/h speed, without any obstruction, rubbing or scrapping.
- 3.6.3 **Roof Ventilators:** TRA type roof ventilators shall be provided. The ventilator shall not violate the schedule of Dimensions.
- 3.7 **Air Space:** The air space between the outer and inner sheeting of the roof shall be suitably ventilated as also the air space inside walls and end walls. Attachments may pass through the air space as required, but must be designed, so that they do not cause sections to form sealed chambers or lodgments for condensed moisture. Ventilators should not violate the schedule of dimensions.
- 3.8 **Underframe and Body shell:**
- 3.8.1 The main structural member of the car shall be of rolled section, folded plates or pressed sheet. They shall be assembled in jigs and fabricated by welding. Material used for the construction of car body shell shall be of corrosion resistant low alloy high tensile strength.
- 3.8.2 **Headstocks:** These shall be of robust design suitable for coupling and buffing gear arrangements detailed in this specification.
- 3.8.3 **Draw gear members:** The members provided for carrying the trimmer casting shall be of strong and rigid construction capable of transmitting buffing forces specified in clause 3.1.1 under the most adverse operating conditions. They shall be braced together to the main sills in such a manner as to form, in conjunction with the flooring system between the transom and headstock a rigid assembly capable of withstanding all cross-racking forces, which may occur in service. The design shall, as far as possible, ensure that the load is applied symmetrically about the neutral axis of the longitudinal, and is concentric to them.
- 3.8.4 **Draw & Buff Gear :** The car shall be provided with screw coupling and side buffers. The arrangement shall be such that car shall be couplable with existing BG rolling stock of Indian Railways. At present Indian Railway is using draw gear arrangement to RDSO Drawing No. RDSO/SK-99003, side buffer arrangement to RDSO Drawing No. RDSO/SK-98145 and screw coupling arrangement to RDSO drawing No. RDSO/SK-99001 as per IRS R-10 in the coaching stock.
- 3.8.5 **Lifting Pads:** The car body shell end itself to repeated lifting in workshop by overhead cranes or jacks risk or damage. Suitable lifting pads shall be provided and marked in a readily distinguishable manner on the car body.

3.8.6 **Insulation** : An insulation layer of suitable thickness of non-asbestos material shall be provided inside the car shell. The end walls and sidewalls shall be provided with suitable anti-drumming and anti-corrosive compound. The underside of the under frame over the engine area shall be properly insulated to minimize heat transfer to the compartment.

3.9 **Noise Suppression:** The tenderers shall indicate any noise suppression features incorporated in the design. Maximum noise level should not exceed 75 dB in side the cab.

3.10 **Corrosion protection:**

- i) Sheets and plates used for car construction, shall be suitably treated against corrosion before fabrication.
- ii) Sub- assemblies shall be treated against corrosion as per UIC Code 842-5 after they are manufactured.
- iii) Car shall be treated after fabrication as per UIC Code 842-5.
- iv) In addition to above, the car design shall be such as to minimize the incidence of corrosion. Indian Railways experience is that most corrosion takes place due to seepage of water from the floor and window openings.
- v) The tenderer may suggest any better corrosion protection system that he may have adopted with success in cars manufactured by him.
- vi) The tenderer shall note that car floors are washed at time. Hence the floor construction should be such that it does not permit water to seep through the floor and cause corrosion to trough floor and under frame members.
- vii) Tenderers may note that Indian Railway have noticed heavy corrosion on coaches under the lavatories. As such, use of stainless steel for construction of floor and adjacent members under lavatories and the neighbouring bays may be considered.

3.11 **Lavatories:**

The car will have two lavatories, which shall be provided with fittings as approved by the purchaser.

3.12 **Roof Water Tank:**

Roof water tank of stainless steel of not less than 450 litres capacity shall be provided. The tank shall be mounted so as to be readily removable for repairs. Side filling arrangement only shall be provided for filling water.

3.13 **Exterior Fittings:**

Exterior painting of the car shall be executed as per contractors standard procedure. However, prior approval of the purchaser for the same shall be taken.

3.14 **Extra Fitting:**

- 3.14.1 1) Door steps shall be provided at all body side doors.
- 2) Continuous water wriggles from one end of the car to the other shall be provided.

3) Tail lamp bracket to IRS Drg. No.C.BF-113 shall be fitted at each end of the shell.

4) Rain water gutters of suitable design over the door way shall be provided.

5) Tenderers may note that the car may be washed mechanically. Tenderers may also note that the exterior of the car may be washed in automatic car washing plants. Exterior of the car shall be designed keeping this in view.

3.14.2 **Interior furnishing :**

The car shall be furnished with light weight fire retardant material. The material used for finishing and furnishing shall be suitable for use under Indian climatic conditions and shall be as far as possible fire proof, non-hygroscopic and vermin and rot proof. The furnishing shall be as agreed between the contractor and purchaser. It may be noted that Indian Railways are presently using 3mm decorative/resin bonded laminated plastic sheets as per IS:2046 possessing resistance to spread of flame as indicated in para 5.16 of IS:2046. With a view to retarding the spread of fire, the continuity of LP sheets shall be broken by the provision of a suitable metal barrier at locations, such as doorways and car ends.

3.14.3 **Ceiling and panelling:**

The ceiling in compartments shall be of 2 mm thick NFTC to RDSO spec. No. C- K 511 (Latest Revision) or non- asbestos limpet sheet to RDSO spec. No C-K601 (Latest Revision)

The ceiling of Engine Room shall be of 1mm thick mild steel sheet.

3.14.4 **Panelling**

The interior paneling in the compartment shall consist of 3mm thick resin bonded thermo- setting laminated plastic sheets of approved shades. The laminated plastic sheets shall conform to STR for decorative thermosetting synthetic resin bonded laminated sheet for coaching stock No. C-K-514 (Latest Revision)

Sidewall partitions of Engine Room shall be 1mm thick M.S. Sheets.

3.14.5 **Flooring:**

Floor construction arrangement shall consist of aluminum chequered plates of approved quality laid over compreg board to RDSO spec. C-9407 screwed on to the trough floor. Floor construction should be such as not to permit water seepage to trough floor.

3.14.6 **Trap Doors:**

Suitable trap doors shall be provided on the flooring for attention of underslung equipments, during service. The design of trap door shall be such that it can be conveniently lifted when attention to equipment is required but strong enough to

withstand normal passenger loading. The trap door shall remain in level to the floor of the car.

3.15 Brake System

3.15.1 The car shall be fitted with graduated release air brakes. The brake system shall be of UIC approved type and shall meet all UIC requirements. It shall have the following distinct positions.

- i) Release Position
- ii) Minimum reduction position.
- iii) Full service position..
- iv) Emergency position.

Note (i) Panel mounted air brake system of approved make conforming to Spec. No. MP-0.01.00.19 (Rev-00), July'2006 should be provided in order to achieve high reliability, low weight, better sensitivity and easy maintainability.

3.15.2 The emergency braking distance (EBD) for fully loaded car from maximum speed of 110km/h shall not be more than 800m.

3.15.3 It is proposed to use the car for hauling a loaded bogie flat wagon weighing 60 t (see clause 2.2.10(iv)). The manufacturer shall indicate the braking distance that can be obtained with the flat wagon in the rear both in unbroken state and braked state.

3.15.4 The car shall be provided with the following additional brake requirements:

- i) An emergency brake valve in each driving cab on extreme right hand side.
- ii) Stand-by brakes, in case of failure of distributor valve or any component in the main brake system.

Note: Stand-alone VCD of approved make conforming to Spec. No. MP-0.34.00.04 (Rev-03), Aug'2006 should be provided in lieu of **dead man device**.

3.15.5 Application of any type of brake provided on the car shall result in simultaneous cutting of the power to the driving axles.

3.15.6 The brake rigging arrangements shall be light and as simple as possible with minimum number of levers and fulcrum points permitting easy access to brake blocks and other wearing parts. With clasp brakes, brake block to ICF Drg. No. T-3-1-605 shall only be used. However, tread brake units will be preferable.

3.15.7 Brake system shall be provided with automatic slack adjuster built into the brake cylinder.

3.15.8 Adequate safety straps shall be provided below the moving components of the brake rigging and other components to prevent falling on the track in the event of failure of any component.

3.15.9 Parking brake to RDSO spec CK 408 (latest revision) capable of holding fully loaded car on 1 in 60 down gradient under wet condition shall be provided.

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- 3.15.10 In order to couple car with standard rolling stock with vacuum brake system, suitable vacuum pipe may be provided in the underframe of car to provide continuity of the vacuum brake system.
- 3.15.11 The supplier shall submit details of brake system covering brake schematic diagram, working principle, brake power diagram calculation for EBD, number, dimension and type of brake blocks and literature on brake equipments proposed along with offer and get the brake system approved from RDSO before manufacture of the prototype.
- 3.15.12 Air dryer of approved make conforming to Spec. No. MP-0.01.00.09 (Rev-01), May'2005 should be provided in line with latest equipment on EMU/DEMU Coaches
- 3.15.13 Main reservoirs of adequate capacity shall be provided. In addition, a separate braking reservoir and a non-return valve be provided for braking only. Suitable drain valves/cocks shall be provided to drain off the condensate in the reservoir (s). An automatic drain valve shall be provided where feasible in addition to manually operated drain valves/cocks.
- 3.15.14 The tenderer shall be required to supply the detailed drawings, specifications and testing procedure for rubber components/parts of all the valves/cocks used in the brake system and shall guarantee for satisfactory working of the components at least for 24 months from the date of supply and 18 months from the date of commissioning. The supplier shall also get the brake schematic approved by the RDSO.
- 3.16 **Compressor:**
- 3.16.1 The car shall be provided with a suitable air-cooled compressor, directly driven by the diesel engine. The tenderer shall give a technical justification for the compressor capacity such that the requirements of braking, including trailer vehicle, wipers, horns and other accessories are fully met. (the bed plate of compressor unit shall be sufficiently strong to withstand the vibrations during run). Main reservoirs of adequate capacity shall be provided. In addition, a separate braking reservoir of adequate size and a non-return valve be provided for braking only. Suitable drain valve/cocks shall be provided to drain off the condensate in the reservoir(s). An automatic drain valve shall be provided where feasible in addition to manually operated drain valves/ cocks.
- 3.16.2 The compressor shall be provided with suitable governor/unloader to cut in and cut out at a nominal pressure of 7.0 kg/cm² and 8.0 kg/cm² respectively. In addition, a safety valve of sufficient capacity set at 8.5 kg/cm² shall be provided to safeguard the system against over charging.
- 3.16.3 Suitable inter-cooler and after-cooler shall be provided to cool the compressed air delivered by the compressor.
- 3.17 The following information shall be furnished by the tenderer alongwith the offer:
- 1) Transverse cross section of the proposed car alongwith principal dimensions so as to illustrate the general construction of the shell. Also superimposed upon this should be the schedule of dimensions as embodied in the Indian Railways Schedule of dimensions as embodied in the Indian Railways Schedule of dimensions –1676 mm gauge, revised 2004 infringements, if any, should be accurately defined in the sketch.

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- 2) A “Section” view of the plan of the car, showing the layout of the major equipments alongwith principal dimensions.
- 3) Side elevation of the proposed car.
- 4) A “Sectional” side elevation of the car underframe showing the disposition of the major equipments on the underframe.
- 5) A representative sectional view of the car floor, illustrating the floor construction. The specifications of the materials used in its construction should be identified.
- 6) Furnishing material intended to be used by the tenderers-specifications should be identified.
- 7) Insulating material proposed by the manufacturer specifications should be identified.
- 8) Ceiling material proposed to be used by the manufacturer specifications should be identified.
- 9) Steel proposed for the construction of the car shell specifications should be identified.

It may be noted that the prescribed steel is “corrosion resistant” low alloy high tensile steel. In case different steel is proposed for structural work, its specification should be indicated.

- 10) Principal features of noise suppression should be identified.
- 11) Principal features of making body “ corrosion retardant” should be identified.
- 12) Principal features showing adequate fire redundancy should be identified.
- 13) To demonstrate his capability for designing car body, the tenderer shall submit a set of actual calculations pertaining to car structure for any bogie vehicle, designed by him in the past . These shall be submitted alongwith his tender.
- 14) Tentative brake rigging diagram alongwith details of brake cylinder and slack adjuster proposed to be used shall be submitted with the tender.
- 15) The schematics of the brake pneumatic alongwith the internal schematics of the valves proposed to be used shall be furnished alongwith the tender. The schematics shall be accompanied with a write up on sequence of events during application release and emergency.
- 16) Compressor type and its capacity shall be indicated alongwith tender. This will be accompanied with a technical justification for the compressor capacity selected.
- 17) In case parking brakes are proposed the features of the brake actuator, its type and the schematics of its operation shall be furnished alongwith the tender.
- 18) Estimated weight of the car structure shall be furnished alongwith the tender. Also weights of principal assemblies mounted on the car structure shall also be furnished.

3.18 Fire extinguishers and first aid equipment:

Four fire extinguisher CO₂ type of 5 kg capacity shall be provided in both the operating cabs and workmen's lobby. Space shall be provided for keeping a first aid box and one stretcher. Tendere shall submit the design drawing for provision of space for first aid box for approval of purchaser.

3.19 Piping

3.19.1 Pipes and pipe fitting used for air brake system shall be stainless steel as per RDSO spec. o. 04-ABR (Latest Revision). It will be preferable if sizes of pipes are limited to a minimum. Sharp bends must be avoided and where necessary, connections shall be used.

3.19.2 Pipes, ducts and conduits shall conform to an identification colour scheme. Which shall be approved by RDSO after the contract is let.

3.19.3 Chart showing the colours for identification of pipes shall be displayed in cab at a prominent place where it is likely to be needed for reference.

3.20 Lubrication

3.20.1 Flexible pipes used for lubrication purposes shall be of special quality to withstand the climatic conditions.

3.20.2 Auxiliary oil boxes and grease nipples shall be selected from IR part Drawings listed in Annexure-A

3.21 BELTS

3.21.1 Special attention shall be paid to all belt arrangements, which shall permit easy and quick replacement when required and which can be adjusted and replaced in service.

3.21.2 Sizes and shapes of belts used on the car shall be selected from those available in India.

3.22 PARTICULARS TO BE SUPPLIED FOR THE INSPECTION CAR ALONGWITH THE TENDER OFFER:

The following data shall be supplied for the car with the tender offer:

- | | | |
|---|---|-------|
| 1 | Length of the car overhead stock. | ...mm |
| 2 | Total wheel rigid base | ...mm |
| 3 | Height of car floor (under tare) | ...mm |
| | Distance between bogie centers. | |
| 4 | Distance between side buffers | ...mm |
| | height of buffers when wheels are new and fully worn out. | |
| 5 | Maximum height of the car with | ...mm |

- wheels in new condition.
- 6 Maximum height of the cab at ...mm
corners with wheels in new condition.
- 7 Maximum width of the car. ...mm
- 8 Minimum height above rail level ...mm
of any component with the car
wheels in maximum worn conditions.
- 9 Reduction in the above height in the ...mm
event of spring rigging failure.
- 10 Diameter of wheels over tread ...mm
(New/worn.)
- 11 Height of the center of gravity ...mm
of car above rail level.
- 12 Axle load maximum/minimum. ...t
- 13 Adhesive weight. ...t
- 14 Total weight of the car.
- in fully loaded condition ...t
- in empty condition ...t
- 15 Maximum speed of the car.
- Geared ...km/h
- Safe vehicular ...km/h
16. Maximum tractive effort at rail ...kg
- 17 Maximum continuous tractive effort ...kg
- 18 Maximum speed of operation ...km/h
at maximum continuous tractive
effort.
- 19 (a) Fuel oil consumption at 75% of ...l/h
rated output of the diesel engine.
(b) Lubricating oil consumption at ...l/h
75% of rated output of the diesel engine.

3.23 BOGIES:

3.23.1 General Design.

The car shall have two 2-axle bogies of well-proven design. It shall be of robust welded design suitable for taking the brake gear, final drive, suspension etc. The bogies shall be capable of withstanding the maximum static and dynamic stresses under the loaded conditions and load upto 40% in excess of the maximum gross load and to meet the performance requirement specified in para 2.2.10. The weight of the bogies shall be as low as possible consistent with strength and robustness. The design shall provide primary and secondary suspension. The design shall ensure that the sperling Ride Index value does not exceed 4.0 at a maximum speed of 110 km/h plus 10%.

3.23.2 The general design of the bogies shall permit easy access to running gear and brake gear and to final drive in the case of powered bogie when in position under the car body and shall permit easy replacement of brake blocks without the need

- of special on the track. The whole arrangement of bogie alongwith design/details shall be submitted to RDSO for approval before manufacture is commenced.
- 3.23.3 The suspension system shall be preferably of two-stage type with suitable spring and damping arrangement. Springs for primary and secondary suspension shall be designed to cater for actual service conditions. Calculations for determining the spring characteristics and the damping value in various modes shall be submitted to RDSO for approval. The manufacture and supply of the helical springs shall be as per RDSO specification No. C-8303.
- 3.23.4 Effective measures shall be adopted to minimize the weight transfer while starting, stopping and during runs. The tenderer shall furnish detailed calculations for weight transfer and adhesion efficiency for the powered bogie.
- 3.23.5 Safety straps of adequate size shall be provided to ensure support in the event of failure of links, hangers or other components.

3.24 WHEEL, AXLES AND AXLE BOX

- 3.24.1 Wheels shall be to IRS R-19/93 and axles shall be to IRS R-16/95 for non-powered axles and IRS R-43/92 for powered axles designed to take up roller bearings of approved design.
- 3.24.2 Wheels shall be to IRS Drg. No. W/WL-or ICF Drawing No. T-0-2-514 both with 915mm dia. The wheel profile shall conform to RDSO Drg.No.SK-91146 (latest alteration).
- 3.24.3 Wheel and axle dimensions shall meet the requirements of Indian Railways Schedule of Dimensions 1676 mm gauge-(BG) revised 2004.
- 3.24.4 Design calculations for the powered axle shall be submitted for approval of RDSO.
- 3.24.5 Roller bearings shall have a minimum life rating of 3×10^6 km when computed as per method given in ISO Standard ISO 281/1.
- 3.25 **Anti-pilferage measures.**
- 3.25.1 While securing compartment fittings, anti-pilferage measures shall be incorporated
- 3.25.2 Cattle Guard: Detachable type cattle guards shall be provided under each buffer beam. The cattle guard shall be fitted with adjustable rail guards so as to maintain the minimum free space above the rails under all conditions (See Clause 2.2.6).
- 3.25.3 The speed indicators shall be so mounted as to make the dial easily visible to the driver.

Chapter - IV

ELECTRICAL EQUIPMENT

- 4.0 Illumination: Driving cabs, staff cabins and workshop shall be provided with level of illumination at least 30 lux at the working plan level (1m above the floor level).
- 4.1 The level of illumination for storage space shall be 20 lux.
- 4.2 Driving cabs, staff cabins and workshop shall be provided with two, 110V, 300mm fans conforming to IS:6680.

4.3 AUXILIARY ALTERNATOR

- 4.3.1 **Engine mounted auxiliary alternator** of adequate capacity with rectifier for the speed range between idle and maximum of engine speed shall be provided on each engine to supply 24V DC for charging the battery provided for engine starting:
- 4.3.2 Engine driven **Auxiliary Alternators with rectifier and voltage regulator** of adequate capacity shall be provided. The drive for the alternator shall be taken from auxiliary end of engine. The auxiliary alternators shall cater to the following electric loads:
1. Two twin beam head lights, one at each end.
 2. Flasher Light and marker light
 3. 110 V supply for controls and cab equipments
 4. Charging of 110 V, 120 Ah batteries
 5. Light & Fan load of OHE car.

Rectifier –Regulator

- 4.3.3.1 The rectifier –regulating equipment shall be under frame mounted. Crimping sockets required for inter-connecting and output cables shall be supplied along with the equipment.
- 4.3.3.2 The rectifier regulator box shall have an openable front cover, which shall be capable of being closed and locked in position by a suitable hinged bolts and with nuts.
- 4.3.3.3 The rectifier regulated box shall be of protection level IP 55 (hose proof).
- 4.3.3.4 The rectifier-regulator box shall be electro-galvanised and painted grey.
- 4.3.3.5 The regulator shall have provision of potentiometers for currents and voltage setting for adjustment depending upon the service conditions.
- 4.3.3.6 The rectifier-regulator shall conform to IEC:571.

4.4 BATTERY

- 4.4.1 Two different sets of Lead acid storage batteries shall be provided:

- 24 V, 290 Ah batteries for engine starting and shall cater to Six cranking of engine at 10 seconds interval.
- 110 V, 120Ah for controls & Lighting shall cater to all auxiliary electrical load of the OHE car for two hours in case of failure of auxiliary alternator.

Lead acid storage battery of suitable capacity conforming to IS: 6848 –1972, shall be provided to cater for the power supply for lights and fans for 5 hours. the battery fuse shall be located close to the battery terminals.

4.4.2 Terminals for charging the batteries from external charging equipment shall also be provided. The location of the batteries shall be such that there is no danger of their getting damaged due to tools and equipment inadvertently falling on them. If the cells are packed in two rows in the battery box, a hylam sheet shall separate the two rows.

4.4.3 **Testing:**

4.4.3.1 The following tests shall constitute type tests which are to be carried out at the manufacturer's works to ensure compliance of the specifications.

- i) Verification of dimensions of assemblies' auxiliary alternator, rectifier and regulating equipment.
- ii) Temperature rise test at minimum speed for full output as well as the maximum speed.
- iii) Insulation resistance test.
- iv) Load test.
- v) Drooping voltage characteristics test.
- vi) Water tightness test for rectifier-regulator.

4.4.3.2 **Routine tests**

All tests other than those indicated at serial nos.(ii)&(vii) of type tests mentioned above, shall be carried out.

4.4.4 Lead acid storage battery of suitable capacity conforming to IS:6848 –1972, shall be provided to cater for the power supply for lights and fans for 5 h. the battery fuse shall be located close to the battery terminals.

4.4.5 The battery shall be charged by the engine driven alternator/rectifier mentioned in clause 4.3.1.

4.4.6 A socket for charging the battery from an external source shall be provided.

4.5 **Generator**

4.5.1 An engine mounted d.c generator or an alternator with rectifier and regulating equipment of suitable capacity shall be provided to deliver power at 27.5V d.c. The output of the generator shall cater for battery charging for diesel engine starting (battery voltage 24V). The maximum power demand will be required when the car is stationary and with engine running at low idling speed.

- 4.5.2 Suitable capacity, 3 phase, 415V, diesel generating set for power supply to lifting platform and drilling machine in workshop shall be provided with car.
- 4.5.3 A skid mounted portable generator of suitable capacity, 240V, 50 Hz for working 3 nos. 500 W portable search lights, emergency lighting and for other purposes shall be provided with the car.
- 4.6 **Circuitry**
The load shall be suitably distributed based on standard practice.
- 4.7 Specification for electrical switches, lamps holders plugs etc.
- 4.7.1 Electrical equipment such as switches, lamp holders and other items shall conform to the following specifications:
 IS:6965: Switches for use in Railway coaching stock.
 IS:1258: Bayonet lamp holders.
 IS:1293: Three pin plug and socket outlets.
 IRS:EA-199: For ceiling light fittings with clear glass gloves.
- 4.7.2 Power for head lights, tail lights.
- 4.7.3 Headlights tail lights, flasher lights, marker lights dash board lights and driver's cab lights shall be worked off the alternator/ rectifier provided with diesel engine. This is to ensure that failure in the other lighting system does not affect the mobility of the car.
- 4.7.4 **Head light:** Twin Beam head lights shall be provided at both ends . The head light shall conform to RDSO,s specification No ELRS/SPEC/PR/0022(Rev-1) Oct,2004.The operating voltage of head light shall be 24 V DC.
- 4.7.5 **Tail light:** Two aspect (red and white) LED type 24 V 15 W tail light shall be provided at each end to comply with general rule of Indian Railway.
- 4.7.6 **Flasher light:** Flasher light of LED type as per RDSO's specification No ELRS/SPEC/LFL/0017(Rev-1) Sept,2004 shall be provided.
- 4.7.7 **Marker Light:** Marker light of LED type as per RDSO's specification No ELRS/SPEC/PR/0022(Rev-1) Oct,2004 shall be provided.
- 4.7.8 **Search Light:** Car shall be provided with two 250 W searchlights with halogen lamps one on each end for inspection of the overhead equipment while on the run. Searchlight shall provide a high intensity illuminating beam and capable of swiveling on universal joint type supports.
- 4.7.9 Wiring-Electrical wiring shall conform to IRS:E-45-1977. However, only copper conductors shall be used for wiring.
- 4.7.10 **Horns:** The car shall be fitted with two horns with different tones on both sides. Horns may be operated by battery or compressed air. These shall be operated by a footswitch provided within the access of the driver.

Chapter - V

POWER EQUIPMENT & CONTROL

- 5.1 This part of the specification deals with power equipment and controls requirement for operation of Broad Gauge, single car unit, Self-propelled diesel-Hydraulic 8-wheeler Overhead Equipment (OHE) Inspection Car. It shall be powered by two sets of power equipment, for rail traction application, each set comprising of an under slung diesel engine transmitting power through hydro dynamic transmission and cardan shaft(s) to the axle drive mounted on the inner axle of each bogie. The conceptual power equipment layout to RDSO drawing No. SK.DP- 3874 is placed at Annexure – I.
- 5.2 The offered power equipments shall be capable to meet the performance capabilities given in clause no 2.2.10 of specification.
- 5.3 The two power pack units shall be synchronized such that they work like a single unit when controlled from either of the cabins. Provision shall also be made to isolate any power pack and run the vehicle with single power pack unit.
- 5.4 The scope of supply of equipment for each OHE CAR shall be as under:

SN	Item Description	Qty/ OHE
.1	Fuel efficient diesel engine, of not less than 285 hp under standard UIC condition with anti-vibration mounting pads, mounting brackets & bolts, engine driven alternator for charging battery for engine cranking, cooling equipment complete with radiator, hydraulic system, cooler and Fuel pipes, check valve, hoses and fittings.	2
.2	Hydraulic transmission with hydrodynamic element, anti-vibration mounting pads, mounting brackets & bolts, standstill detector & associated equipments and controls.	2
.3	Axle drive gearbox of suitable gear ratio, complete with powered axle & torque arm assembly.	2
.4	Cardan shaft for drive between: a) Input to transmission b) Between Transmission and Axle drive c) Input to Aux. alternator	2 2
.5	Controls and instrumentations for two cabs for bi-directional operation of vehicle.	2 set

5.5 DIESEL ENGINE

- 5.4.1 Diesel engine complete shall be offered as per clause 5.4.1 under scope of supply. The two under slung power packs together shall develop not less than 570 hp under standard UIC condition. The diesel engine shall be of proven make and suitable for traction application. The tenderer shall indicate the continuous horsepower at rated out put of offered engine under site condition. He shall also indicate if any de-rating of engine is considered for operation in adverse conditions referred in clause 3 above.
- 5.4.2 The supplier shall indicate the total horsepower required for auxiliaries with break-up of power requirements for each of the auxiliary machines at rated output and also indicate net power input to the transmission.
- 5.4.3 The engine shall be provided with a flywheel mounted flexible coupling. The coupling shall be of adequate capacity to withstand high deflection and torque (at starting, stopping and due to any misfiring of the cylinders) so that no damage is caused to transmission and engine components in service.
- 5.4.4 The detailed torsional vibration analysis of the complete dynamic system under normal engine working as well as under conditions of one cylinder misfiring for the complete operating range including 10% over speed shall be furnished.
- 5.4.5 The tenderer shall submit graphs showing the BMEP/engine output torque and SFC at all notch levels in case a stepped throttle control is proposed. In case step-less control is proposed, the graphs for above parameters shall be given at 25%, 50%, 75% and full load.
- 5.4.6 The tenderer shall furnish a copy of Type Test report of the engine by a Statutory Body in support of their claim regarding performance, reliability and specific fuel consumption. In case the engine offered is not Type tested earlier, the testing shall be carried out in the presence of RDSO's authorized representative.
- 5.4.7 The exhaust emission shall be below the limit laid down in latest UIC code or equivalent for industrial engines. The tenderer shall indicate the code followed and the values under various load conditions in the offer.
- 5.4.8 Filters for engine air intake shall be of adequate airflow capacity with restriction indicator to ensure satisfactory performance under dusty environment.
- 5.4.9 Air intake arrangement with filters, ducts and exhaust arrangement shall be compatible with engine system and shall be located at suitable position within the overall dimensions of the vehicle.
- 5.4.10 The exhaust pipe shall be horizontal and located under floor avoiding the position near footsteps to the OHE car.
- 5.4.11 The diesel engine shall work satisfactorily with fuel oil to Indian Standard Specification No. 1460 (2005).
- 5.4.12 The tenderer shall supply engine driven alternator of adequate capacity as standard accessory for charging battery for engine cranking and coach lighting and controls.
- 5.4.13 The tenderer shall submit along with his offer, complete technical data of engine, Transmission system and Auxiliaries etc. as per Annexure-III.

5.6. TRANSMISSION

- 5.6.1 Hydraulic transmissions complete shall be offered as per clause 5.4.2 under scope of supply. In case hydro-mechanical power shift transmission is offered, the gear shifting shall be automatic and it shall not call for any attention from the operator. The transmission shall be offered with all the necessary accessories, standard attachments and safety devices.
- 5.6.2 The supplier shall carryout torsional vibration analysis of the matched power equipment system to ensure that there is no secondary vibration in the system that can lead to failure of any component of the transmission during operation at idle or under loaded condition.
- 5.6.3 The transmission shall be suitable for cardan shaft connection with the diesel engine (if remotely connected) and axle drive gearbox.
- 5.6.4 Special care shall be taken to ensure reliable and efficient performance of the transmission without developing a temperature beyond the safe permitted limit during full load operation. The system shall not call for any special care on the part of the driver to protect the transmission from damage under any circumstances.
- 5.6.5 The tenderer shall furnish a copy of Type Test Report of the transmission from a statutory body in support of their claim regarding performance and reliability.
- 5.6.6 To minimize the secondary vibrations in under-slung power pack, mounting of engine and transmission on Skid mounting shall be preferred.
- 5.6.7 The combined performance of the twin power equipment shall not be inferior to the tractive effort curve No. G.DP- 1165, placed at annexure – II. Tenderer shall submit TE Vs speed curve superimposed with above curve alongwith complete matching calculation of offered power equipments and equipment lay out drawing.
- 5.6.8 Transmission shall have provision of secondary lubrication arrangement to protect the transmission from damage during towing in train formation.

5.7 COOLING SYSTEM

- 5.7.1 The cooling equipment shall be guaranteed to work efficiently under climatic conditions specified under Clause 1.5. Apart from meeting the requirement of Diesel engine including after cooler, the cooling equipment shall be required to dissipate heat of lube oil, hydraulic oil used for hydrostatic fans with 30% choked condition of radiator used. Airflow required for the radiator fan shall be at least 15% more than actually required to make up for any reduction in air flow

due to train movement. The limiting ambient capability of the cooling system should be minimum 55 °C with 30% choked condition.

- 5.7.2 The fan and the cooling arrangement shall be of adequate capacity to cope up with the service demands under the most severe temperature conditions. The maximum water temperature shall not normally exceed 85°C, the safe operating temperature of the engine. The system shall be adequately pressurized and vented to avoid all possibilities of cavitations. The complete technical details of the Radiator and its fan shall be furnished
- 5.7.3 The initial fill of hydraulic oil for hydrostatic operation of fans in the cooling system as recommended by the manufacturer shall be in the scope of supply.
- 5.7.4 Hydraulic hoses of proven make with adequate factor of safety shall be used for cooling system. The hoses shall be properly routed and secured so that it does not fail due to vibration or infringement.
- 5.7.5 Suction type roof mounted radiator fan shall be provided such that the fan sucks air from side-mounted radiator and blows out through roof opening provided for fan.
- 5.7.6 During operation at maximum out put, the radiator fan shall not be source for noise and vibration.
- 5.7.7 The maximum temperature of hydraulic oil shall not exceed 70 °C.
- 5.7.8 The hydraulic oil tank shall be of stainless steel. It shall be provided with oil level indicator, temperature indicator, oil level switch and oil filter with restriction indicator. A micro/limit switch shall be provided and interlocked with delivery side shut-off valve.
- 5.7.9 The following calculations in support of offered cooling system shall be submitted:
- Cooling requirement for all sources of heat (with break up)
 - Heat dissipation characteristics of the radiator and its resistance characteristics.
 - Radiator fan characteristics showing the air flow Vs total heat at different speeds.
 - Cooling system-matching calculations.
 - Schematic cooling circuit diagram showing water, oil and air flow through each equipment.
- 5.7.10 The tenderer shall submit drawing for mounting details of radiator assembly, fan drive arrangement and ensure that these fit completely within the overall dimensions of OHE car.

5.8 **CARDAN SHAFT**

5.8.1 Cardan shaft of robust design shall be offered as per clause 5.4.4. It shall be well proven and suitable for transmitting rated horsepower and maximum torque encountered during operation.

5.8.2 The resultant angularity of cardan shaft shall be maintained within 5°.

5.9 AXLE DRIVE GEAR BOX WITH POWERED AXLE

5.9.1 Axle drive gearbox of suitable gear ratio, complete with powered axles & torque reaction arm as per clause 5.4.3 shall be offered. The tenderer shall take care that the offered power equipment is well matched with the axle drive and meets the performance requirements.

5.9.2 The axle drive gearboxes shall be robust in construction and designed to transmit continuous rated horse power/ maximum torque with adequate safety margin. The tenderer shall furnish the maximum torque transmission capacity of the axle drive gearbox at start. The tenderer shall indicate the final drive gear ratio.

5.9.3 The input flange of the axle drive shall be oil injection mounted.

5.9.4 The powered axle shall conform to IRS specification R-43 latest version.

5.10 CONTROLS AND GAUGES

5.10.1 OHE car shall be provided with driving control cab at both ends for bi-directional operation of vehicle. Adequate control equipment including gauges, instruments, and safety devices shall be provided for safe and satisfactory operation of the OHE car. The equipment and controls shall be so arranged in the driving cab, that they facilitate easy access for operation and maintenance. Interlocks shall be provided such that OHE car can be operated **from one driving cab only at a time**

5.10.2 Power On-Off indication for each power pack shall be provided on control panel of each driving cab.

5.10.3 Gauges, Instruments and Safety Devices:

5.10.3.1 Diesel Engine

- (i) Engine starting switch/push button.
- (ii) Lube oil pressure gauge
- (iii) Lube oil temperature gauge
- (iv) Cooling water temperature gauge
- (v) Battery charge/discharge Ammeter
- (vi) Engine hour meter and engine speed indicator
- (vii) Engine stop switch/push button
- (viii) Emergency stop (Engine)
- (ix) Fuel level indicator

- (x) Radiator water level indicator

5.10.3.2 **Transmission**

- (i) Transmission oil temperature gauge
- (ii) Transmission oil pressure gauge
- (iii) Forward/ Reverse/ Neutral indicator

5.10.3.3 **Other Gauges**

- (i) Main reservoir pressure gauge : 4 inches
- (ii) Brake cylinder pressure gauge.
Duplex type indicating brake
cylinder pressure of both the bogies : 4 inches
- (iii) Brake pipe gauge : 4 inches
- (iv) Vehicle speed indicator cum recorder (in one Driving Cab)
- (v) Vehicle speed indicator (in other Driving Cab)

All gauges shall be of proven make and reliable design. Graduations of the gauges shall be in metric units.

5.10.4 The following safety devices shall be provided:

- .1 Water temperature too high - Engine to idle & Transmission to neutral
- .2 Transmission oil temperature high - Engine to idle & Transmission to neutral
- .3 Low lube oil pressure - Engine to shut down & Transmission to neutral
- .4 Engine speed too high - Engine to shut down & Transmission to neutral
- .5 Radiator water level too low - Engine to shut down & Transmission to neutral
- .6 Emergency engine stop - Fuel supply to engine cut off & Transmission to neutral
- .7 Emergency brake application - Engine to idle & Transmission to neutral
- .8 Vigilance Control Device application - Engine to idle & Transmission to neutral

5.10.5 The following Audio-Visual Signals or Reference panel lights shall be provided in the driver's cab:

- .1 Lube oil temperature too high

- .2 Radiator water temperature too high
- .3 Engine lube oil pressure low.
- .4 Engine shut down by safety relay
- .5 Forward/ Reverse proving lamp.
- .6 Engine starting
- .7 Battery charging

5.10.6 The control system shall have the provision for connecting the Vigilance Control Device. When the device operates, the engine should come to idle and simultaneously the de-clutching of transmission should take place.

5.10.7 **SPEED INDICATOR / RECORDER**

Speed indicator and recording equipment of 0 -200 km/h range, shall consist of an axle box mounted opto-electronic speed sensor, one speed indicator, one recorder cum indicator unit with micro controller containing FLASH EEPROM internal memory for calculating and recording the journey data a portable FLASH memory card for external memory. The equipment shall conform to RDSO specification No.MP-0.3700-07 (Rev.03) of April'2003. One cab of OHE car shall have one recorder-cum-indicator and the other cab shall have one indicator only.

Chapter – VI

MISCELLANEOUS:

6.1 **Tools**

- 6.1.1 Each car shall be supplied with a complete kit of tools and spare parts required by a driver in an emergency and for normal working of the car. These will be arranged in a tool box provided in a cab. These tools shall be listed in the offer and provided at no extra cost.
- 6.1.2 The complement of tools to be provided for use in Maintenance Depot shall include tools necessary for maintenance and repair of the entire car including specified equipment for auxiliary and ancillary equipment. The tenderer should list and quote for these tools.
- 6.1.3 All special tools shall be listed and catalogued illustrating the method of application.

6.2 **Maker's test certificate.**

- 6.2.1 copies of maker's test certificates guaranteeing the performance of the car shall be supplied in duplicate alongwith the delivery of each car.

6.3 **Weightment:**

- 6.3.1 Each completed car shall be weighed 4 times successively and vertical load exerted by each wheel on the track shall be measured, with due regard as to the accuracy of the measuring equipment. The pre-weightment run shall be over a section of track containing difference of levels. No. alternation or adjustment shall be made to the car after passing or adjustment shall be made to the car after passing over this section of track and before weightment. The arithmetic mean of the values taken during 4 successive weightment shall be the value of measurements.
- 6.3.2 After weightment, a check shall be made to ensure the following:
 - i) Total weight is within +/- 1% of the nominal weight
 - ii) Axle load is within +/- 2% of nominal axle load.
 - iii) The difference between the two wheel loads of any axle is not more than 4% of the axle load. Each completed car shall be subjected to squeeze test to ensure that it shall withstand a maximum end load of 200t without any signs or permanent distortion. The test conditions shall be as specified in clause-3.1.1

Chapter-VII

INSPECTION

- 7.1 The whole of the materials or fittings used for works covered by this specification shall be subjected for inspection by the Inspecting officer to be nominated by the purchaser and shall be to his entire satisfaction.
- 7.2 The Inspecting officer shall have the power to: -
- a. Adopt any means he may think advisable to satisfy himself that the materials for fittings specified are actually used throughout the construction.
 - b. Take samples for such tests as he may consider necessary by an approved Metallurgist selected by him, whose report shall be final and binding on the contractors.
 - c. Visit at any reasonable time and without previous notice the contractor's works to inspect the progress and quality of the work and the contractor shall provide free of charge all equipment and labour required by him for this purpose.
 - d. Reject any material or fittings that do not conform to the relevant specification or good practice, which shall be marked in a distinguishable manner, and shall be disposed off in such a manner as the Inspecting Officer directs. Such rejected parts shall be replaced by the contractor without extra charge.
- 7.3 Tests of materials and fittings shall as far as possible be carried out at the works of the maker's of the materials or fittings. The contractor shall provide such additional materials or fittings as may be required or arrange for test pieces to be incorporated in forgings and castings as required by the Inspecting Officer and for their removal in his presence for test purposes. All tests in the works of the contractors and their sub-Contractors shall be at the cost of the contractors.
- 7.4 No work shall be dispatched or packed until it has been passed by the Inspecting Officer. Such passing shall in no way exonerate the contractor from their obligation in respect of quality and performance of the car.
- 7.5 In the event of dispute between the Inspecting Officer and the Contractor, the decision of the purchaser shall be final and binding.
- 7.6 Radiographic testing of steel castings.
- 7.6.1 All steel castings wherever used and welding joints shall be subjected to radiographic testing after manufacture / repair, to a suitable scheme/ standard suggested/approved by RDSO.
- 7.7 One of the power and trailer bogies shall be subjected to exhaustive stationary tests at Contractor's works in the presence or RDSO representative. The tests on bogies shall include dynamic fatigue testing and strain measurement. The test shall be under simulated loading conditions to represent the service load. The body shell shall also be subjected to loads for validating the design calculations of shell. The contractor shall afford all facilities for conducting these tests at his cost.

7.9 **Acceptance tests.**

Besides the checking and testing carried out during manufacture and before dispatch of the car to India it shall be subjected to the following tests before final acceptance.

7.10 **Performance capability tests.**

The car shall be subjected to tests to establish its performance based on the supply by the tenderer against the specification. The contractor shall at his own expense provide the services of competent Engineers/Supervisors and supporting staff during the performance capability tests of the prototype.

7.11 **Riding quality tests.**

7.11.1 The riding quality tests shall be conducted at a speed which is 10% higher than the maximum specified operating speed, i.e. 121/km/h-125km/h on a section of mainline track over which there are no temporary speed restrictions and which is considered by the railway as being in a generally run down condition for main line standards but without speed restrictions. The tests shall be conducted from a reasonably low speed, which is considered safe by the Indian Railways, upwards insteps of 10-15 km/h to establish the performance at the specified speeds.

7.11.2 The following shall be the track standards of the test section:

(i) **Track structure:**

90R rail with M+4 sleeper density and 200mm ballast cushion below sleeper, of which at least 75mm shall be clean and rest in caked up condition.

(ii) Permitted irregularities

- Gauge +/- 6mm
- Unevenness on 3.6m base - upto 15mm
- Twist on 3.6m base - upto 3.5mm/m
- Alignment on 7.2m base - upto 7mm

Ten isolated peaks/km of track exceeding the above limits of irregularity are permitted.

7.12 **Acceptance criteria:**

The dynamic augment at maximum speed of 110 km/h plus 10% shall preferably be within 50% at rail level. The lateral forces at maximum speed will be within 4-t per axle. The vertical acceleration shall not exceed 0.3 g both in vertical and lateral modes in tare and loaded conditions. The sperling ride index shall not exceed four. The derailment co-efficient shall not exceed one.

SPECIFICATION NO. TI/SPC/OHE/8WDHTW/0070

APPENDIX-A

LIST OF EXHIBITED DRAWINGS

S.No.	Drawing No.	Description	Clause Ref.
1	Diagram ID 1676 mm gauge (BG) of IR schedule of dimension	Maximum moving dimension.	2.2.6
2	RDSO/SK.No.99003	Draw gear arrangement.	3.8.4
3	RDSO/SK.No.98145	Side buffer arrangement.	3.8.4
4	RDSO/SK.No.99001	Screw coupling assembly.	3.8.4
5	C/BF/113	Tail lamp bracket.	3.15.1
6	W/WL-1660	Wheel	3.24.2
7	ICF T-0-2-514	Wheel	3.24.2

ANNEXURE-III

PARTICULARS TO BE SUPPLIED BY SUPPLIER

1. The following particulars pertaining to diesel engine and auxiliary equipment shall be submitted by the tenderer

1.1 Diesel Engine

General Data

- .1 Exact description and model of the engine
- .2 Rated output of the engine under UIC and site condition
- .3 Rated engine speed
- .4 Number and arrangement of cylinders
- .5 Cylinder bore
- .6 Piston stroke
- .7 Compression ratios
- .8 Mean piston speed
- .9 BMEP at rated output
- .10 Normal no load idling speed
- .11 Peak firing pressure
- .12 Full test result and data pertaining to UIC or equivalent engine tests
- .13 Specific fuel consumption at various throttle position with tolerance band under UIC and site conditions Indicate the lower calorific value of the fuel used in arriving at the specific fuel consumption figure.
- .14 Fuel oil consumption at idle speeds (normal & low)
- .15 Lube oil consumption at rated output as percentage of fuel oil consumption
- .16 De-rating calculation for site condition
- .17 Safety devices provided
 - Over speed
 - Low lube oil
 - Overload
 - High cooling water temperature
 - High lube oil temperature
 - High exhaust temperature
 - High intake temperature
 - Any other
- .18 Number of engines of this type in traction service
- .19 Weight of engine excluding oil and water

- .20 Weight of water contained in the engine
- .21 Weight of oil contained in the engine
- .22 Weight of major equipment
 - Turbocharger
 - Charge Air cooler
 - Crank case bare
 - Piston and connecting rod
 - Cylinder liner
 - Cylinder head
- .23 Temperature of exhaust gas at turbo inlet at rated output under UIC and site conditions
- .24 Method of starting giving details of equipment
- .25 Estimated period between top and major overhaul
- .26 Periodicity of overhauling the following critical items
 - Turbocharger
 - Piston and piston rings
 - Air and exhaust valve
 - Main bearings
 - Connecting rod bearings
 - Fuel injection pump
 - Fuel injectors
- .27 Special design features of engine high-lighting the measures which have been taken to achieve : -
 - Lower specific fuel consumption
 - Lower lube oil consumption
 - Reduced thermal and mechanical loading of critical components
 - High reliability
 - Maximum availability
- .28 General arrangement and dimensional details
- .29 Characteristic curves for torque, output and specific fuel consumption for different setting of the fuel injection pump
- .30 Torque-speed curve, which the manufacturer considers to be the maximum torque that, should be used for rail traction.
- .31 The curve of fuel consumption for no-load running commencing from the minimum idling speed, expressed in kg/h.

1.2 Air compressor

- .1 Make
- .2 Model
- .3 Maximum pressure
- .4 Capacity (at idle & full speed of engine)
- .5 Installation drawing showing overall dimensions.
- .6 Weight - dry/full supply

- .7 Cooling
- .8 Graph showing speed Vs. horse power & capacity

1.3 Auxiliary Alternator

- .1 Make
- .2 Model
- .3 Continuous / short time rating with details of voltage and current regulation
- .4 Installation drawing showing overall dimensions.
- .5 Weight

1.4 Hydraulic Transmission

- .1 Make
- .2 Type
- .3 Maximum input hp
- .4 Complete transmission characteristic curves including input power, output power, input & output torque, transmission efficiency for 100%, 75%, 50% & 25% of full load, against output speed.
- .5 Basic characteristic curve of torque converter/ hydraulic coupling
- .6 Normal & max. permissible oil temp. of torque converter
- .7 Weight of transmission dry & with full supply

1.5 Reversing Arrangement

- .1 Method of reversing with full details

1.6 Axle Drive Gear Box

- .1 Make & Type
- .2 Gear ratio
- .3 Installation and detail design drawings
- .4 Horse power rating & torque and speed characteristic
- .5 Maximum torque at start
- .6 Details of torque arm with mounting details

1.7 Cardan Shaft

- .1 Make & Type
- .2 Torque rating, life rating and permissible angularity
- .3 Minimum compressed length with permissible length compensation
- .4 Installation drawings

1.8 Hydraulic Pump for Cooling system

- Type (fixed / variable)
- Model

- Make
- Flow rate (LPM @ speed)
- Pressure settings
- Maximum permissible leak-off
- HP consumed

1.9 Hydraulic motor for cooling system

- Type (fixed / variable)
- Model
- Make
- Flow rate (LPM @ speed)
- Pressure settings
- Maximum permissible leak-off
- HP consumed

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