GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

Technical Specification
Of
8-Wheeler Rail Borne Maintenance Vehicle (RBMV)
Diesel-Hydraulic Drive for BG (1676 mm)
Specification No-TM/HM/RBMV-422 of 2018

RESEARCH DESIGNS AND STANDARDS ORGANISATION,
MANAK NAGAR, LUCKNOW-226011
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Abbreviations

ASTM : American Society for Testing and Materials
AVM : Anti Vibration Mounting
BHEL : Bharat Heavy Electricals
EBD : Emergency Braking Distance
FAD : Free Air Delivery
FEA : Finite Element Analysis
GA : General Arrangement
ICF : Integral Coach Factory
IR : Indian Railways
IRS : Indian Railways Standard
IRSOD : Indian Railways Schedule of Dimensions
MIG : Metal Inert Gas
MMD : Maximum Moving Dimension
NUCARS : New and Untried Car Analytic Regime Simulation
PCD : Pitch Circle Diameter
RCF : Rail Coach Factory
RDSO : Research Designs and Standards Organization
RBMV : Rail Bourn Maintenance Vehicle
TIG : Tungsten Inert Gas
UIC : Union Internationale des Chemins de Fer (International Union of Railways)
VCD : Vigilance Control Device
Specification for Diesel Hydraulic Self-propelled Rail Bound Maintenance Vehicle (RBMV)

1.0 EXPLANATORY
The Research Designs & Standards Organization, Govt. of India, Ministry of Railways, Manak Nagar, Lucknow –226011, India is hereafter referred to as RDSO. Eight-wheeler Rail Borne Maintenance (RBMV) Diesel Hydraulic Drive for BG (1676 mm) Vehicle is hereafter referred to as “RBMV” only.

1.1 SCOPE
This specification covers the requirements for design, manufacture, supply and delivery including commissioning into service of self-propelled RBMV for carrying out maintenance operation on Broad Gauge system of the Indian Railways.

1.2 The RBMV is a single vehicle self-propelled unit powered by under slung twin power pack equipment and a hydraulically operated crane mounted on the frame on board.

1.3 RBMV shall be provided with end cabins for bi-directional operation.

1.4 The General layout of RBMV shall be in accordance with RDSO drawing No. RDSO/TM/05A/18 placed at Annexure - IIA. Any other layout submitted by the tenderer may also be considered, provided it meets with overall requirement of space on the vehicle, speed / running characteristics of the vehicle and the desired amenities asked for in the subsequent paragraphs of this specification.

1.5 The conceptual layout of power equipment shall be in accordance with RDSO drawing No. RDSO/TM/05B/18 placed at Annexure - IIB.

1.6 The design of the crane shall meet the operational requirements given in Chapter- V of this specification.

1.7 One portable diesel operated generator preferably indigenously make with proven record of service of at least 5 KVA capacity shall be provided along with the RBMV for general lighting, welding and other works.

1.8 Initial fill of oils and lubricants as recommended by the manufacturer shall be in the scope of supply.

1.9 This specification consists of seven chapters as follows:

<p>| Chapter - I | : General |
| Chapter - II | : Structure and Design of RBMV |
| Chapter - III | : Power Equipment, Controls and Auxiliaries |
| Chapter - IV | : Brake System |</p>
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<td>VI</td>
<td>Lighting Arrangement</td>
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<td>VII</td>
<td>Inspection and Speed Certificate</td>
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1.11 Shall there be any point of difference between the specifications and / or exhibited drawings that this specification fails to clarify, the tenderer shall submit each such item to RDSO for immediate clarification.
CHAPTER-I

General

1.0 Dimensional and Operating Requirements
The RBMV shall be diesel powered vehicle which shall be robust, of latest design, reliable and suitable for working on plain track, transitions and curved tracks (up to $10^0$) on the Broad Gauge (1676 mm) track of IR. The design and dimensions of the RBMV and components shall be to metric standards and should comply with provision of Indian Railways Schedule of Dimensions–1676 mm gauge (BG), revised, 2004 incorporating all correction slips/amendments.

1.1 The RBMV shall be 8-wheeler self-propelled, with bi-directional operation, bogie type vehicle with diesel hydraulic drive. The 8-Wheeler RBMV uses the power generated by the Diesel Engine provided in the RBMV.

1.2 General Atmospheric Service Condition:

<table>
<thead>
<tr>
<th></th>
<th>Ambient temperature</th>
<th>-5°C to 55°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>Storage temperature</td>
<td>Up to 70°C</td>
</tr>
<tr>
<td>b)</td>
<td>Relative Humidity</td>
<td>Up to 100%</td>
</tr>
<tr>
<td>c)</td>
<td>Rain Fall</td>
<td>Fairly heavy</td>
</tr>
<tr>
<td>d)</td>
<td>Atmospheric condition</td>
<td>Very dusty, heavy fog</td>
</tr>
<tr>
<td>e)</td>
<td>Altitude</td>
<td>Up to 1750 m from MSL</td>
</tr>
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The RBMV shall dimensionally conform to the following:

<table>
<thead>
<tr>
<th></th>
<th>Track Gauge</th>
<th>1676 mm</th>
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<tr>
<td>i)</td>
<td>Minimum radius of curve</td>
<td>Normally 175 meters, sharper curves with radius less than 175 meter are also available at isolated location. Regarding minimum radius of curvature for slip points, turnouts or crossover roads, para 17 of chapter II of Schedule-I of IRSOD (BG) Revised 2004 with latest correction slips/amendments shall be applicable which provides for minimum of 175 m radius curves in case of 1 in 8.5 scissors crossover</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Maximum super elevation</th>
<th>185 mm</th>
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<tr>
<td>ii)</td>
<td>Maximum Super - elevation deficiency</td>
<td>100 mm</td>
</tr>
<tr>
<td>iii)</td>
<td>Maximum wind pressure</td>
<td>200 Kg/m$^2$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>vi)</td>
<td>Maximum moving Dimensions</td>
<td>Maximum moving dimensions shall conform to diagram 1D (Annexure-I) of SOD 1676 mm gauge (BG) revised 2004 with latest correction slips/amendments.</td>
</tr>
<tr>
<td>vii)</td>
<td>Maximum permissible wheel base length of the RBMV, overhang beyond bogie center, buffer height draw bar height</td>
<td>These shall conform to SOD 1676 mm gauge (BG) revised 2004 with latest correction slips/amendments. Adequate clearance shall be allowed so that no component of the RBMV shall infringe a minimum of 102 mm above rail level with wheels in fully worn conditions, full deflection of springs and effect of dynamics.</td>
</tr>
<tr>
<td>viii)</td>
<td>Maximum Axle load</td>
<td>20.32 t</td>
</tr>
<tr>
<td>ix) &amp; x)</td>
<td>(a) Maximum Speed when coupled to a train (b) Max operating speed under its own power</td>
<td>105 Km/h 105 km/h</td>
</tr>
<tr>
<td>xi)</td>
<td>Brakes</td>
<td>All wheels with clasp brakes.</td>
</tr>
<tr>
<td>xii)</td>
<td>Performance capabilities (i) Pay load-15 t. (ii) Shall be capable of starting &amp; hauling a loaded bogie flat rail wagon (BFR) on up gradient of 1 in 33 with 65 t hauling load. (iii) Period of continuous running at 105 km/h on generally tangent track followed by frequent to and fro movement at crawling speed for 1.5 h shall be 5.5 h. (iv) The RBMV shall be capable of running up to a speed of 40 km/h on 1 in 33 up gradient. (v) The emergency braking distance (EBD) for fully loaded (20.32x4=81.28 t) RBMV from maximum speed of 105 km/h to zero shall not be more than 800 m on flat section. The contractor shall also submit calculation for EBD on 1 in 33 down gradient.</td>
<td></td>
</tr>
</tbody>
</table>

1.3 The diesel-powered equipment shall be robust, reliable and suitable for working on Indian Railways. The design and dimensions of the RBMV components shall be to metric standards.

1.4 The RBMV shall be an 8-wheeler vehicle. The disposition of crane, 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.
1.5 The profile of the RBMV longitudinally and in cross section during transfer as Self-propelled vehicle or towed in train formation shall be within the maximum moving dimensions shown in diagram 1- D of revised SOD - 2004 with latest amendments and corrigendum slips.

1.6 During transfer from one station to another, it shall be capable of travelling on its own at a speed of 105 km/h and at a speed of 105 km/h when hauled in a train formation. Since the RBMV is likely to cover long distance on its own power, the travel drive system should be robust to sustain these requirements during the life of the RBMV without significant break down/failure.

1.7 RBMV shall be capable of working without requiring power block in electrified sections. On Indian Railways, 2*25 KV AC supply is used for traction through an overhead wire at 5500 mm above rail level. On bridges and tunnels, the height is restricted to 4800 mm.

2.0 FUNCTIONAL REQUIREMENT AND WORKING MECHANISM

2.1 The RBMV shall be capable of working on all types of track structures including long welded rails of 60Kg / 52Kg / 90R on concrete/ metal/ wooden sleepers on plain track as well as turn-outs (1 in 8 ½ to 1 in 16) as per IRS layout.

2.2 Since the RBMV is to work in dusty environments, all the components including gearboxes, bearings, pumps, electric and electronic control shall be robust. Pumps, electric and electronic control shall be of robust design, shielded and sealed from the dust and spill over ballast pieces. Suitable protections covers must be provided so that these components do not fail prematurely. The various assemblies and the RBMV as a whole should provide adequate safety to workmen working close-by in connection with the RBMV operations. The necessary safety equipment shall form a part of the RBMV tools and plants. The tenderer should indicate these items in their offer.

2.3 RBMV should cater for following requirements:

2.3.1 It should be possible to carry minimum 2 rails of 13 m length each with weight per unit length of 60 Kg/m and / or two sets of switch and stock rail assembly along with fittings without infringing the Maximum Moving Dimensions.

2.3.2 There should be well designed adequate space to store small track machines, tools and equipments as per Annexure - V. For this a room of sufficient size is required to be provided. The store shall have well-designed racks to accommodate above material and some small track machines and its spare parts, consumables etc as per details shown in Annexure –VI.

2.3.3 There should be enough seating space for the officials accompanying RBMV. For this, one cabin having seating capacity of 12 persons shall be provided as given in the general layout.
2.3.4 RBMV shall have a crane as per requirements indicated in Chapter – V to handle heavy Permanent Way Materials such as rails, sleepers, crossings switches and SEJs etc.

2.3.5 Two number of tool boxes shall be provided along the wall of store and cabin. These toolboxes shall have a width of approximately 600 mm and cushioned seats shall be provided on the top of toolboxes. The top of the box shall be designed in such a way that the seats do not fall when the boxes are opened. Small cantilever sheds shall be provided over these boxes.

2.3.6 The entire RBMV including bogies, superstructure along with equipment is to be effectively earthed as per standard practice for rolling stock.

2.3.7 The equipment and their arrangement shall withstand satisfactorily the vibration and shocks normally encountered in service as indicated below:

a. Maximum vertical acceleration 3.0 g  
b. Maximum longitudinal acceleration 5.0 g 
c. Maximum train acceleration 2.0 g 
   (g being the acceleration due to gravity)

3.0 DESIGN DEVELOPMENT & APPROVAL OF DRAWINGS

3.1 The contractor shall develop the design based on the details given in this specification and sound engineering practices. The entire design data shall be submitted in metric units with calculations to RDSO within 8 weeks from the date of placement of order.

- RBMV weight balancing calculations in longitudinal & lateral modes under tare and loaded condition.
- Calculation of centre of gravity of RBMV from rail level and details of weight transfer calculation
- FEA analysis of under frame and bogie under load specified in Clause 2.5 of Chapter-II.
- Calculation for safety against derailment. Calculation for stability of the vehicle against wind force shall be supplied.
- Tractive effort versus Speed curve.
- Calculation of powered axle.
- Calculations for determining the spring and damper characteristics under tare and loaded condition.
- Simulation of ride behaviour and stability using frequency domain and time domain analysis.
- Braking effort and EBD calculation
- The tenderer shall provide sketches of the RBMV in plan and shall give calculations along with Vogel’s diagram to prove that the RBMV does not cause infringement while negotiating a 10° curve at any cross section.

3.2 Contractor shall prepare a full set of working drawings in standard sizes complete in all respects. The drawings shall include:-

- General arrangement of RBMV
• Diagram showing end view of the RBMV superimposed on Diagram 1- D of Revised SOD- 2004 with latest amendments and corrigendum slips.
• Equipment layout
• Power pack arrangement & its mounting details
• Engine & transmission cooling arrangement with radiator mounting details
• Compressor drive arrangement & capacity justification
• Axle drive gear box
• Torque reaction arm and its details
• Wheel, axle and axle boxes.
• Suspension arrangement
• Brake schematic & rigging arrangement including hand brake & its details
• Sanding gear arrangement with details
• Cab superstructure & control panel layout details
• Control system & cubicles etc.
• Fuel tank arrangement with details

Apart from it, submission of any additional drawings shall be indicated by RDSO to the contractor during design approval stage and contractor has to comply with the same. All drawings shall include description of equipment, weight, quantity per RBMV, material specification, welding symbol, tolerances etc.

3.3 Materials used for manufacture of the RBMV shall comply with the relevant IRS or BIS specifications. Alternate materials can be used provided their quality should be same or superior to the specified and are of globally accepted standards.

3.4 The welding standard followed for manufacturing of machine should be to ISO: 3834, EN:15085 or any other equivalent standard for welding railway vehicles and components. The manufacturer should specify the standard followed and certify that it meets the welding standard mentioned above.

3.5 To facilitate filing of drawings in RDSO, it is essential that each drawing prepared for the manufacture/operation/maintenance shall be marked so that it can be identified. The contractor shall, therefore, ensure that all prints submitted are marked legibly at the right hand bottom corner. 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
4. Nomenclature of the RBMV
5. Descriptions

3.6 Where parts are required to be marked with Railway initial letters, they shall be “I.R.”

3.7 Following drawing shall be got approved from RDSO before commencement of the manufacture of Prototype:
(i) General Arrangement (GA) drawing of the vehicle
(ii) Diagram showing end view of the RBMV superimposed on Diagram 1-D of Revised SOD- 2004 with latest amendments and corrigendum slips.

(iii) Power pack arrangement & its mounting details.

(iv) Suspension arrangement.

(v) General Arrangement of Bogie.

4.0 PROTOTYPE

The Contractor shall manufacture a prototype RBMV vehicle well in advance of series production for inspection and approval of RDSO. Further manufacturing is not to be proceeded until the prototype is approved by the RDSO.

5.0 INSPECTION of PROTOTYPE

5.1 Stages of Inspection of Bogie:

(i) The inspection shall be carried out for stage inspection of major sub-assemblies of bogie.

(ii) Inspection of complete bogie frame/bolster shall be carried out after complete welding.

(iii) After complete of first two bogie frame/bolster, waive off any or all items of the stage inspection may be considered by RDSO/Purchaser on request by the manufacturer. This will depend upon the experiences gained at the time of inspection of first two bogies/bolsters and the level of confidence built-up. The manufacturer will proceed further in manufacturing the bogies only after taking clearances at each stage as specified above.

(iv) The Purchaser/Inspection Agency shall have access at all reasonable times to the works where bogie frame/bolster is manufactured and material is stored and the right to inspect die, jig and fixtures and measuring instruments being used by the manufacturer. All the facilities labour, appliances, gauges, measuring instruments etc. necessary for testing and inspection shall be provided by the manufacturer free of cost.

(v) Dimension Control Charts, Chemical and Mechanical properties test certificates, Magnetic Particle Test certificates, Radiography Test Reports, Heat Treatment records etc. shall be supplied along with the Bogie Frames/Bolster to the purchaser.

5.2 The inspection officials from RDSO shall inspect the prototype RBMV after receiving readiness from the manufacturer. The manufacturer shall provide all required assistance for carrying out the inspection. The inspecting officials shall verify the conformity of the machine with respect to individual specification as above.

5.2.1 The machine's conformity/non-conformity issue in respect to each item shall be jointly recorded before issue of the inspection certificate. Inspection report shall include clause-wise comments of the inspection of the RBMV as laid down in the specification.
5.2.2 Following arrangements shall be made by the supplier/Manufacturer at the inspection premises for carrying out inspection of the machine by inspecting officials:

- Machine to be stabled on straight & level BG track. The length of the track should be at least 10 m more than buffer to buffer length of machine.

- In order to check Maximum Moving dimensions in cross section, a Sturdy frame of IR Max Moving Dimensions shall be provided by the manufacturer and passed over the machine holding it perpendicular to track, centre aligned with track centre. Adequate arrangements shall be made to the satisfaction of inspecting officials.

5.2.3 Following tests shall be carried out during prototype inspection:

(i) Alignment check for various sub-assemblies such as under frame, cab and bogies to check accuracy of work.

(ii) Performance and leakage test for Hydraulic and Pneumatic systems.

5.2.4 Test certificates of major vendor items like diesel engine, hydraulic transmission, radiators, cooling pumps, cardan shaft, axle drive, wheel, axles, roller bearings, axle box, suspension springs, brake systems, battery, wiper etc. shall also be supplied along with each RBMV. Testing parameters will be included in the test certificates. The documents are to be submitted before inspection of the prototype vehicle.

6.0 EXHIBITED DRAWINGS AND STANDARD SPECIFICATIONS

6.1 “Exhibited Drawings” means the drawings, which are exhibited or provided by RDSO for the guidance of the tenderer.

6.2 The design of the vehicle 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.

6.3 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.

6.4 The contractor shall provide himself at his own expense with copies of all the Specifications and drawings required for the manufacture of the vehicle.

7.0 SUPPLY OF DRAWINGS
The contractor, after inspection and approval of the prototype shall correct, wherever necessary, the drawings and schedule of material conforming to the prototype unit. The contractor after incorporating all changes and modifications shall furnish three copies of final drawings along with schedule of material to RDSO within 4 weeks of clearance of the prototype. Two copies of drawings shall be supplied with each RBMV to the consignee. One complete set of drawings shall be supplied as hard copy and as soft copy in Auto Cad Version 2000 on CD to RDSO respectively.

8.0 TRAINING OF IR OFFICIALS

8.1 Two officials for each RBMV from Zonal Railways and 4 officials from RDSO / Railway Board shall be trained as under:

(a) Training for a period of two weeks in the manufacturing plant and field operation abroad (for foreign manufacturing), shall be provided by the supplier/Manufacturer at manufacturing plant on the following key points:

- Key aspects of Operation and Maintenance of RBMV;
- Driving of the vehicle and crane operation.
- Assimilating various maintenance schedules of the Vehicle;

Cost of boarding, lodging and travel of IR Officials will be borne by the purchaser.

8.2 In addition to the above, on the job operation and maintenance training for 2 weeks for 3 machine supervisors per RBMV, shall be provided during and/or post commissioning to the satisfaction of purchaser.

8.3 COMMISSIONING OF RBMV:

Tenderer will arrange to commission the machine within 90 days of its arrival at the ultimate consignee premises and will also arrange for tests to be conducted according to the contract as required by the purchaser or his nominee.

9.0 TESTING KIT

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

10.0 TOOLS

List of tools required for maintenance and overhaul with tender shall be submitted by the tenderer. One set of such tools required for day to day maintenance work of the vehicle shall be supplied along with each vehicle.

11.0 SERVICE ENGINEERS
11.1 The Contractor shall provide, at his own expense, the services of competent engineers during the guarantee period and also during the first major overhaul of RBMV as may be agreed upon. The service engineers shall be available for testing/commissioning of the RBMV, training of operating and maintenance staff. The service engineers shall also advise the Railways on maintenance, testing and operating facilities considered necessary for efficient performance of RBMV.

11.2 The Contractor shall arrange for the supervision of commissioning of the vehicle 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 shipment or transit damages.

11.3 The Contractor or his agent shall ensure commissioning of the car within 30 days from the date of intimation by the consignee.

11.4 The performance of the vehicle shall be demonstrated by the Contractor or his agent after its successful commissioning at the consignee’s works.

11.5 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.

12.0 SERVICE MANUALS AND SPARE PARTS CATALOGUES

12.1 The prime contractor shall prepare a draft Maintenance Schedule of major power equipments like diesel engine, transmission, axle drive, controls etc. and submit for approval of RDSO within one month of clearance of prototype RBMV after inspection at manufacturer’s place.

12.2 Three copies each of detailed operating, maintenance & service manual and spare parts catalogue specially prepared for RBMV shall be supplied free of charge per RBMV to the consignee by the supplier.

12.3 In addition, one set of all the manuals and diagrams should also be sent to the Principal/IRTMT, Allahabad, one set to ED/TMM, RDSO, Lucknow, one set to DTK (MC)/Railway Board and one set to Director/IRICEN/Pune along with supply of first machine of similar group. In case, there is any subsequent amendment in above documents based on field performance, the amendment/amended documents should also be sent to above mentioned authorities.

12.4 The prime contractor shall also supply three copies of User Manual containing details of various sub-systems with illustrations and block diagrams.

13.0 DESCRIPTIVE INSTRUCTIONS PAMPHLETS
The supplier shall supply at least three copies of descriptions instruction / OEM Pamphlets/manual/brochure pertaining to items like Diesel Engine, Hydraulic transmission, Axle drive, Cardan shaft and brake equipments etc. free of cost with each set of power equipment. The pamphlet shall include disassembly and assembly procedure with suitable illustration and diagram/drawing with exploded view along with general arrangement, brake arrangement & schematic, electrical wiring diagram and lubrication diagrams/charts.

14.0 MAINTENANCE

14.1 The tenderer shall submit quotation separately for Annual Maintenance Contract for the following equipments. The Railways will have the right to accept or reject the offer for Annual Maintenance Contract. The scope of proposed AMC for traction power equipment is as under:

- Diesel Engine
- Hydraulic transmission
- Drive system (Axle drive, Cardan Shaft etc.)
- Controls and Safety items
- Cooling system complete.

14.2 The Contractor shall also submit comprehensive list of minimum consumable and non-consumable spares required to be stored as emergency spares to meet the out of schedule requirements.

14.3 The Contractor shall ensure the reliability of spares used during routine or periodic maintenance. In case of premature failure of such components, it shall be the responsibility of the contractor to replace them free of cost.

14.4 In case of any failure that calls for out of schedule attention, the Contractor will attend the same with utmost priority. If situation warrants, he shall carry out failure analysis of failed component and ensure that such failures are not repeated.

15.0 CONTRACTOR’S RESPONSIBILITY

The contractor shall be entirely responsible for the execution of the contract strictly in accordance with the terms and conditions of the specification not withstanding any approval, which RDSO or the Inspecting Officer may have given:

- Of the detailed drawings prepared by the Contractor.
- Of his sub-contractors for materials, components & sub-assemblies.
- Of other parts of the work involved in the contract.
- Of the tests carried out by the Contractor/Sub-Contractor or RDSO or the Inspecting Officer.

16.0 OPERATORS
Number of operators and allied staff for working of the vehicle under normal condition shall be indicated, specifying their duties and minimum qualifications.

17.0 SPARE PARTS

17.1 The tenderer shall submit the list of spare parts. The name and address of the manufacturer / supplier of spare parts should also be indicated.

17.2 Stand by spares: The prices for the stand by spares shall be quoted separately. These spares shall be for every set of 10 RBMV or part thereof. The prices for the following spares shall be quoted separately.

i) Diesel engine (complete) - 1 unit
ii) Power transmission unit along with flexible coupling / engine connection (complete)
iii) Air compressor (complete) - 1 unit
iv) Power bogie (complete) - 1 set
v) Trailer Bogie - 1 set
vi) Air brake equipment excluding air compressor & the items forming parts of bogies
vii) Generator for charging of starter batteries - 1 unit
viii) Drive system

Cardan shaft - 1 unit
Axle drive - 1 set
ix) Control and safety items (safety switches including LCWL) - 1 set
x) Cooling system (Hydraulic pump, motor, relay) - 1 set

Price for optional items, if any, to be quoted separately. Decision of buying optional items shall rest with the purchaser.

17.3 Recommendatory Spares

17.3.1 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.

17.3.2 The list of recommendatory 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 are already being manufactured in India.

17.3.3 The tenderer shall be responsible to ensure subsequent availability of the spare parts for the trouble free operation of the respective equipment.

18.0 PHOTOGRAPHS

18.1 During manufacture, colour photographs shall be taken of various assemblies / sub-assemblies especially of the rigid frames, articulation arrangement, cab suspension arrangement on rigid frames, power pack and body in various stages of production and of parts, which cannot be conveniently photographed after assembly. After completion, photographs of side, end and Isometric views of RBMV as also of the interior layout will be taken.
18.2 The photographs shall not be less than 380 mm x 255 mm for the side view of the completed RBMV, or less than 255 mm x 200 mm for other views and shall be taken on non-curl film. The negative and three prints of each photograph shall be furnished to RDSO, the prints being mounted on sheet to form complete sets.

18.3 After the RBMV has been manufactured, 4 numbers of photographs (size 380 mm x 325 mm) duly laminated along with negative should be supplied to RDSO for display.

19.0 WARRANTY

The supplier shall at his expense, replace any part of the equipment failing or proving unsatisfactory in service due to defective / faulty design, defective material or bad workmanship within a period of 24 months from the date of placement in service or 30 months from date of delivery whichever is earlier. The period of warranty would stand extended by the duration for which the RBMV remains inoperative. Further, any design modification made in the equipment as a result of any defect/ fault/short coming in the original design, the period of 24 months would commence from the date the modified equipment is put into service.

20.0 Maker's Test Certificate
Copies of maker's test certificate guaranteeing the performance of the RBMV shall be supplied in duplicate along with the delivery of each vehicle.

********
CHAPTER - II
STRUCTURE AND DESIGN OF RBMV

1.0 GENERAL LAYOUT

General layout of RBMV shall be in accordance with RDSO drg. No. RDSO/TM/05A/18. This layout is for the guidance of the manufacturer. Any changes that are necessary to be made in the layout keeping in view the overall design requirements can be made with the approval of RDSO.

2.0 VEHICLE STRUCTURE

2.1 The RBMV shall be of lightweight construction of corrosion resistant Steel to IRS: M - 41 or IS: 2062 Grade E 250 Cu (Fe 410 WC). The under frame, side wall, end wall and roof structure shall be joined by welding, which with respect to its strength, is adequately dimensioned to withstand, without any permanent distortion and excessive stresses. The assembly groups for under frame, sidewalls, roof and end walls shall be made up from pressed plates and sheets that are suitable for welding.

2.2 The vehicle body shall lend itself to repeated lifting in the workshops by overhead cranes or jacks without any risk or damage. Suitable lifting pads shall be provided and marked in an easily distinguishable manner on the vehicle body.

2.1 The contractor shall advise the corrosion protection measures adopted for the vehicle body. These measures will require approval of Indian Railways before the design is finalized.

2.2 The weight of the RBMV shall be kept as low as possible and consistent with adequate strength to meet the loading specified in Clause 2.5 given below and without exceeding the stresses and deflection stipulated in Clause 2.6 given below. The design shall be sufficiently rigid to withstand stresses imposed by lifting with overhead or breakdown cranes, or by jacks applied to the headstock.

2.5 The RBMV shall be designed to meet the following loads:

- Uniformly distributed vertical load of 3 t/m (including all equipment weights). The weight of various equipments mounted in the RBMV shall be considered as concentrated load and shall be simulated as such during load/strain testing. During load/strain testing concentrated load of equipments shall be deducted from the total UDL and remaining load is applied as UDL at rest of the area of the vehicle. However if concentrated load of the equipment at the area where equipment is mounted is less than 3 t/m then in such case only uniformly distributed vertical load of 3 t/m shall be considered.

- Adequacy of considering the vertical load of 3 t/m shall be verified by E&S/TMM Directorate.

- Comment on this clause is made with a consideration that UDL is inclusive of concentrated load of various equipments. If this is not so, the comments made for this clause shall be treated as invalid.
Uniformly distributed vertical load of 3 t/m. The weight of the various equipments mounted in the RBMV shall be considered as concentrated load and shall be simulated as such during load / strain testing.

ii) A horizontal squeeze load of 102 t applied at buffers CBC rear stops.

iii) A combination of loads specified at (i) and (ii) above.

2.6 The stresses estimated by an approved method shall not exceed 14.2 kgf/mm$^2$ for members made from steel to IS: 2062 Grade E 250 Cu (Fe 410 WC), 20.1 kgf/mm$^2$ for members made from Corten Steel to IRS: M-41, 23.3 kgf/mm$^2$ for members made from stainless steel –301grade and 21.3 kgf/mm$^2$ for members made from stainless steel - 409M grade for the uniformly distributed vertical load. Also for the squeeze loads, referred to above the stress should not exceed 90% of the lower yield point or proportional limit of the material in the load carrying member of the shell and 95% of the lower yield point or proportional limit of the material in the end construction. The estimated vertical deflection of the vehicle at the center of the RBMV shall not exceed 10 mm under any loading condition detailed at (i) to (iii) of Clause 2.5 given above.

3.0 UNDERFRAME

3.1 Material: Under frame shall be of corrosion resistant structural steel to IRS: M- 41 or any other approved copper bearing quality steel, of welded integral structure. Trough floor of 1.7mm thick stainless steel to AISI -301 shall be provided in covered area.

3.2 Sole bar: These shall be continuous members from headstock to headstock, adequately braced together to withstand the head on loading and cross racking forces and shall be capable to withstand jacking for the purpose of lifting the vehicle. The sole bar shall be of steel to IRS: M-41.

3.3 Body bolster: These may be fabricated from pressed section and shall have suitable pads on which lifting slings may be placed. Body bolster shall be of steel to IS: 2062 Grade E 250 Cu (Fe 410 WC).

3.4 Head stock: These shall be of robust design suitable for the attachment to breakdown lifting tackles etc. and for the coupling and buffing arrangements detailed in this specification. Head stock shall be of steel to IRS M-41. 3.5 Draft gear members: The members provided for carrying the trimmer casting shall be of strong and rigid construction capable of transmitting the buffing forces under the most adverse operating conditions. They shall be braced together, and to main sills in such a manner as to form in conjunction with the flooring system between the transoms and headstocks, 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 these longitudinal and is concentric to them.

3.6 Floor bearers: The design of floor bearers shall include robust main floor bearers placed transversely between the main sills and an adequate number
of racking panels between the main sills and diagonal braces. The transverse floor bearers shall be designed to carry the maximum super-imposed load under maximum load conditions as well as to act as bracing between the main sills, and shall be flush with the top face of the main sills, and a suitable surface for the floor covering. The design shall generally ensure adequate drainage, so that corrosion is avoided, or is confined to parts, which can be readily renewed without affecting the main flooring members. Floor bearers shall be of corrosion resistant structural steel to IRS: M-41 or IS: 2062 Grade E 250 Cu (Fe 410 WC).

4.0 BOGIE

4.1 General Design: The RBMV 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. 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 the value as per extant criteria applicable to the vehicle at a maximum speed of 115 km/h. 4.2 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 attention on the track.

4.2 The suspension system shall be 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. 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.

4.3 Safety straps of adequate size shall be provided to ensure support in the event of failure of links, hangers or other components.

4.4 The springs of the above bogies shall be suitably designed for the loads encountered in service, and shall conform to RDSO Technical Specification No.WD-01-HLS-94 (Rev.2) with latest amendments.

4.5 Stress Relieving: The stress relieving of the bogie frame/bolster shall be carried out in a suitable furnace equipped with thermocouples and recorders. Adequate measures shall be taken to avoid any appreciable distortion of the bogie/bolster during heat treatment. If any resetting is required to be done after heat treatment in order to achieve required dimensions, the bogie frame/bolster shall be again suitably heat treated after such resetting.
4.6 Shot Blasting:
(i) The entire bogie frame/bolster shall be subjected to shot blasting after heat treatment for cleaning of rust, scales, spatters etc. Special care shall be taken to protect the threads of axle box duisde during shot blasting.
(ii) immediately after shot blasting and inspection the bogie frame/bolster shall be coated with one coat of anti-corrosive paint in order to arrest rusting and corrosion.

4.7 Dye penetration test of weld joints should be ensured.

5.0 WHEELS AND AXLES

5.1 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.

5.2 The wheel profile shall conform to RDSO Drg. No. SK-91146 with latest alteration.

5.3 Wheel and axle dimensions shall meet the requirements of Indian Railways Schedule of Dimensions 1676 mm gauge - (BG), Revised 2004 with latest amendments and correction slips.

5.4 Roller bearings shall have a minimum life rating of $3 \times 10^6$ km when computed as per method given in ISO Standard ISO 281/1. Any type of roller bearing shall be used to cater for the axle load prescribed in the specification. Roller bearing shall be grease lubricated & sealed and also supplied by any manufacturer approved by UIC/AAR. Roller bearing shall be conforming to EN 12080:2017 and shall have minimum L10 life of $3 \times 10^6$ km (3.0 million km) when computed as per method given in ISO Standard 281/1.

5.5 The design of wheel should be as per EN 13979-1/UIC 510-5 and non-powered axle as EN 13104.

6.0 DRAW AND BUFF GEAR

The vehicle shall be provided with transition coupling as per RDSO specification no. 56-BD-07 RDSO/2009/CG-22 with latest revision along with side buffers to RDSO drawing no. RDSO/SK-98145 with latest alteration. The arrangement shall be such that the vehicle can be coupled with existing BG rolling stock of Indian Railways.

7.0 CATTLE GUARD

Cattle guard of suitable design to ICF drg. no. DMU/DPC3-2-6-301 shall be provided at the driving ends of RBMV.

8.0 DOORS

8.1 Swing type doors with inward opening of 535 mm with locking arrangement shall be provided in driver's compartment and Sliding doors have a clear
opening of 610 mm & 910 mm shall be provided in cabin and store compartment respectively.

8.2 All body side doors shall be provided with integral safety catches at top and bottom with padlocking arrangement at top only. One door on either side of the coach shall be provided with staples for padlocking from outside.

8.3 The body side doors shall also be provided with carriage door lock suitable for locking unlocking with standard square key both inside and outside.

Door hand holds: Door hand holds of stainless steel tubes 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.

8.5 The door footsteps assembly shall be of mild steel and shall have Compreg board to RDSO spec. No. C - 9407 (latest revision). The edge shall be protected with metallic treads. Any other suitable arrangement can also be considered.

9.0 WINDOWS

9.1 The window guides, and sills shall be of FRP, and shall be as per RDSO Schedule of Technical Requirement STR No. RDSO/2007/CG-03 with latest revision.

9.2 Glass window frames and louvers shutters shall be of FRP as per RDSO STR No. RDSO/2007/CG-02 with latest revision.

9.3 Frames, guides and sills should be manufactured from sheet moulding compound (SMC) to RDSO spec. No. RDSO/2007/CG-01 with latest revision.

9.4 All window openings shall be true to square dimensions and of uniform width. The window opening shall not at any point exceed 2 mm over or under the specified dimensions and shall not be out of square by more than 2 mm.

9.5 The window sills of the body side windows shall have an outward slope of approximately 5°.

9.6 The body side windows shall have two shutters, one louver on the outside and a glass on the inside.

9.7 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.

10.0 DRIVER'S COMPARTMENT
10.1 The RBMV shall have both ends with driver's compartment. The RBMV shall be equipped with fully enclosed cabins with safety glass window. In view of the high ambient temperature prevailing in India, special attention should be paid to free circulation of air and ventilation in the driver's cabin. It shall be possible to have a clear view of the track ahead while driving the RBMV in either direction. The design of drivers cab shall be asper UIC-651. Visibility diagram should be submitted along with the design details.

10.2 Sitting space in each of the driving cabs for 4 persons in addition to the driver. For this purpose a foldable cushion seat shall be provided.

10.3 The gauges, instruments and controls shall be suitably located in the operator's cab so that they can be observed without undue fatigue to the operator.

10.4 Stone proof single fixed lookout glasses shall be provided in the end wall of each driver's compartment and these shall be glazed, clear, colourless polycarbonate glass to ICF Spec. No. ICF/MD/SPEC -159 with latest revision.

10.5 Provision of windscreen wiper arm and blade assembly to be provided as per RDSO Spec. No. C - K 306 with latest revision.

10.6 Fixed sun-control film affixed to the front look out glass up to 8" from top of the lookout glass shall be provided.

10.7 Provision of clip pad for caution orders, adjustable sun visor, walkie-talkie and tumbler holder arrangement shall be made on driver's desk.

10.8 A footrest shall be provided in front of driver's seat.

10.9 Provision of fluorescent light and spotlight shall be made in driver's cab.

10.10 Modular switches to IS: 3854 shall be used in driver's cab.

10.11 Drivers Desk top sheets shall be of fire retardant FRP material with steel structure.

10.12 Inter-communication equipment between cabs, stores and cabin through hand free sets with its own battery shall be provided.

10.13 2 numbers, 24 V sockets for hand signals in each cab shall be provided.

10.14 LED Flasher lights, LED search lights and LED marker lights at both ends of the cab shall be provided.

11.0 FLOORING
The floor of RBMV in drivers cab and staff cabins shall consist of 2 mm thick PVC sheet to RDSO STR No.C-K604 RDSO/2006/CG-12 (Latest) with 12 mm Compreg sheet to RDSO STR No.C-9407 (Rev.2 Latest) as padding below
the PVC flooring sheet. At other places steel galvanized Chequered plates of 6 mm thick shall be provided to IS: 2062.

12.0 **CEILING**

The ceiling of the driver’s cab and cabin shall be of flexible non-metallic heat insulating material NFTC sheet to RDSO STR No. C - K514 RDSO/2016/CG-02 (Latest).

13.0 **INSIDE PANELS**

Sidewalls and partitions of cabin shall be panelled with 3mm thick resin bonded laminated plastic (LP) sheet as per RDSO STR No. C - K 514 (Latest). The sheets shall be procured from the list of the approved suppliers issued by RDSO ICF/Chennai.

14.0 **SEATS FOR DRIVER’S COMPARTMENT**

The driver’s seat shall be of the folding and swivelling type to permit the driver to manipulate the controls either while sitting or standing. The seat frame or swivelling arrangement shall be robust design, easy to operate and hold in any desired position. The driver’s seat cushioning shall be as per RDSO specification no. C - K607 with latest revision properly vented and upholstered with covering to RDSO specification no. RDSO/2006/CG-16 with latest revision RDSO/2008/CG-07 (Latest).

15.0 **SEATS & BERTHS**

All berths cushioning shall be as per RDSO specification no. C - K607 with latest revision properly vented and upholstered with covering to RDSO specification no. RDSO/2006/CG-16 with latest revision RDSO/2008/CG-07 (Latest).

16.0 **TRAP DOOR (INSPECTION DOOR)**

Suitable trap door will be provided on the flooring of RBMV for inspection of under slung equipment, which needs attention during services. The design of trap door will be such that it can be conveniently lifted when attention to equipment is required but strong enough to withstand loading. The trap door shall remain flush to the floor.

17.0 **TOPPLING**

The under slung and on-board equipment and fittings shall be suitably located so as to ensure that weight of the equipment is uniformly distributed with respect to the centre line. Adequate measures shall be taken to ensure proper balancing and balance weight where necessary are provided so as to avoid toppling of the RBMV.

18.0 **WATER WRIGGLES**
Continuous water wriggles with design such that the water falls off from the front of the coach shall be provided from one end of the cabin to the other, formed by upsetting the sides of the roof sheets. Gutters of suitable design of pressed shape shall be welded directly to the roof skin over the doorways.

19.0 ROOF VENTILATORS

TRA type roof ventilators to ICF drg. No. WLRRM4-7-3-402 with latest alteration shall be provided in RBMV.

20.0 WARNING HORN

Dual tone pneumatic horns shall be mounted vertically in front of the driver’s compartment and these shall be operated by robust foot operated valves.

21.0 FIRE PREVENTION MEASURES

Fire prevention measures shall be in accordance with RDSO / CMI No. - K402 of Code of Practice for Prevention of Fires on DMU’s Stock with latest amendments.

22.0 ANTI-CORROSION TREATMENT

22.1 Epoxy paint to Spec. No. RDSO/M&C/123-06 shall be laid inside the sole bar, sidewall and body pillars up to waist rail level. In case of stainless steel, trough floor welded area between trough floor and sole bar shall be cleaned and passivated after welding. No bituminous coats shall be provided on stainless steel trough floor.

22.2 Insulation: The interior surface of the roof sheet shall be provided with 25 mm thick double side laminated aluminum foil claded glass wool padding to spec. no. AS/NZS-4200.1.

22.3 Sheets and plates used for car construction shall be suitably treated against corrosion before fabrication.

22.4 In addition to above, the RBMV 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.

22.5 The tenderer may suggest any better corrosion protection system that he may have adopted with success in vehicles manufactured by him.

23.0 INTERIOR FURNISHING

23.1 The interior finish and furnishing must be to the best standards of coachwork, and shall combine a good and clean appearance with durability and serviceability. The interior surface, such as walls, partitions etc. shall be rounded and joints shall be avoided. All surfaces liable to frequent handling
shall be finished with materials suitable for periodical washing or cleaning, and shall be of a colour which will not show up stains.

24.0 EXTERNAL FITTING & FURNISHING

24.1 Footsteps shall be provided at all body side doors.

24.2 Steel step iron shall be provided at the entrance to the driver’s compartment and shall be so located as to provide a convenient foothold without infringement of the maximum moving dimension.

25.0 INTERIOR COLOUR SCHEME

The interior colour scheme shall be as follows:

<table>
<thead>
<tr>
<th>Section</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Floor to cant rail in compartment, doorways passages and outside lavatories</td>
<td>Laminated plastic sheet (3 mm thick) of stardust Grey pattern to RDSO specification C—K 511 C- K 514 (Latest).</td>
</tr>
<tr>
<td>c) Ceiling</td>
<td>White paint To be fitted with NAFTC sheet to RDSO STR No. RDSO/2016/CG-02 (Latest) which is white colour in built. No painting is required.</td>
</tr>
</tbody>
</table>

26.0 MARKING & COLOUR OF MACHINE:

26.1 The machine body shall be painted in golden yellow colour of Indian Standard Colour code of 356 as per IS:5 The exterior painting shall be polyurethane binder based conforming to RDSO Specification No. M&C/PCN/100/2013 (Specification for Epoxy cum Polyurethane Painting System –Two packs for the Exterior Painting of Railway Coaches, Diesel and Electric Locomotives and other Industrial Applications) or ISO 12944.

26.2 Following should be written in black on the machine at appropriate location in English & Hindi as per direction of Indian Railway official

i) India Railways logo of height between 300 mm to 600 mm as suitable on all four faces of the machine.

ii) The text “INDIAN RAILWAYS” shall be written in Bold and in Black colour of size equal to or slightly smaller than the size of logo but of size not less than 250 mm on both side faces and below the Indian Railways logo.

iii) Machine model and manufacturing Year shall be written in black colour and in letter of size less than the size in which Indian Railways is written but not
less than 200 mm in any case below the text “INDIAN RAILWAYS” mentioned above.

iv) If required, the Manufacturers Name may be written in size not more than 150 mm and should not be at more than four locations. Also the Manufacturers Logo may be provided at not more than two Locations and should be of size less than 200mm.

27.0 TESTS ON MECHANICAL PARTS

27.1 Certificates for following tests, conducted on mechanical parts on prototype RBMV, shall be provided to the inspecting officials at least 30 days before the proposed date of inspection.

(i) Squeeze load test under load conditions as specified in Clause 2.5 given above.
(ii) Tests on brake equipment on individual coaches.
(iii) Tests on parking brake arrangement.

27.2 The test scheme for above tests shall be finalized after completion of prototype in consultation with the manufacturer.

28.0 CLEARANCES

The first completed vehicle shall be placed on level straight track, the buffer and screw coupling height, spring height and other clearances shall be checked under tare and loaded conditions. The vehicle shall under these conditions, be passed through a structure representing the maximum moving dimensions as per diagram 1-D of revised SOD - 2004 with latest amendments and corrigendum slips. The RBMV shall also meet the other requirement of revised BG SOD-2004 with latest amendments and corrigendum slips.

29.0 TARE WEIGHT

The tare weight of prototype RBMV shall be taken by using load cells / weigh bridge and provided to inspecting officials at least 30 days before the proposed date of inspection.

30.0 RUNNING TESTS

30.1 The supplier who complete the design of RBMV as per specification, the technical details as per Annexures VIII A & B enclosed should be supplied for conducting oscillation trial so that it can be permitted to move on track. On case-to-case basis, more technical details (other than mentioned in Annexure VIII A & B) can also be asked for conducting oscillation trial.

30.2 The following running tests shall be conducted on the rake to assess its speed potential and brake capabilities:

1 Oscillation trials: Oscillation trials on prototype unit to assess the riding quality at a maximum test speed of 115 km/h with RBMV is self-propelled and
in train formation condition. The speed potential of the vehicle should meet the criteria as given in Annexure – VII.

2 Braking distance trials from the maximum operating speed of 105 km/h. to ensure that emergency braking distance shall be substantially less than 1.0 Km.

30.3 The test scheme for the above trials shall be finalized before conducting the trials in consultation with the manufacturers.

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CHAPTER – III
POWER EQUIPMENT, CONTROLS & AUXILIARIES

1.0 GENERAL

1.1 This part of the specification deals with power equipment and controls requirement for operation of Broad Gauge, single unit, Self-propelled diesel - Hydraulic Rail Bound Maintenance Vehicle (RBMV). 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. RDSO/TM/05B/18 is placed at Annexure – IIB.

1.2 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.

2.0 SCOPE OF SUPPLY

2.1 The scope of supply of equipment for each RBMV shall be as under:

<table>
<thead>
<tr>
<th>SN</th>
<th>Item Description</th>
<th>Qty./RBMV</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fuel efficient diesel engine, of adequate capacity with anti-vibration mounting pads, mounting brackets &amp; 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.</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Hydraulic transmission using hydro-dynamic elements and preferably provided with hydraulically reversible arrangement with anti-vibration mounting pads, mounting brackets &amp; bolts, standstill detector &amp; associated equipments and controls.</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Axle drive gearbox of suitable gear ratio, complete with powered axle &amp; torque arm assembly.</td>
<td>2</td>
</tr>
</tbody>
</table>
| 4  | Cardan shaft for drive between:  
  a) Input to transmission (if, required) 
  b) Between Transmission and Axle drive | 2         |
| 5  | Controls and instrumentations for two cabs for bidirectional operation of vehicle. | 2 sets    |
| 6  | Battery: 
  a. 24 V, 290 Ah for engine starting 
  b. 110 V, 120Ah for controls & Lighting | 2 sets    |
|    | 1 set                                                                             |
| 7  | Speed indicator cum recorder for one cab and only speed indicator for other cab    | 1 set     |
| 8  | Hydraulic pump driven by one of the engines for power supply to the crane operation. | 1 set     |
3.0 DIESEL ENGINE

3.1 Diesel engine complete shall be offered as per Clause 2.1.1 under scope of supply. Twin under slung power pack, each powered by fuel-efficient diesel engine of adequate capacity shall power RBMV. The diesel engine shall be of proven make and suitable for traction application. The tenderer shall indicate the continuous horsepower at rated output 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 1.2 of Chapter-I above.

3.2 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 net power input to the transmission.

3.3 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.

3.4 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

3.5 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 may be given at 25%, 50%, 75% and full load.

3.6 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.

3.7 The exhaust emission of diesel engine shall follow the UIC – I (UIC 624, 1st edition, April’2002) standards or better.

3.8 Filters for engine air intake shall be of adequate airflow capacity with restriction indicator to ensure satisfactory performance under dusty environment.

3.9 Air intake 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.

3.10 The exhaust pipe shall be horizontal and located under floor avoiding the position near footsteps to the RBMV.

3.12 The tenderer shall supply engine driven alternator of adequate capacity as standard accessory for charging battery for engine cranking and coach lighting and controls.

3.13 The tenderer shall submit along with his offer, complete data of engine, Transmission system and Auxiliaries etc. as per Annexure-III.

3.14 The engine should have Electronic Control Module (ECM) or similar arrangement for taking out operating parameters on real time basis such as RPM, load, fuel consumption, temperature, pressure maintenance and diagnostic data as well as trip and historical data. These data should be displayable on centralised computer based control and monitoring system as mentioned in 3.22 above. It should also be possible to take out these informations on USB device.

4.0 TRANSMISSION

4.1 Hydraulic transmissions complete shall be offered as per Clause 2.1.2 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 include all the necessary accessories, standard attachments and safety devices.

4.2 The supplier shall carry out 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.

4.3 The transmission shall be suitable for Cardan shaft connection with the diesel engine (if remotely connected) and axle drive gearbox.

4.4 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.

4.5 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.

4.6 To minimize the secondary vibrations in under-slung power pack, mounting of engine and transmission on Skid mounting shall be preferred.

4.7 The combined performance of the twin power equipment shall not be inferior
to the tractive effort curve placed at Annexure – IV. Supplier shall submit TE Vs Speed curve superimposed with above curve with complete matching calculation of offered power equipments along with equipment lay out drawing.

4.8 Transmission shall have provision of secondary lubrication arrangement to provide protection to transmission from damage during towing in train formation.

5.0 COOLING SYSTEM

5.1 Radiator of adequate capacity for cooling the water, lubricating oil and transmission oil, shall be provided. The cooling system shall be with excess capacity of 30% towards choking. The heat dissipating requirement of the transmission oil shall be heat equivalent of 30% of the maximum horsepower input to the transmission under most adverse site conditions.

5.2 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 ºC, 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

5.3 The calculations in support of above shall be submitted, comprising mainly of:
• 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.

5.4 The tenderer shall indicate the suitable location for mounting Radiator and submit mounting details of radiator assembly, fan drive arrangement such that all equipments fit completely within the overall dimensions of RBMV.

6.0 CARDAN SHAFT

6.1 The cardan shaft shall be of robust design and well proven in performance capability, suitable for transmitting rated horsepower and maximum torque encountered during operation.

6.2 The resultant angularity of Cardan shaft shall be maintained within 5º.

7.0 AXLE DRIVE GEAR BOX WITH POWERED AXLE

7.1 Two numbers proven axle drive gearbox of suitable gear ratio, complete with powered axles & torque reaction arm 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.

7.2 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.

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

7.4 The powered axle shall conform to IRS specification R-43 (latest).

8.0 AUXILIARY ALTERNATOR

8.1 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.

8.2 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 LED 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 RBMV.

9.0 BATTERY

9.1 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, 120 Ah for controls & lighting shall cater to all auxiliary electrical loads of the RBMV for two hours in case of auxiliary alternator failure.

9.2 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.

10.0 CONTROLS

10.1 RBMV 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 RBMV. 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 RBMV can be operated from one driving cab only at a time.

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

11.0 GAUGES, INSTRUMENTS AND SAFETY DEVICES

11.1 Gauges should be self-illuminated with LED and flush mounted.

11.2 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
(ix) Radiator water level indicator

11.3 Transmission

1 Transmission oil temperature gauge
2 Transmission oil pressure gauge
3 Forward/Reverse/Neutral indicator

11.4 Brake system

11.4.1 All the pneumatic gauges shall be back lit type self-illuminated and calibrated in 0.1 kg/cm² pressure and least count should be 0.1 kg/cm². Following gauges shall be provided in the cab to indicate the driver regarding air pressure level in various parts of the system.

1 MR pressure gauge
2 Brake pipe pressure gauge
3 Parking brake gauge
4 Brake cylinder pressure gauge duplex type indicating BC pressure of both the bogies
5 Any other gauges, which are required as per the system, offered. All gauges should be of 4” diameter.

11.5 Other Gauges

1. Vehicle speed indicator cum recorder (in one Driving Cab)
2. Vehicle speed indicator (in other Driving Cab)

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

11.6 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. Provision of standalone vigilance control device - Application of penalty brake, Transmission to neutral & Engine to idle.

11.7 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

12.0 SPEED INDICATOR / RECORDER

12.1 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.04) of April 2007 Aug.'17 or latest. One cab of DPC shall have one recorder-cum-indicator and that of other cab shall have one indicator only.

13.0 HEAD LIGHT

13.1 The RBMV shall be equipped at both ends with standard LED headlights to RDSO specification for Twin Beam LED Head Light – conforming to specification no. RDSO/2017/EL/SPEC/0134 (Rev.-0) and specification for DC-DC Converter for electric loco./diesel electric loco No. ELRS/SPEC/DC-DC Converter/0021, (Rev-1), Sept’2004 or latest.

14.0 FLASHER LIGHT

14.1 The RBMV shall be provided with Flasher lights to RDSO Spec. for LED based Flasher light units for electric loco/diesel hydraulic loco/EMU/DMU No. ELRS/SPEC/LFL/0017(Rev.1) of Sept’2004 or latest.
15.0 MARKER LIGHT

15.1 The RBMV shall be provided with Marker light to RDSO specification for LED Marker light for electric loco/diesel electric loco No. ELRS/SPEC/PR/0022, (Rev-1) October 2004 or latest.

16.0 PIPING

16.1 All pipe joints will be as per ICF standard practice. Schematic piping to suit the engine shall be to the relevant ICF drawings. Flexible pipes shall be provided at the locations prone to vibrations.

17.0 LUBRICATION

17.1 Grease nipples shall conform to IS specification No. 4009. All the grease nipples & adapters, wherever used, shall be tack welded to prevent them from unscrewing and falling off in service.

18.0 FIRE EXTINGUISHING

18.1 Four Halon type fire extinguishers shall be provided, two in each cab.

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CHAPTER – IV
BRAKE SYSTEM

1.0 General
1.1 The self-propelled RBMV shall be provided with twin pipe graduated release air brake system. It shall have the following distinct positions:

i) Release positions
ii) Minimum reduction position
iii) Full service position
iv) Emergency position

1.2 Provision shall be made that during emergency brake application, engine should come to idle.

1.3 Panel mounted air brake system of approved make conforming to Spec. No. MP-0.01.00.19 (Rev-00), July’2006 shall be provided but multiple unit feature need not be provided.

1.4 The brake system / rigging shall be bogie mounted and shall be provided with non-asbestos composition ‘K’ type brake blocks.

1.5 The RBMV shall be provided with the following additional brake equipment:
   i) Air dryer of approved make conforming to Spec. No. MP-0.01.00.06 (Rev-03), March ‘2007 should be provided.
   ii) Stand alone VCD of approved make conforming to Spec. No. MP-0.34.00.04 (Rev-04), Dec ‘2008 should be provided.
   iii) D-1 Emergency brake valve (Air brake) in each driving cab on the extreme right hand side.
   iv) Stand-by brakes, in case of failure of distributor valve or any component in the brake system.

1.6 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. All the brake rigging pins/joints shall be provided with bulb type cotters.

1.7 The brake gear bushes shall be as per RDSO Schedule of Technical Requirements for plastic brake gear bushes for passenger coaches to C-9203 latest revision / alteration.

1.8 The supplier shall submit details of brake system covering Brake schematic diagram, working principle, Brake power diagram, Calculation for EBD, Number, dimension & type of brake block and Literature on brake equipments proposed along with offer and get the brake system approved from RDSO before manufacture of the prototype.

2.0 PARKING BRAKE
2.1 Provision of spring applied parking brake shall be made in RBMV to RDSO specification no. C-K 408.

3.0 AIR COMPRESSOR:

3.1 RBMV shall be provided with engine mounted twin cylinder air compressors (one with each engine). The total FAD of compressor shall be 350 lpm at 8 Kg/Cm² at idle speed of the engine. The tenderer shall ensure the adequacy of offered compressor. Tenderer shall submit compressor capacity calculations in this regard. Cut-in and cut-out of compressors will be at 7 Kg/Cm² and 8 Kg/Cm² pressure respectively.

4.0 PIPING AND PIPE FITTINGS

4.1 Seamless stainless steel pipe bright annealed to ASTM A 269, Gr.304, which can be bent cold, shall be used. The layout of piping shall be designed to keep all pipes, especially the brake cylinder pipes, as short and straight as possible. Bends should be used throughout, but where elbows have to be used, they shall be of round type. Where the pipes itself are bent, their internal area shall be maintained uniformly.

4.2 Double ferrule pipe fitting consisting of body, front ferrule, back ferrule and nut shall be provided. The body and nut will be of carbon steel to ASTM A-108 Grade II with electro cobalt zinc plating with chromic passivation. The front ferrule and back ferrule will be made from Stainless Steel to ASTM A 276 TP 316 SS and conforming to ICF specification no. ICF/MD/SPEC-166 rev.2 with latest amendments.

4.3 All pipes shall be adequately clamped to the frame assembly. Compreg type - II clamp to RDSO spec. no. C-9407 shall be used.

4.4 Flexible hose connections conform to spec. SAE 100R₁ only shall be used.
CHAPTER – V

TECHNICAL REQUIREMENTS OF CRANE

1.0 RBMV shall have hydraulically operated type fixed crane mounted on it and the crane shall be without outriggers /jacks. The crane shall be of knuckle boom or pillar jib type with telescopic jib.

2.0 The crane shall be structurally integrated with the under frame of RBMV. Mounting arrangement shall be made in the under frame so that it should be rigid and upright without infringing BG moving gauge during run.

3.0 The crane shall be capable of lifting a load of 1t at 8m radius with 360° slewing. The tenderer shall submit the lifting capacities at various radii. The crane should be capable of loading / unloading P Way materials lying along the track on either side viz. rails, concrete sleepers, switches and SEJs etc. (the details of which may be obtained from RDSO), from ground and 1.2m below rail level to RBMV and vice-versa. Suitable attachment like loading platform, lifting tackles / lifting clamps for handling the heavy materials shall be provided along with crane. The tenderer shall submit the details of the same. Slings required for picking up rails, sleepers or crossings shall also be supplied as part of the crane. Necessary make-up blocks (if required) shall be supplied by manufacturer/supplier for steady transfer of load during operation of the crane.

4.0 It shall be possible to start the loading / unloading at site within five minutes of arrival. In case, the tenderer is not able to meet the above requirement, the set-up time shall be indicated by the tenderer and shall have to ensure the same during testing.

5.0 The crane operation shall be such that there is no infringement with overhead electric equipments including adjacent track, if available either by crane or items to be lifted as indicated in Clause 3 above. Suitable safety devices shall be provided to prevent such infringement, if any. The crane shall be properly secured while traveling to protect it from damages.

6.0 **Power Equipment: & Controls:**

6.1 Separate power pack preferably of indigenous make with its operating and control panel and operator’s seat shall be provided for independent operation of crane. In case of power pack failure, an alternative provision shall also be made through traction power pack for uninterrupted operation of crane.

6.2 The diesel engine for crane operation shall work satisfactorily with fuel oil to IS Specification No.1460 (2005).

6.3 A separate fuel tank with adequate capacity sufficient for continuous operation of 24 hours shall be provided. Sight glass type fuel measuring gauge shall be provided on the fuel tank.
6.4 Control panel with operator’s seat shall be provided at a suitable place near the crane for its operation. The equipment and controls shall be arranged near operator’s seat to facilitate easy access for operation of the crane. Care shall be taken to protect the controls from environmental hazards.

7.0 The operation of crane viz. hoisting, derricking, slewing shall be hydraulic/electric. The hydrostatic system shall have hydraulic pumps, motors and their equipment of proven make and reliable.

8.0 Hydraulic tank of adequate capacity shall be provided at suitable location. Hydraulic hoses of proven make shall be used.

9.0 Indigenously available hydraulic oil and approved by OEM shall be used.

10.0 Tenderer shall submit hydraulic schematic diagram for crane operation, load charts and stability calculation.

11.0 Provision shall be made to bring the crane in folding condition in case of crane power pack failure by manually operated pump or any other means.

12.0 The system shall be provided with suitable hydraulic valve to protect against accidental lowering of load due to system failure.

13.0 Tenderer shall submit technical details of offered crane along with hydraulic pump and motors for crane operation as per **Annexure- III.**

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CHAPTER – VI
LIGHTING ARRANGEMENT

1.0 This covers the requirements of lighting equipment to be installed in the RBMV. Lights and fans shall be as per layouts mentioned in Annexure – IIA of this specification.

2.0 The coach of the RBMV shall be provided with an emergency electrical connection for lighting load only. The battery provided on vehicle in case of auxiliary generator failure will cater to the lighting load.

3.0 WIRING

3.1 The code of practice for wiring as per EL/TL/48 shall be generally followed. Each driving cab shall be provided with a control panel with controlling switches for lighting and fan circuits. Suitable indication lamps shall be provided to indicate the working of the generator and ON/OFF positions of various feeders. The configuration of coupler wires shall be such as to meet the above requirements. The controls of lights and fans shall be possible from any of the driving cabs.

4.0 DISTRIBUTION FUSE BOARDS

4.1 Distribution fuse boards for the entire coach shall be located uniformly along the length of the coach. Each board shall be accessible through a separate hinged cover. The cover shall be provided with a suitable locking device that could be opened by the same key as for the junction box. A suitable key shall also be provided for keeping the cover in open position.

5.0 FANS

5.1 Brush less DC (BLDC) fixed type of fans of 400 mm sweep conforming to RDSO/PE/SPEC/TL/0021/2000 (Rev.0) with Annexure – H to IS: 6680-1992 issued by RDSO in June/2003, shall be provided. Each fan shall be controlled by its own switch. The fan base shall be insulated from the coach body and the coach wiring shall be terminated to 2-way connectors supplied with the fan and fixed on the ceiling.

6.0 LIGHTS

6.1 Interior: Fluorescent fittings shall be used for lighting the compartment as shown in layouts indicated in Annexure-IIA of this specification.

6.2 Exterior: External light fittings will work on 110 V DC. 15W LED lamps to IS: 897 shall be fitted at locations as shown in the coach layouts (Annexure-I of this specification). The coach wiring shall be terminated on 2-way connectors to IRS Drg. No.E101/M/B and the connection to the light fitting shall be given from 2-way connectors using flexible wires.
6.3 All the lights shall be grouped into L-I and L-II circuits, which shall consist of essential and non-essential lights respectively. 50% of the compartment lights and doorway lights shall be wired as essential lights and all the other lights as non-essential lights.

6.4 One electrical socket on either side of the RBMV shall be provided to facilitate the use of portable inspection lamp for the examination of underframe equipment.

7.0 SWITCHES

7.1 Modular switches for the control of compartment fans shall be located on the body sidewall pillars between windows in the respective bays. All light points shall be wired without individual switch. A separate switch shall be provided in the driver’s cab for control of headlights.

8.0 TEST CERTIFICATES

8.1 Electrical test shall be carried out on each coach in accordance with EL/L/48. One copy of test certificate after counter signature by Inspecting Engineer shall be made available to the Railway to which the coach is allotted.

9.0 MARKINGS

9.1 At either end panel underneath the emergency coupler socket, following shall be stencilled. “Junction box provided inside”.

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Chapter-VII
Inspection & Speed Certificate

1.0 Inspection

1.1 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.

1.2 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.

1.3 In the event of dispute between the Inspecting Officer and the Contractor, the decision of the purchaser shall be final and binding.

2.0 Radiographic testing of steel castings

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.

2.1 The powered bogie shall be subjected to exhaustive stationary tests at Contractor’s works in the presence of 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.

2.2 While inspecting the RBMV before dispatch from the supplier’s premises, the inspecting officer shall verify the conformity of the RBMV with respect to individual specification as above. The RBMV’s conformity /non conformity with respect to each item shall be jointly recorded before issue of the inspection certificate and approval for dispatch of the RBMV as per Annexure–IX enclosed.

3.0 Following arrangements shall be made by the supplier/Manufacturer at the inspection premises for carrying out inspection of the RBMV by inspecting officials:
i) RBMV is to be stabled on straight & level BG track. The length of the track should be at least 10 m more than buffer to buffer length of RBMV.

ii) In order to check Maximum Moving dimensions in cross section, a Sturdy frame of IR Max Moving Dimensions shall be provided by the manufacturer and passed over the RBMV holding it perpendicular to track, centre aligned with track centre. Adequate arrangements shall be made to the satisfaction of inspecting official.

3.1 The following documents shall be provided to the Inspecting Official (IO) at least 30 days before the proposed date of inspection.

i) One copy of complete technical literature mentioned in clause 13.0 of Chapter-I, in English language, including operation, service and field maintenance manuals/instructions and complete electrical, hydraulic and pneumatic circuit diagrams, trouble shooting charts, component drawings/description and other relevant technical details as a reference documents in soft & hard copies for the inspecting officer.

ii) Cross section of the RBMV super imposed on IR maximum moving dimensions envelope shall be provided to IO in advance.

iii) Clause by clause comments of the manufacturer is to be sent to Inspecting Official (IO) in advance for his review. Comments should state manufacturer’s conformity of compliance of each of the requirement stated in each clause, elaborating where necessary the details/manner in which the requirement has been complied. The proforma for the clause-wise comments is given below:

<table>
<thead>
<tr>
<th>Clause no.</th>
<th>Clause</th>
<th>Comments of Supplier/manufacturer</th>
<th>Comments of Inspecting Official</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

iv) Manufacturer’s Internal Quality Inspection Report of the RBMV.

v) Manufacturer’s quality certificate and/or test reports for bought out assemblies/sub-assemblies are to be provided to IO, containing serial number wherever applicable.

vi) Draft Inspection Report is to be prepared by the manufacturer, containing all annexure mentioned at clause 8.8.

vii) Details of arrangements made for checking Maximum Moving Dimensions for his approval. Supplier will incorporate amendments/further clarification in the above documents to the satisfaction of the Inspecting Officer keeping in view the Inspecting Officer’s comments, if any.

3.2 List of documents to be annexed in the draft Inspection Report should include:
i) Maker’s Test Certificate.

ii) Manufacturer’s Internal Quality Inspection Report

iii) Quality Certificates of Bought out assemblies/sub-assemblies

iv) Cross section of the RBMV super imposed on the IR MMD

v) Vogel's diagram

vi) List of spare parts to be dispatched along with the RBMV

vii) List of tools to be dispatched along with the RBMV

viii) List of Manuals, Drawings, Spare Parts Catalogues, etc. to be dispatched along with the RBMV, duly indicating the number of sets of each.

ix) Manufacturer’s certificate on standards followed for design of wheels and axles.

These above documents in soft & hard copies shall be part of final inspection report

4.0 ACCEPTANCE TEST:

In addition to verification of the various items of specifications covered earlier, the following tests shall be carried out in India at the purchaser’s premises by the purchaser’s nominee at the time of commissioning of the RBMV.

(i) Dimensional check of loading gauge, i.e. maximum moving dimensions, buffer heights, clearances, length of machine, bogie distance, clearance on curves etc.

(ii) Performance of crane as per Chapter-VI.

(iii) Testing for negotiability on 1 in 8½ turnouts.

(iv) Construction and engineering of the RBMV.

The pre-commissioning tests shall be completed and the machine shall be commissioned within 90 days of its arrival at the premises of the final consignee.

4.1 Should any modification be found necessary as a result of the tests, these shall be carried out by the supplier at his own expenses.

5.0 Speed Certificate:

5.1 Provisional Speed Certificate:

Whenever a new rolling stock is introduced in Indian Railways, a provisional speed certificate is issued by RDSO based on certain design parameters of the vehicle. Final speed clearance of the vehicle is given after conducting detailed oscillation trials of the vehicle, which is a time taking process. Therefore, issue of provisional speed certificate for the vehicle becomes a necessity and based on the same the approval of running of the vehicle on
Indian Railway track is taken from Commissioner of Railway Safety. For issue of provisional speed certificate, following actions are required to be taken by the suppliers.

a) **Current Supplier, whose models are approved:**

The supplier shall give details of the model, year of introduction in Indian railway, details of speed certificate issued, etc. The supplier shall certify that no change has taken place in the model being offered with respect to design of under carriage i.e. suspension system/ arrangement, wheel & axle assembly, bogie braking arrangement loading pattern of the vehicle etc and the distribution of axle loads, lateral forces, unstrung mass and braking force coming on rail is the same if, there is any change in above respect, the action shall be taken as detailed in Para (b) below.

b) **Current Supplier, whose models are not approved / or new:**

As soon as the supplier completes the design of the machine as per specification, the technical details as per Annexure (VIII A and VIII B) which in no case should be more than six months from signing of contract, shall be supplied to Track Machine and Monitoring Directorate of RDSO for processing of provisional speed certificate for the machine so that it can be permitted to move on track on case to case basis, more technical details (other than mentioned in Annexure VIII A and VIII B) can also be asked for issue of provisional speed certificate for the machine. The firm will also submit the technical details as per proforma placed at Annexure-IX for NUCARS vehicle dynamic simulation. The cost of NUCARS vehicle dynamic simulation is to be borne by the supplier.

c) **New supplier, whose models are new:**

The technical details shall be supplied as detailed in para (b) above.

5.2 **Final Speed Certificate:**

Final speed clearance of the vehicle is given after conducting detailed oscillation trials of the vehicle. For this purpose IR shall conduct running speed tests on the IR main line track on one of the RBMV supplied to them preferably within warranty period, in accordance with procedure outlined in Annexure-VII with the RBMV running up to speed 10% higher than the maximum speed mentioned in clause 1.3(ix) of chapter-II above.
Annexure-I

Diagram No. 1D (EDOT-2202)

MAXIMUM MOVING DIMENSIONS

1676mm GAUGE

NOTE-
ALLE DIMENSIONS ARE IN MILLIMETRES
EXCEPT WHERE OTHERWISE SHOWN.

LEVEL

102 MIN

305 MIN

1770

1875 MAX

1220 MAX

4265 MAX

3735 MAX

2633

1082

1676 GAUGE

3330 MAX

2440 MAX
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

I 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 & maximum permissible oil temperature of torque converter
7 Weight of transmission dry & with full supply

1.5 Reversing Arrangement
1 Method of reversing with full details
2 Ratio - forward & reverse

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

1.9 Hydraulic motor for crane operation
• Type (fixed / variable)
• Model
• Make
• Flow rate (LPM @ speed)
• Pressure settings
• Maximum permissible leak-off
• HP consumed

1.10 Power unit for crane operation
• Make & type of engine.
• Max. power and rpm.
• Details of filters used
• Type of cooling: air or water.
• Fuel tank capacity (litres)
• Overall dimensions: L x B x H
• Weight with frame, pump & power unit.

1.11 Crane particulars:
• Length of fully retracted jib from slew center from horizontal condition.
• Tail radius from slew center if any.
• Length of fully extended jib from slew center.
• Hoisting speed with full capacity load (Minimum)
• Derricking time from maximum to minimum operating radius with rated load.
• Telescopic time from full retracted to fully extended condition with rated load.
• Slew time for complete circle from rest.

---x---
TRACTIVE EFFORT Vs SPEED CURVE FOR
RAIL BORNE MAINTENANCE VEHICLE (RBMV)
## List of Equipment & Tools to be kept on RBMV

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description of items to be kept on RBMV</th>
<th>Length (cm)</th>
<th>Width (cm)</th>
<th>Height (cm)</th>
<th>Qty.</th>
<th>Unit Weight (Kg)</th>
<th>Total weight (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Walkie Talkie (04 sets in a box)</td>
<td>20</td>
<td>10</td>
<td>10</td>
<td>4 sets</td>
<td>01</td>
<td>04</td>
</tr>
<tr>
<td>2.</td>
<td>Portable field telephone</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>1</td>
<td>04</td>
<td>04</td>
</tr>
<tr>
<td>3.</td>
<td>Disc cutter</td>
<td>107</td>
<td>42</td>
<td>95</td>
<td>1</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>4.</td>
<td>Rail cutting machine</td>
<td>110</td>
<td>50</td>
<td>60</td>
<td>1</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>5.</td>
<td>Rail drilling machine</td>
<td>103</td>
<td>45</td>
<td>57</td>
<td>1</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>6.</td>
<td>Chamfering kit (Torque wrench, chamfering unit, box wrench etc. in a box).</td>
<td>130</td>
<td>20</td>
<td>20</td>
<td>1</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>7.</td>
<td>Rail welding equipment with hydraulic (mechanical tensor)</td>
<td>450</td>
<td>60</td>
<td>80</td>
<td>2 set</td>
<td>785(635)</td>
<td>1570 (1270)</td>
</tr>
<tr>
<td>8.</td>
<td>Weld Trimmer</td>
<td>117</td>
<td>37</td>
<td>55</td>
<td>1</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>9.</td>
<td>Rail profile grinder K-oil operated (electrical operated)</td>
<td>102</td>
<td>46</td>
<td>35</td>
<td>1</td>
<td>80 (30)</td>
<td>80 (30)</td>
</tr>
<tr>
<td>10.</td>
<td>4 no. off-track hand-held tamper with 2 generators Generator Set – Tools (brief case)</td>
<td>80</td>
<td>45</td>
<td>70</td>
<td>1 set</td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td></td>
<td></td>
<td>62</td>
<td>41</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Lifting jack-Hydraulic (mechanical)</td>
<td>30</td>
<td>16</td>
<td>25</td>
<td>4</td>
<td>21 (11)</td>
<td>84 (44)</td>
</tr>
<tr>
<td>12.</td>
<td>Lifting cum slewing device- TRALIS</td>
<td>70</td>
<td>80</td>
<td>60</td>
<td>2</td>
<td>60</td>
<td>120</td>
</tr>
<tr>
<td>13.</td>
<td>De-stressing items (complete set for de-stressing 3 km LWR)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.1</td>
<td>Rail Tensors- Hydraulic (mechanical)</td>
<td>170</td>
<td>40</td>
<td>30</td>
<td>2 sets</td>
<td>350(200)</td>
<td>700(400)</td>
</tr>
<tr>
<td>13.2</td>
<td>600 rollers, (one roller @ 10 m) (in a box) (for 3 km)- (for 1 km)-</td>
<td>110 (110)</td>
<td>30 (30)</td>
<td>312 (104)</td>
<td>1 set</td>
<td>1500</td>
<td>1500</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.3</td>
<td>30 wooden mallets</td>
<td>92</td>
<td>28</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>PWI Inspection kit including vernier, micrometer, rail thermometer, etc, having 26 items</td>
<td>50</td>
<td>10</td>
<td>38</td>
<td>1</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>15.</td>
<td>Gauge-cum-level</td>
<td>185</td>
<td>8</td>
<td>7</td>
<td>1</td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>16.</td>
<td>Rail dolly</td>
<td>323</td>
<td>80</td>
<td>94</td>
<td>6</td>
<td>80</td>
<td>480</td>
</tr>
<tr>
<td>17</td>
<td>Rail (mono) cum road trolley</td>
<td>65</td>
<td>40</td>
<td>30</td>
<td>2</td>
<td>18</td>
<td>36</td>
</tr>
<tr>
<td>18.</td>
<td><strong>Warning system consisting of</strong></td>
<td></td>
<td></td>
<td></td>
<td>1 set</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>18.1</td>
<td>Red banner flag</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>18.2</td>
<td>Red hand signal lamp</td>
<td>30</td>
<td>25</td>
<td>25</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>18.3</td>
<td>Green hand signal flag</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>18.4</td>
<td>Detonator (In a Box)</td>
<td></td>
<td></td>
<td>10</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>18.5</td>
<td>Remote control hooter</td>
<td>25</td>
<td>12</td>
<td>25</td>
<td>1</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>19.</td>
<td>Gas cutting equipment with accessories</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>A.</td>
<td>Weight of equipment excluding de-stressing material as mentioned in item no.13</td>
<td></td>
<td></td>
<td></td>
<td>2908(2505)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Weight of equipment excluding off-track tamper materials as mentioned item no.10, 11 &amp; 12</td>
<td></td>
<td></td>
<td></td>
<td>4712 (4062)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Additional weight of equipment T&amp;P, manpower normally to be loaded on the RBMV</td>
<td></td>
<td></td>
<td></td>
<td>2081</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Design Weight (A+C)</td>
<td></td>
<td></td>
<td></td>
<td>(4989)-5t</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**

i) During de-stressing, fastening will also be required for casual/through renewal. The same will be transported separately.

ii) The Gang tools like crow bars, hammer, beaters, rail tongues etc. required for de-stressing work will be transported separately.

iii) It is assumed that during de-stressing work, the item listed at sl.no.10, 11 & 12 shall not be used. Also T&P required for 1.0 km of de-stressing shall only be taken to site.

iv) It is assumed that de-stressing work is not required for the whole year. As such the items listed at sl.no.13.1 and 13.2 shall not be required to be taken to site all the time. With 5t design payload capacity, and minor adjustment of T&P, machines etc, required for specific site, it will be possible to take care of most of the situation for which the RBMV shall be use.

(Track Machine and Monitoring Directorate )

Spec. of RBMV-2018  Page 53 of 60
### ADDITIONAL LIST OF EQUIPMENT, TOOLS & MANPOWER NORMALLY REQUIRED FOR MMU-1
### ALONG WITH THEIR WEIGHT TO BE LOADED ON RAIL BOUND MAINTENANCE VEHICLE F(RBMV)

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Description of items to be kept on RBMV</th>
<th>Length (cm)</th>
<th>Width (cm)</th>
<th>Height (cm)</th>
<th>Qty.</th>
<th>Unit Weight (Kg)</th>
<th>Total weight (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Manpower</td>
<td></td>
<td></td>
<td></td>
<td>15</td>
<td>65</td>
<td>975</td>
</tr>
<tr>
<td>2</td>
<td>First-Aid Box</td>
<td>25</td>
<td>15</td>
<td>20</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>60 kg rails of 6.5m length/Glued joints</td>
<td>650</td>
<td>16</td>
<td>18</td>
<td>2</td>
<td>390</td>
<td>780</td>
</tr>
<tr>
<td>4</td>
<td>Gang tools</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.1</td>
<td>Crow bar</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>35</td>
<td>70</td>
</tr>
<tr>
<td>4.2</td>
<td>Rail tongs</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>4.3</td>
<td>Beater</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>4.4</td>
<td>Hand Claw</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>Fastening</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.1</td>
<td>ERC, Steel/GFN liners, rubber pads</td>
<td></td>
<td></td>
<td></td>
<td>5 each</td>
<td>1.4</td>
<td>7</td>
</tr>
<tr>
<td>5.2</td>
<td>SEJ bolt</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5.3</td>
<td>130 mm size bolts</td>
<td>30</td>
<td>30</td>
<td>20</td>
<td>4</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>5.4</td>
<td>Stretcher bar bolt</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>5.5</td>
<td>Wooden block + clamps</td>
<td>30</td>
<td>25</td>
<td>20</td>
<td>2+2</td>
<td>15</td>
<td>60</td>
</tr>
<tr>
<td>5.6</td>
<td>Joggle fish-plate (One 60 kg + one 52 kg)</td>
<td>64</td>
<td>4</td>
<td>12</td>
<td>1+1</td>
<td>32</td>
<td>64</td>
</tr>
<tr>
<td>5.7</td>
<td>One meter long fish-plate (One 60 kg + one 52 kg)</td>
<td>100</td>
<td>4</td>
<td>12</td>
<td>1+1</td>
<td>40</td>
<td>80</td>
</tr>
<tr>
<td>6</td>
<td>Grand Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2081</td>
</tr>
</tbody>
</table>
Annexure-VI

Tentative Layout of Store Rake

DETAILS OF STORE

PLAN

SECTIONAL ELEVATION
ACCEPTANCE CRITERIA DURING OSCILLATION TRIALS

The speed potential of the machine offered by the firm should be established based upon oscillation trials conducted in India. The tests will be conducted at a speed usually 10% higher than the maximum speed potential indicated by the firm for the machine under consideration and the following criteria satisfy for the same. For conducting the tests, a section of mainline track will be selected over which there is no temporary speed restrictions and which is considered by the Railway as being in a generally run down condition for mainline standards, but without speed restrictions. The vehicle will be tested generally for new and worn clearance conditions and where relevant for operation in the forward and backward directions. The vehicle selected for tests will be one in average condition for normal maintenance. The criteria to assess the performance of the RBMV in oscillation trials will be as applicable in Indian Railways at the time of actual oscillation trials. However, the criteria applicable at present are given below:

1. A lateral force lasting more than 2 metres should not exceed the Prud Home’s limit of $0.85 \left(1 + \frac{P}{3}\right)$ tonnes, where $P$ is the axle load in tonnes.

2. Isolated peak values exceeding the above limit are permissible provided the record shows stabilizing characteristics of the vehicle subsequent to the disturbances.

3. A derailment coefficient should be worked out in the form of ratio between the lateral force ($H_y$) and the wheel load ($Q$) continuously over a period of $1/20^{th}$ second, the value of $H_y/Q$ shall not exceed 1.

4. The values of acceleration recorded in the cab at location as near as possible to the bogie pivot (as near as possible to axle in case of 4-wheelers) shall be limited to $0.55$ $g$ both in vertical and lateral directions.

5. The peak values up to $0.60$ $g$ may be permitted, if the records do not indicate a resonant tendency in the region of peak value.

6. In case of such vehicles where measurement of forces is not possible, evaluation shall be in terms of ride index, based on the accelerations measured as detailed in para 4 above, which shall not be greater than 4.50, but a limit of 4.25 is preferred.

7. A general indication of stable running characteristics of the whole vehicle as evidenced by the movements of the bogie in straight, station yard and curved track and lateral force and derailment coefficient or accelerations as the case may be.
Annexure-VIIIA

Particulars required in respect of the RBMV under consideration

1. A diagram showing elevation salient dimensions:
   a) **Wheel spacing, Wheel diameter, bogie centres, and axle load.**
      i) Overall length of the vehicle :
      ii) Length over head stock :
      iii) Length over buffers :
      iv) Distance apart for Centre of buffers :
      v) Max./Min. height of centers of buffers above rail level
   b) i) Wheel base
      ii) Axle load (max)
      iii) Bogie Centres :

2. Wheel dimension :
   i) New :
   ii) Worn out :

3. i) Tread and flange profile of the wheel indicating clearly whether it is Indian Railway standard profile or differs from standard flange profile.
      ii) Wheel gauge dimension – (back to back of tyre flange).

4. Whether the stock is designed to be used as a general purpose or in a closed circuit in specified sections under defined conditions.

5. Maximum design speed
   i) Own Power :
   ii) In train formation :

6. Unsprung weight per axle in tonnes
   i) Driving axle :
   ii) Running axle :

7. Expected lateral force in tonnes per axle At maximum design speed.

8. Increase in the impact load during motion (Dynamic Augment)

9. Method of operation -
   Whether single only or coupling together is possible. If coupling is possible, the number which can be coupled and what is trailing load.

10. Maximum tractive effort at start and at the speed of operation -
    i) At working drive at start :
       at operation speed :
    ii) At transfer drive at start :
       at maximum speed :
11. Maximum braking force coming on to the rails per wheel
   At working axle : 
   At transfer axle : 

12. Drawing indicating suspension arrangement details of bogie and axle.

13. Height of centre of gravity from rail level

14. Height of floor from rail level

15. Type of coupler provided - Indian Railways Standard

   Coupling : 
   Buffer : 

16. Any infringement to the moving dimensions Sketch provided in the Indian Railways
    Standard Schedule of Dimensions – Chapter IV (A).
**Annexure-VIIIIB**

Following information as detailed below is also required along with the information required for processing the case for issue of provisional speed certificate for new vehicles to be introduced on IR

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>a)  Brake System details  &lt;br&gt; b)  Gross Braking Ratio</td>
</tr>
<tr>
<td>2.</td>
<td>Brake rigging arrangement drawing and calculation of braking force</td>
</tr>
<tr>
<td>3.</td>
<td>Maximum Braking Effort. at start and at the speed of operation -  &lt;br&gt; a) at working drive  at start  :  &lt;br&gt; at operation speed  :  &lt;br&gt; b) at transfer drive  at start  :  at maximum speed  :</td>
</tr>
<tr>
<td>4.</td>
<td>Characteristics of springs used in suspension indicating free height, working height, dynamic range, stiffness and locations etc.</td>
</tr>
<tr>
<td>5.</td>
<td>Characteristics of the dampers if used, and over all damping factors and locations of dampers.  &lt;br&gt; Calculation of the following frequency of the vehicle to be attached :-  &lt;br&gt; i) Bouncing  ii) Pitching  iii) Rolling  &lt;br&gt; Wave length of free axle and bogie</td>
</tr>
<tr>
<td>6.</td>
<td>Write up and salient design calculations on suspension system, type of suspension whether it is of coil suspension with or without dampers and laminated bearing springs and double link suspension.</td>
</tr>
<tr>
<td>7.</td>
<td>What are lateral clearance of axle box / horn, wheel flange/rail and other locations for the negotiability of the vehicle on curve and turn out (enclose Vogels Diagram for negotiability on maximum degree of curve and turn out permitted on Indian Railways) of new and worn out wheel.</td>
</tr>
<tr>
<td>8.</td>
<td>Wheel and axle assembly drawings</td>
</tr>
<tr>
<td>9.</td>
<td>Calculation for flange force</td>
</tr>
<tr>
<td>11.</td>
<td>Calculation of natural frequency</td>
</tr>
<tr>
<td>12.</td>
<td>Calculation of spring characteristics and critical speed of the vehicle.</td>
</tr>
<tr>
<td>13.</td>
<td>Simulation result showing ride index, lateral force and acceleration results.</td>
</tr>
<tr>
<td>14.</td>
<td>A certificate regarding the speed of the vehicle for which it has been designed.</td>
</tr>
</tbody>
</table>
Annexure-IX

INSPECTION CERTIFICATE OF INSPECTION OF RBMV (__________) BY INSPECTING OFFICIAL AND APPROVAL FOR DESPATCH OF RBMVS

(STRIKE OUT WHICHEVER NOT APPLICABLE)

This is to certify that I have inspected the RBMV (type)__________________________bearing Sl.No.__________________from (date) __________ to __________ at (Place) __________ for its conformity/non-conformity with respect to the laid down Technical Specifications in contract Agreement No._________________________ dated ______________________ between President of India through Director/ Track (P) and M/s. (Name of Supplier) ________________________________ ________________________________.

The detailed Inspection Note regarding its conformity/non-conformity to the laid specifications is to be enclosed along with this certificate. It is observed that (strike out whichever is not applicable):-
The RBMV conforms to all the laid down specifications except those at Sl.No._________________________.
The above deviations are minor/major affecting/not affecting the performance of the equipment in substantial way.

The following T and P/manuals/drawings are to be supplied along with the RBMV:

________________________________________

________________________________________

Based on the above, the RBMV is certified/not certified to be conforming to the specifications.

The RBMV is approved/not approved for despatch to ________________

__________________________ (Consignee) Indian Railway.

SIGNATURE AND DATE

For M/s.__________________________ INSPECTING OFFICIAL

________________________________________ (NAME AND DESIGNATION)

For and on Behalf of President of India