TECHNICAL SPECIFICATION FOR RAIL BORNE MAINTENANCE VEHICLE (RBMV) FOR BROAD GAUGE (1676 mm)

(*Specification No.TM/HM/RBMV/422 Rev.02 of 2022*)

1.0 GENERAL

1.1 3-tier System of track maintenance shall be adopted on Indian Railways for mechanized maintenance as per Indian Railways Permanent Way Manual. In 3 tiers of track maintenance, one is Mobile Maintenance Units (MMU). The MMU shall be equipped with small track machines, tools & equipment used for day to-day track maintenance. To accommodate and transport these equipment and track workmen at worksite each MMU shall be provided with one self- propelled vehicle. This specification has been framed to reflect the technical performance and quality requirements of such vehicle, hereinafter called Rail Borne Maintenance Vehicle (RBMV).

1.2 The technical specifications have been drafted to reflect the performance and quality requirements of the RBMV in a neutral manner without bias to any specific manufacturer. Bidders are requested to carefully study the specifications and assure that their machine fully comply with these specifications. Thereafter, if a bidder feels that his machine can substantially meet the performance and quality requirements of the machine but does not fully satisfy a particular specification, he shall mention the deviations if any, in the statement of deviation from the specifications, giving the details how the functional requirements are going to be met with.

1.3 The bidder shall specify the make/model offered and furnish a detailed technical description of the same. System/sub-systems of the working mechanisms of the machine as per para 3.0 in particular and all the items of the specifications in general shall be described in detail, along with the sketches to show the manner in which the requirements of the specifications are accomplished by the RBMV (model) offered.

1.4 Photographs and videos of the type of the RBMV offered, in working mode and technical literature shall be enclosed with the offer. The photographs shall also show close-ups of various working assemblies/systems and the full RBMV. The tenderer shall also furnish compact disc or DVD or USB showing the working of RBMV under field conditions. Tenderer shall also submit the names of countries & railways where the offered machines are working and where their working at site can be visited by Indian Railways officials.

1.5 The bidder 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 bidder.
- Of his sub-bidders for materials, components & sub-assemblies.
- Of other parts of the work involved in the contract.
- Of the tests carried out by the bidder/Sub-bidder or RDSO or the Inspecting Officer.

2.0 DIMENSIONAL AND OPERATING REQUIREMENTS

2.1 The RBMV shall be self- propelled diesel-powered, 8-wheeler bogie type vehicle with bi-directional operation and diesel hydraulic or diesel electric drive. The RBMV shall be robust, of latest design, reliable and suitable for working on the Indian Railways Broad Gauge (1676 mm Gauge). The design and dimensions of the machine components shall be to metric

standards and shall comply with provision of Indian Railways Schedule of Dimensions-1676 mm gauge (BG), revised, 2022 incorporating all correction slips/amendments. Quality assurance during manufacturing of the RBMV shall be according to ISO-9001. The welding standard followed for manufacturing of machine shall conform to ISO: 3834/EN: 15085 or any other equivalent standard for welding railways vehicles and components. The manufacturer shall specify the standard followed and certify that it meets the welding standard mentioned above. The RBMV shall be suitable for working on straight, transition, curved track (up to 10º) and on turn out Broad Gauge (1676 mm) of Indian Railways.

2.2 The profile of the RBMV (including its units) longitudinally and in cross section during transfer as self-propelled vehicle or towed in train formation shall be within the maximum moving dimension shown in the Indian Railways Schedule of Dimensions-1676 mm gauge (BG), revised, 2022 incorporating all correction slips/amendments. The maximum moving dimensions are shown in Annexure-I. The tenderer shall provide sketches of the RBMV, both in plan and elevation and shall give calculations for moving dimensions on 10º curves to show the extent of lateral shift at the ends, centre and any other relevant cross section to prove that the RBMV does not cause any infringement while moving on a 10º curve at any cross-section.

2.3 In the past Indian Railways have condoned certain infringements to the Indian Railways Schedule of Dimensions-1676 mm gauge (BG), revised, 2022 incorporating all correction slips/amendments of such dimensions as rigid wheel base, length of stocks, distance apart of bogie centres and maximum height of floor above rail level in certain track machines after due consideration of their design features vis-à-vis safety and operational requirements of Indian Railways. However, condonation of an infringement in another track machine in the past does not by itself entitle the manufacturer to assume acceptance of the same in other track machines by Indian Railways. Where an infringement to Indian Railways Schedule of Dimensions-1676 mm gauge (BG), revised, 2022 incorporating all correction slips/amendments is considered necessary by the manufacturer as intrinsic to the design of the machine for meeting the work performance requirements laid down in this specification while meeting the safety and operational requirements of Indian Railways, the condonation of the same may be permitted by Indian Railways. However, only those infringements which are acceptable shall be permitted.

2.4 Adequate clearance shall be allowed so that no component/part infringes the minimum vertical clearance of 91 mm from rail level while travelling on track up to condemnation limit of wheel.

2.5 Wherever applicable axle load of RBMV shall be less than 20.32 t with minimum axle spacing of 1800 mm while moving on track. Load per meter shall not exceed 7.67 t. Axle loads up to 22.82 t and lower axle spacing may be permitted provided the load combinations do not cause excessive stresses in the track and bridges of Indian Railways. Stresses in the track and bridges shall be calculated by IR/RDSO based on design data submitted by the firm as per Annexure–VII and decision of IR/RDSO shall be final in this regards.

2.6 The floor height of the open platform shall be within minimum 1145 mm (loaded) to maximum 2100 mm (unloaded).

2.7 It shall have a desirable wheel diameter of 914 mm (new wheel profile). However, lesser diameter up to 763 mm (new wheel profile) can also be considered, provided it meets the criteria condition laid down in Clause 2.4 & 2.5 at its condemnation limit as per design and provided the rail wheel contact stresses for 72 UTS rails are within permissible limits. Forged wheels to Indian Railways profile shall be provided on the machine. It is desirable

that 50 mm margin between new and permitted worn wheel diameter are available, but this should not be less than 30 mm. The worn out wheel diameter (condemning worn out diameter) based on the criteria of rail wheel contact stresses for various maximum axle loads are as under:

Maximum Axle load(tone)	Minimum worn out wheel diameter(mm)
22.82	908.00
22.00	878.00
21.50	860.00
21.00	841.00
20.32	816.00
20.00	805.00
19.50	787.00
19.00	768.00
18.50	750.00
18.00	732.00
17.50	713.00

Permitted worn out wheel diameter should be specified by the manufacturer. The diameter of wheel for assessment of permitted axle load will be the worn out wheel diameter.

2.8 The new wheel profile in the machine shall be as per Indian Railways standard drawing attached as Annexure-III which is titled as "WORN WHEEL PROFILE."

2.9 Wheels shall be conforming to Indian Railways Standard R-19/93 or European Standard EN13262 and design shall duly conform to European Standard EN 13979. The supplier shall mention the standard followed & shall submit certificate for detailed design calculation along with material parameters at the time of supply of the machine. However, in case of wheels sourced from RDSO approved Indian suppliers, Inspection certificate of the wheels to be provided in lieu of design and material parameters certificate.

2.10 The non-powered axles shall be conforming to Indian Railways Standard R-16/95 or European Standard EN 13261(EA1N). The supplier shall submit certificate for detailed design calculation along with material parameters at the time of supply of the machine. However, in case of non-powered axle sourced from RDSO approved Indian suppliers, Inspection certificate of the non-powered axles to be provided in lieu of design and material parameters certificate.

2.11 The powered axles shall be conforming to Indian Railways Standard R-43/92 or European Standard EN 13261(EA4T).The design shall conform to EN: 131031:1:2017 or latest. The supplier shall mention the standard followed & submit certificate for detailed design calculation along with material parameters at the time of supply of the machine. However, in case of powered axle sourced from RDSO approved Indian suppliers, Inspection certificate of the powered axles to be provided in lieu of design and material parameters certificate.

2.12 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 $3X10^6$ km (3.0 million km) when computed as per method given in ISO Standard 281/1.

2.13 It shall be capable of negotiating curves up to 10^o curvature (175 m radius), super elevation up-to 185 mm, maximum cant deficiency 100 mm and gradients up-to 1 in 33 in travel mode. The supplier shall specify the minimum attainable speed by the machine under the above limiting conditions.

2.14 It shall be capable of continuous operation during the varying atmospheric and climatic conditions occurring throughout the year in India. The range of climatic conditions is as follows:

Ambient temperature	:	-5º C to 55ºC
Altitude	:	up-to 1800 m above mean sea level
Humidity	:	up-to 100%
Maximum rail Temperature	:	70ºC
Rain fall	:	Fairly heavy
Atmospheric condition	:	Very dusty, heavy fog

All the system components on the machine, which are vulnerable to moisture ingress and adversely affected during rains, shall be covered by roof or suitable arrangement so that the machine is able to work continuously even during rains.

2.15 During transfer from one station to another (self-propelled travel mode without trailing load), it shall be capable of travelling on its own speed at 100 kmph. It shall be capable of being hauled in train formation at a speed not less than 100 kmph. It shall be capable of hauling one or more empty/loaded wagon or 8 wheeler coach (maximum trailing load of 65 MT) at a speed not less than 100 kmph. It shall be able to negotiate steepest gradient of 1 in 33 prevailing on Indian Railways with this trailing load. During towing of the machine (RBMV), simple neutral position of gears shall be sufficient. No opening of cordon shaft etc. shall be required.

2.16 For re-railing, 2 freely accessible lifting points (for hydraulic jacks, lifting jacks or cranes) are to be fitted on each of the long sides of the vehicle for recovering the vehicle with attached wheel sets. All lifting points incl. box structure are to be provided with a lifting plate (size: min. 200x100 mm) and are to be designed in such a way that no permanent deformations occur in case of uneven lifting (e.g. when re-railing). The re-railing concept must be documented.

2.17 It shall be capable of working and travelling without requiring power block in electrified sections except while lifting the swivelling platform for inspection of FOB/ROB mentioned in clause 3.8. On Indian Railways, 25 KV or 2x25 KV AC power supply is used for traction through an over head wire at 5500 mm above rail level. On bridges and tunnels, the height is restricted to 4800 mm.

2.18 The complete machine must be designed and manufactured in accordance to the Fire safety norm EN 45545-2 incl. hydraulic hose, cables, seats and interior. All Cabin openings where cables are passing through shall have fire resistant cable gland systems in accordance to EN45545-2. Cables shall also confirm to EN 50264 (excluded for cranes and access platform).

2.19 Provision for protective earthing against electrical hazard shall be in line with EN 50153: Railway applications - Rolling stock - Protective provisions relating to electrical hazards. All electrical equipment shall be provided with essential interlocks & keys as may be adequate to ensure the protection of the equipment and the safety of those concerned with its operation and maintenance.

2.20 While working on double/multiple line sections, it shall not infringe the adjoining track and it shall be possible to permit trains at full speed on that track. Minimum spacing of track is 4265 mm centre to centre. The RBMV or its any part shall not infringe adjoining track as per Indian Railways Schedule of Dimensions-1676 mm gauge (BG), revised, 2022 incorporating

all correction slips/amendments, during travelling or its operation including opening and closing of the work.

2.21 The RBMV shall be capable of carrying pay load of 15 t. The description 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.

2.22 The General layout of RBMV shall be in accordance with tentative layout placed at Annexure-XII. 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. It shall be powered by under slung diesel engine transmitting power through hydrodynamic transmission and Cordon shaft(s) to the axle drive mounted on the inner axle of each bogie.

2.23 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 (g being the acceleration due to gravity)	:	2.0 g

3.0 WORKING MECHANISM:

3.1 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 8.5 to 1 in 16) as per IRS layout.

3.2 There shall be a loading platform on the RBMV itself so that it is possible to carry minimum 2 rails of 13 m length each with weight per unit length of 60 Kg/m, two sets of switch and stock rail assembly along with fittings and CMS crossings along with equipment. Dimension of the Rails, CMS crossings and equipment to be carried on RBMV platform in Annexure-IV/A, Annexure-IV/B, Annexure-X/A and Annexure- X/B without infringing the maximum moving dimensions.

For rail transport, it should be possible to transport the rails longitudinally in the main machine frame or on the vehicle. For fixing of the rails a mechanical locking system shall be installed to avoid the movement of Rails during travelling.

3.3 The loading platform shall be provided all-around with a collapsible sidewall/railing of about 450 to 600 mm height to protect the men and materials from falling.

3.4 The RBMV shall have a crane as per requirements indicated in clause 4.0 to handle heavy permanent way materials such as rails, sleepers, crossings switches and SEJs etc. The crane fixed on the RBMV should be capable of efficiently handling the equipment and materials to be carried on RBMV. All parts that are important for the function must be secured against self-acting changes.

3.5 There shall be well designed adequate space to store small track machines, tools and equipment as per Annexure-X/A and Annexure-X/B. 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-XI.

3.6 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. Easy-care seats made of non-absorbent, breathable and antistatic material. The width of the seat is at least 460 mm. An adjustable seat with backrest shall be provided for the driver's seat.

3.7 Two number of tool boxes shall be provided along the wall of store in the cabin or on the loading platform. These tool boxes 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.

3.8 There shall be provision of lifting and swiveling platform for inspection of the underneath of FOB/ROB, a lifting and swiveling platform with hydraulically operated mechanized adjustment for height and rotation and capable of taking minimum 280 kg load with under-noted features shall be provided over the roof. Control for lifting, lowering and swiveling shall be provided on the platform. The raising and swiveling of the platform shall be gradual and without jerks. In addition two emergency stop switches shall be provided on each side of the platform to bring the RBMV to an emergency halt. Two search lights of 24 V (100 w) halogen lamps with intensity of light as 55 lux at 3.20 m distance shall be provided on the platform for inspection of the ROB/FOB. Search lights shall be capable of swiveling on universal joints type support and swiveling control shall be on the swiveling platform. Mechanical locking arrangement shall be provided to avoid lifting of platform during running of RBMV. The traffic block and power block (on adjacent tracks also) is necessary for working of Inspection platform.

a.	Length of platform	4500 mm
b.	Width of platform	1500 mm
c.	Platform floor level above rail level when elevated	6150 mm
d.	Maximum lifting time to full height	45 s
e.	Rotation range of platform towards sides	90º
f.	Side shifting reach of platform	3200 mm
g.	Full height of collapsible railing above platform floor	1100 mm
h.	Maximum time of rotation from 0º position to 90º	45 s
i.	Electrical sockets for operating hand tools and work lights 1 X 24V, 16 A rating and the other 1 X 230 V 16A complying IP 44	2 nos.
j.	The track limitation should be achieved through a proximity switch which will be fitted with an addition to the slewing angle encoder. The mechanism should be fail safe. The said system should be provided without an option of overriding function.	Adjacent Track Limitation
k.	All hydraulic cylinders provided should be of double acting type, load holding valves have to be provided in the slewing rim and all cylinders.	
l.	The platform should be provided with a radio remote control for different functions.	
m.	The electrical cables should be routed through inside the boom of the platform. The connections should not hinder the 360º slewing of the platform from the column.	
n.	Eyelets in each corner of the swiveling platform for attaching operator's safety harness.	
o.	The platform should have interlocks with the vehicle so that the transport	

	position and operating positions is clearly communicated through a PLC system.

3.9 Since the RBMV is to work in dusty environment, all the components including gear boxes, 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 shall indicate these items in their offer.

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

3.11 The RBMV shall be capable of continuous running at 100 kmph on generally tangent track followed by frequent to and fro movement at crawling speed for 1.5 hour at 5.5 kmph.

3.12 A fault & its effect on the operation of the vehicle shall be indicated to the driver and recorded in the vehicle diagnosis and it shall also be possible to disconnect all drives of a vehicle in following conditions:

i) Speed control for driving at a constant speed on level track.
ii) Initiation of braking in dangerous situations.
iii) Crane not in basic position (exception: working mode).

4.0 CRANE

4.1 The RBMV shall have hydraulically operated type fixed crane mounted on it and the crane shall be without outriggers. The crane shall be of knuckle boom or pillar jib type with telescopic jib. The crane is to be equipped with a crane cabin, all controls for the crane should be able to be carried out from this crane cabin. The crane must be endlessly slew-able. All the cables, pneumatic lines etc., to be properly routed through the centre joint so that the cables, hose pipes etc., are not twisted while slewing the crane.

4.2 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.

4.3 The crane shall be equipped as follows:

- Radio remote control for all crane functions and vehicle creep speed
- Electronic prop and hoist load monitoring
- Overload cut-off
- Electrically switchable vertical and lateral movement limiter (Adjacent track limiter) complying to PLd according to EN 13849
- Key switch for three operating modes:

    a. Lift limitation 4.0 m from top of rail, with key switch
    b. Lift limitation 5.0 m from top of rail, with key switch
    c. Lift limitation off, with key switch

- Key switch for four operating modes:

a. Adjacent track limiter activated for left hand side
b. Adjacent track limiter activated for right hand side
c. Adjacent track limiter on activated for both hand sides
d. No adjacent track limiter activated.

- Manual control valve for all crane functions easily accessible from outside of cabin, without having to expose operators to oncoming traffic.

4.4 A radio remote control for crane functions and vehicle creep speed as per clause 4.3 above. The crane can be operated both with the crane radio remote control and with fixed control levers. The creep speed of the vehicle can be operated from the crane's radio remote control.

4.5 The crane shall be capable of lifting a load of 1 t at 8 m radius with endlessly slew-able; the lifting capacity should not be less than the given capacity at the specified radii even in the height limitation mode. Mechanical lock shall be provided to prevent the crane from swing away. 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 minimum 1.2 m 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 wooden blocks (if required) shall be supplied by manufacturer/supplier for steady transfer of load during operation of the crane.

4.6 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.

4.7 The crane operation shall be such that there is no infringement with overhead electric equipment and adjacent track by crane. 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.

4.8 The crane operation shall be arranged from both traction power packs and shall be operated with one of them at a time.

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

4.10 Provision shall be made to bring the crane as well as Inspection platform in folding condition in case of crane as well as traction power pack failure by electrically as well as manually operated pump.

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

4.12 The operation of crane shall be hydraulic. During movement of the RBMV the operation of the crane shall be strictly prohibited. Provision in the crane operation shall be provided so that no power from traction power pack shall be transmitted during movement of the RBMV.

4.13 The entire geometry of the RBMV including the track inclination is monitored in two axis. In combination with a real-time standard safety evaluation so that there is a continuous monitoring of stability of the unit at various radii and boom position.

5.0 DIESEL ENGINE:

5.1 Twin under slung power pack, each powered by fuel-efficient diesel engine of adequate capacity shall power RBMV. The diesel engine preferably indigenous with proven record of service in tropical countries with wide service network in India. Robust construction and low maintenance cost are particular importance.

5.2 Expected mean life to major parts of the engine for overhauling shall not be less than 8000 engine running hours. The tenderer shall indicate the continuous horse power at rated output of offered engine under site condition. Adequate allowance shall be made for de-rating of diesel engine under the most adverse climatic conditions referred in clause 2.14. Manufacturer of diesel engines, proposed to be provided on vehicle, shall have proven record of design manufacture & supply of engines for heavy duty industrial use/locomotives application/track vehicles application/self-propelled railway rolling stocks (with speed potential as needed for vehicle or more) application.

5.3 The supplier shall indicate the total horse power 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.

5.4 The engine shall be provided with a fly wheel mounted flexible coupling. The coupling shall be of adequate capacity to withstand high deflection and torque (at starting, stopping and due to any misfiring of the cylinders) so that no damage is caused to transmission and engine components in service.

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

5.6 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.

5.7 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.

5.8 The supplier shall furnish the information regarding make and model of the engine proposed to be used and details of agency which will provide after sales service support and availability of spares in India.

5.9 The diesel engine for RBMV and crane operation shall work satisfactorily with High speed diesel oil conforming to IS specification no.1460 (2005).

5.10 Fuel tank/tanks with adequate capacity sufficient for continuous operation of 8 hours shall be provided. Sight glass type fuel measuring gauge preferably of full height shall be provided on the fuel tank. However, fuel tank capacity shall not be less than 1000 liters to keep sufficient reserve for sudden unexpected movement of the machine.

5.11 Remote fuel tank level indicator in the driver's cab.

5.12 For starting the engine, storage batteries of well-known indigenous make with wide service network in India shall be provided. The engine shall normally be push/pull button start type or key type. A battery management system to be provided. It should report too low battery voltage to the vehicle driver and protects the battery from deep discharges. The capacity of the battery must be selected in such a way that, in the event of a battery charge failure and a 50% discharged battery, the vehicle should be able to drive for 30 minute with all safety and operational functions.

5.13 There is a likelihood of dust deposition over the engine body and surrounding area over the lubricants spills over. These locations shall be easy to accessible for daily cleaning and routine maintenance. For water cooled engines, the engine cooling radiator shall be easily accessible for regular maintenance like checking the coolant level and topping up of the coolant whenever necessary. Such maintenance activity shall not require the staff to climb up the machine roof. In case, air cooled engines are proposed by the supplier, maintenance equipment for cleaning and maintenance of the air cooling fins shall be provided by the supplier along with the machine.

5.14 Since the engine has to work outdoor under extreme dusty conditions, the air intake system shall be designed suitably so as not to allow dust through air intake system.

5.15 The engine parameter monitoring gauges like temperature, rpm, engine running hour and lub. oil pressure of electrical/mechanical type shall be provided in the operator's cabin showing the absolute readings along with safe limits suitably colored. There shall be audio visual warning (safety mechanism) to the operators in case of any of these parameters exceeding the safe limit to shut down engine automatically.

5.16 Suitable and rugged mechanism shall be provided to start the prime mover at no load and gradual loading after the start of the prime mover at no load/minimum load and gradual loading after the start of the prime mover. A fail-safe clutch mechanism, if required, may be provided to meet this requirement. The engine power take off shall be coupled to the main gear box through flexible/cordon shaft (propeller shaft). The engine shall be mounted on suitable Anti vibration mountings.

5.17 The engine shall have Electronic Control Module (ECM) or similar arrangement for taking out operating parameters on real time basis such as RPM, load, lube oil pressure, fuel consumption, temperature, pressure and diagnostic data as well as trip and historical data. These data shall be displayed and stored on a panel/PC to be provided in operator’s cabin. It shall also be possible to transfer these data on USB device

5.18 In order to adhere to pollution control norms, the diesel engine should have electronic emission control with minimum compliance of tier 2 stage/UIC-II/BS-II standard.

5.19 The tenderer shall furnish the information regarding make and model of the engine proposed to be used and details of agency which will provide after sales service support and availability of spares in India. If the machine design incorporates an engine, not already operating with the purchaser, the model of the engine is liable for change as per the technical requirements and the maintenance logistics with the purchaser after technical negotiations with the supplier. Nothing extra shall be payable on this account.

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

5.21 The exhaust pipe is to be provided with thermal insulation, which has good thermal insulation properties. The exhaust gases of the diesel engine must be discharged at the level of the undercarriage to the left or right side and swirled (no formation of heat spots).

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

5.23 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.

5.24 The air intake for compressors must not be located in bottom (i.e. above track).

5.25 An automatic air drying and drainage device shall be provided. The residual humidity of the compressed air shall not exceed the values required for the connected equipment. All air lines made of stainless steel.

6.0 TRANSMISSION:

6.1 The power shift transmission shall be hydrodynamic so that there is no wear and tear in field operation. The tenderer shall give the full technical data of the power transmission system. Electromagnetic compatibility (EMI/EMC) test certificate shall be submitted.

6.2 The power pack and transmission equipment shall be mounted on the under frame so that whole assembly occupies as little space over floor as possible.

6.3 Transmission shall be either step less or minimum 3 steps bi-directional with maximum speed possible in both forward as well as in reverse direction.

6.4 The transmission shall provide smooth shifting at full power while shifting to higher or lower steps.

6.5 The cordon shaft shall be of robust design and well proven in performance capability, suitable for transmitting rated horse power and maximum torque encountered during operation. The resultant angularity of cordon shaft shall be maintained within 5º.

6.6 The combined performance of the twin power equipment shall not be inferior to the tractive effort (TE) curve placed at Annexure–XIII. Supplier shall submit TE vs Speed curve superimposed with above curve with complete matching calculation of offered power equipment along with equipment layout drawing.

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

6.8 The protective earth connects all metallic parts (e.g. apparatus housing, machine body, work equipment) to the earth potential. To protect the axle bearings from current flow, the current is transmitted to the wheel set via earth brushes. The earth brushes shall be arranged in such a way that protective earthing via two wheels is ensured even in the case of tracks insulated on one side. The earthing concept shall be documented.

6.9 The machine shall be equipped with hot axle sensor for each axle and also adequate safety circuit such that if any unit/part which may endanger the safety are unlocked or the air

pressure in brake circuit is less than 5 bar, the machine shall not move during run drive. The indication of hot axle, locking and unlocking of all units shall be displayed in the cabin.

6.10 Indigenously available hydraulic oil and approved by OEM shall be used. Hydraulic tank of adequate capacity shall be provided at suitable location. Hydraulic hoses of proven make shall be used.

6.11 On board display for monitoring the quality of hydraulic oil in hydraulic circuit and filtration as required shall be provided. The gauge shall clearly indicate if the hydraulic oil is contaminated beyond the permissible limits and requires immediate replacement.

7.0 COOLING SYSTEM:

7.1 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 horse power input to the transmission under most adverse site conditions.

7.2 The fan and the cooling arrangement shall be of adequate capacity to cope up with the service demands under the most severe temperature conditions. The maximum water temperature shall not normally exceed 85º C, the safe operating temperature of the engine. The system shall be adequately pressurized and vented to avoid all possibilities of cavitations. The complete technical details of the Radiator and its fan shall be furnished.

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

8.0 BRAKES

8.1 The self-propelled RBMV shall be provided with twin pipe graduated release compressed air brake system so that while attached in train formation as last vehicle, RBMV can be braked by the traction vehicle having air braking system.

8.2 No environmentally harmful substances that are hazardous to health may be used in the brake lining. The brake pad holders must ensure proper securing of the brake pads and enable simple quick replacement.

8.3 The RBMV shall be fitted with compressed air brakes system which shall apply brake equally on all wheels which can be applied from driving cabins and provision shall be made to connect air brake system of the machine to that of coach/attached wagon when the RBMV is hauling it. Fail safe braking mechanism system shall be provided so that in case of any failure of brake, there shall be arrangement of automatic application of brake. The brakes shall be protected from ingress of water, grease, oil or other substances, which may have an adverse effect on them. The brake shoe lining shall be suitable for high ambient temperature of 55º C. The force required for operating the brake shall not exceed 10 kg at the handle while applying by hand and 20 kg on the pedal, when applied by foot.

8.4 The spring loaded pneumatic parking brake shall be provided as per RDSO specification no. C-K 408 with latest amendments.

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

8.6 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-0.03), 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 cabin the extreme right hand side
IV. Stand by brakes, in case of failure of distributor valve or any component in the brake system.
V. Mechanical brakes shall also be provided for parking.

8.7 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.

8.8 The supplier shall submit details of brake system covering brake schematic diagram, working principle, brake power diagram, number, dimension & type of brake block and literature on brake equipment proposed along with offer.

8.9 There shall be provision of mechanically operated emergency brake application (operated by a hand lever) in both driver end cabins using the compressed air in the machine, either travelling alone or coupled with the camp coach or loaded wagon, in addition to the normal braking system of the machine. The emergency braking distance (EBD) of the machine (fully loaded i.e. maximum 20.32x4=81.28 t) on the Indian Railways track at the maximum designed speed to zero on a level track shall not be more than 800 m. In this regard necessary design calculations for the braking effort and EBD at the maximum design speed of the machine on level track & at falling grade of 1 in 33 shall be provided by the supplier. Brake design details of the RBMV for calculation of EBD are to be submitted as per Annexure-V.

8.10 Clearly visible brake lights shall be provided at both the ends of the machine, which will be automatically operated when brake is applied and switched off when brake is released. This will be required to alert the operator of machine following this machine when the machines are working in groups.

8.11 The braking system shall be designed so as to meet the air reserve requirement for repeated braking as required in normal operation. In addition, the machine shall be equipped with suitable air brake system in the driving cabins so that the coach while being hauled by the machine can be braked.

8.12 An annexure containing functional requirement on the Brake system of the vehicle is attached as annexure XIV.

9.0 HORN, HOOTER AND SAFETY SWITCHES

9.1 The RBMV shall be provided with dual tone (low tone & high tone) electric/pneumatic horns facing outwards at each end of the RBMV at suitable locations for use during travelling to warn the workmen of any impending danger. Control shall be provided in close proximity to the driver permitting the driver to operate either horn individually or both horns simultaneously. The horns shall be distinctly audible from a distance of at-least 400 m from the machine and shall produce sound of 120-125 dB(A) at a distance of 5 m from horn (source of sound). The higher tone horn shall have fundamental frequency of 370 ±15 hertz. These horns shall be operated by means of push buttons provided in the cabins.Minimum

two nos. safety stop/switches in front on both side and two nos. in rear on both side should be provided all around so that in case of any danger to worker as well as hitting of any obstructions by working unit like signaling cable, joggle fish plate etc. during working, the working can be stopped immediately.

9.2 In addition, separate electric horns with push button type switches shall be provided at suitable locations in all cabins(s) and on machine body for communication between the machine staff and operator about infringement/malfunctioning or any other trouble.

9.3 Pneumatically/electrically operated hooters capable of producing sound of intensity between 105-110 dB(A) at a distance of 5 m (when measured in still air in a closed room) with variation in intensity of sound not more than 5 dB(A) shall be provided. The hooters shall be provided facing outwards at each end of the machine at suitable locations, operated by means of push buttons provided in the cabins to warn the staff working on/around the machine about approaching train on adjoining track. Additionally switches for such hooter shall be provided outside on the machine frame and near the both side exit gates so that it can be operated by staff present at work site near the machine. The hooter shall also be operable by remote switch at a distance of at least 300 m from the hooter.

9.4 Safety equipment like jack, pullers, tirfor and other such equipment specific to the machine for restoring failed units of the machine during working, shall be provided on the machine.

10.0 HOOKS AND BUFFERS:

10.1 The RBMV shall be fitted with transition coupling as per RDSO specification no. RDSO/2009/CG-22 with latest revision along with side buffers to RDSO drawing no. RDSO/SK-98145 with latest alteration on both ends for coupling it with trailing wagons, coach &locomotives while running in train formation as last vehicle. As per Indian Railways schedule of Dimensions, the maximum and minimum height of the buffer centre from rail level is 1105 mm and 1030 mm respectively.

11.0 HEAD LIGHT, FLASHER LIGHT, MARKER LIGHT AND OTHER LIGHTING ARRANGEMENTS:

11.1 The electrical equipment provided shall conform to relevant standard specifications and suitable for Indian climatic conditions. The RBMV shall be equipped with twin beam LED headlight assembly, conforming to RDSO's specification no. RDSO/2017/EL/SPEC/0134 (Rev-2) with the latest amendments ensuring a light intensity of 4.8 lux at ground level at track centre at a distance of 305 m away on a clear dark night, at each end and with two front and rear parking lights, which can be switched to red or white according to the direction of the travel. Powerful swiveling floodlights shall also be provided to illuminate the working area sufficiently bright for efficient working during night. In addition minimum eight power point locations (24 volt DC/15 amp socket) shall be provided on outside frame of the machine two in front, two in rear and two on both sides for providing lighting arrangements during night working. Preferably electric power of 24 V shall be used for operation of any electrical circuit.

11.2 The amber colour LED based flasher lights producing not less than 500 lux at 1 m and 55 lux at 3 m in line measurement in axial direction from flasher light to RDSO Spec No. ELRS/SPEC/LFL/0017 (Rev-1) of Sept-2004 or latest shall be provided at both ends in the machine to give indication to the train arriving on other line about any impending danger.

11.3 The machine shall be provided with marker light to RDSO specification no. is ELRS/SPEC/PR/0022, (Rev-1) October-2004 or latest.

11.4 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.

12.0 CHASSIS & UNDERFRAME:

12.1 The chassis shall be fabricated from standard welded steel sections and of steel sheets, so as to permit transportation of the RBMV in train formation as the last vehicle, without endangering safety of the train. The under-frame shall be constructed with rolled steel section and/or plates shall be designed to withstand a horizontal squeeze load of 102 t at CBC rear stops or 51 t at each buffing point without any permanent distortion. The under-frame shall be sufficiently robust for safe travel of the machine in train formation and not necessarily as the last vehicle.

12.2 The squeeze load test certificate duly mentioning the brief technical procedure adopted for the test with test result should be submitted.

12.3 Suitable capacity of jacks along with hydraulic pumps, aluminium beams, and other accessories shall be provided for lifting and side slewing for re-railing of the machine in case of derailment.

13.0 CABINS:

13.1 The RBMV shall have both ends with driver’s compartment. The RBMV shall be equipped with fully enclosed cabins with safety glass window. One of these cabins is to be designed as a rotating crane cabin, which will enable the crane to be controlled and also contain all the controls for transfer travel. 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 as per UIC-651. Visibility diagram should be submitted along with the design details.

13.2 Injury reducing contours (e.g. sharp corners, cover strips, etc.) are to be avoided. Splinter-free semi-finished sheet and moulded parts are to be provided.

13.3 On the one hand, the interior must not cool down too quickly when outside temperatures are low; on the other hand, excessive heating of the driver's cab by the sun and poorly shielded units must be avoided.

13.4 Entry & exit door to RBMV’s cabin shall open on the loading platform area so that the same operator can work easily in the cabin and on crane of RBMV both and he exits RBMV with good view of adjacent tracks.

13.5 The surfaces must be easy to clean (Hygiene).

13.6 Contact-friendly materials with low thermal conductivity must be used throughout the driver's cab.

13.7 Good sound insulation inside the machine shall be provided. It will largely dampens the penetration of air-borne and structure-borne sound (vibrations) and thus keeps the noise level low.

13.8 The side windows shall be insulating safety glass. The Roller blinds shall be in according to EN 45545-2. The design of the windows and fixing arrangement shall be as per EN 14067 to withstand the pressure from passing of Semi-High speed trains (Vande Bharat etc.)

13.9 The front windows of the driver's cab shall be equipped with a powerful, electrically driven windscreen wiper system with large wiper field, washer system and the following switching stages:

- Off
- Single wipe
- Interval (adjustable)
- Continuous operation slow
- Continuous operation fast.

13.10 The cabin shall have automatic fire/smoke detection systems. This shall be capable of detecting a smoke/fire in machine.

13.11 Suitable number (not less than 6) of fire extinguisher (dry chemical type) shall be provided in the cabins. Easily accessible fire extinguishers are to be installed in the cabins. The exact positioning is determined within the framework of the interior concept. The chemicals used for extinguishing fire by such fire extinguishers shall not chemically react with electronic equipment/components, PCBs, cables etc.

13.12 The gauges, warning panel, instruments and control panels shall be suitably located in the operator's cabin so that they can be observed without undue fatigue to the operator. Wind screen wiper arm and blade assembly to be provided as per RDSO Spec. No. C-K 306 with latest revision.

13.13 The driver’s seat shall be of the folding and swiveling type to permit the driver to manipulate the controls either while sitting or standing. The seat frame or swiveling 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-K 607 with latest revision properly vented and upholstered with covering to RDSO specification no. RDSO/2008/CG-07 (Latest) or EN 45545.

13.14 Sitting space in the driving cab for 4 persons in addition to the driver. For this purpose a foldable cushion seat shall be provided.

13.15 Sitting space in each the crane cabin for 1 person in addition to the driver. For this purpose a foldable cushion seat shall be provided.

13.16 Necessary inter-communication system shall be provided inter-connecting all the cabins and should be so oriented that the operator, sitting in either cabin/working cabin, can distinctly hear the conversation and shall also be the provision of recording the conversation for inter-communication system. The volume control adjustment (preset) of inter-communication system shall be provided on amplifier (PCB).

13.17 Functionally related loads are to be protected by circuit breakers in order to keep the effects of faults low and to facilitate fault location.

13.18 The fire protection on machine shall be designed and constructed in accordance with EN 45545.The applicable Hazard level will be HL2, the supplier shall furnish the relevant fire load calculations in hard as well as in soft copy. One set shall be sent to the Principal/IRTMTC, Allahabad, one set to be sent to PED/Infra-1, RDSO, and Lucknow, one set to DTK (MC)/Railway Board and one set to Director General/IRICEN/Pune along with supply of first machine.

13.19 The machine shall be equipped with speed indicator and recording equipment of range between 0–120 kmph for recording the speed of the machine in real time basis. The equipment shall conform to RDSO specification no. MP-0-0.3700-07, Rev-04, Aug'17 or latest. The recorded data shall be retrievable on computer through memory card/pen drive. It shall be provided in the each driving cabin at suitable place and recording system should have sufficient memory to keep the speed record of minimum 15 days which should always be stored for retrieving as per requirement.

13.20 The electric supply in the cabin for operation of electrical instruments, gauges etc. shall not be more than of 110 V.

13.21 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.

13.22 The floor of RBMV in driver's cab and staff cabins shall consist of 2 mm thick PVC sheet to RDSO STR No. RDSO/2006/CG-12 (Latest) with 12 mm Compreg sheet to RDSO STR No.C-9407 (Latest) as padding below the PVC flooring sheet or according EN45545-2. At other places steel galvanized chequered plates of 6 mm thick shall be provided to IS:2062.

13.23 All cabins shall be air-conditioned.

13.24 Detachable type cattle guards shall be provided under each buffer beam. The cattle guard shall be fitted with adjustable rail guards so as to maintain the minimum free space above the rails under all conditions. Cattle guard shall be as per RCF Drawing No. EM26108 with Latest revision or similar.

14.0 SUSPENSION SYSTEM:

14.1 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. Effective measures shall be adopted to minimize the weight transfer while starting, stopping and during runs.

14.2 The suspension shall be tuned to avoid resonance vibrations in all speed ranges (independent of the load condition of the vehicles and the wheel wear).

15.0 TOOLS AND INSTRUCTIONS MANUALS:

15.1 Each RBMV shall be supplied with a complete kit of tools required by the operator in emergency and for normal working of the RBMV. The list of tools to be provided shall also include all tools necessary for maintenance and repair of the entire RBMV including

specialized equipment. All special tools shall be listed and catalogued illustrating the method of application.

15.2 The tenderer shall along with his offer, submit the list of tools, manuals, circuit diagrams and other technical literature/drawings in English language to be supplied along with each machine as above, for operation, servicing, maintenance, assembly overhauling, periodic overhauling and troubleshooting guides/manuals. The list can be modified to suit the purchaser's requirement, while examining the offer.

15.3 Detailed operating manual, maintenance & service manuals and user manual indicating capabilities of machine shall be specifically prepared in English language with colour and four hard as well as soft copies of these shall be supplied with each RBMV.

15.4 As a part of service manual, the manufacturer shall also supply circuit diagram in hard and soft copies of electrical, hydraulic, pneumatic and electronic circuits used on the RBMV. Trouble shooting diagram/table shall also be supplied. In additions, the manufacturer shall provide dimensional drawings with material description of items like rubber seals, washers, springs, bushes, metallic pins etc. and main features such as type; discharge etc of items like hydraulic pumps, motors and such other bought out components/assemblies shall be furnished by the tenderer. These shall be specially prepared in English language and four hard as well as soft copies of these shall be supplied with each RBMV.

15.5 The supplier/manufacturer shall provide detailed technical drawings and specifications of wheels and axles used on the machine (RBMV) along with detailed code of procedure for ultrasonic testing axles of all types and test report of wheels shall be submitted along with other documents. The above details shall be provided in four sets with each machine (RBMV).

15.6 While offering the RBMV for first inspection, the supplier shall submit one copy of complete technical literature in English including operation, service and field maintenance manuals/instructions, complete electrical, hydraulic and pneumatic circuit diagrams, troubleshooting charts, component drawings/description and other relevant technical details for keeping as a reference document for the inspecting officer.

15.7 One set of all the manuals and diagrams in hard as well as in soft copy (one set for a group of similar machines) shall be sent to the Principal/IRTMTC, Allahabad, one set for Chief Workshop Manager (Track Machines) CPOH Workshop, PO. Dhoomanganj, Prayagraj - 211011, one set for Chief Workshop Manager (Track Machines) CPOH Workshop, South Central Railway, Rayanapadu, Vijaywada, Dist.-Krishna, Andhra Pradesh-521241, one set for Chief Workshop Manager (Track Machines) CPOH Workshop, Eastern Railway, Bhutbagan Railway Colony, Kanchrapara, P.S: Bizpur, P.O.: Kanchrapara, West Bengal-743145, one set for Chief Engineer. C.P.O.H, Western Railway, Divisional Office, Near Chamunda Mata Mandir, Naroda Road, P.O. – Saijpur Bodha, Ahmedabad-382345,one set to be sent to ED/TMM, RDSO, Lucknow, one set to DTK (MC)/Railway Board and one set to Director General/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.

15.8 Draft copy of all documents to be supplied with the machine shall be sent 3 months in advance of inspection of the first machine to RDSO for their review regarding adequacy and manner of detailing. Necessary modifications and further detailing as per RDSO's comments shall be carried out and compliance shall be reported to RDSO as well as the Inspecting officer of the first machine.

15.9 One portable diesel operated D.C. welding generator (with the provision of auxiliary output of minimum 2.5 KW, 230 V AC for lighting) of reputed make (preferably made in India) with a minimum 7.5 KVA capacity capable of welding up to 5 mm (dia) electrode at 60% duty cycle shall be supplied. Sufficient length of cable or lead shall be provided with the machine of welding plant for day to day repairing work of the machine and its wearing parts. The diesel tank capacity shall be not less than 15 liters.

15.10 At the time of handing over the vehicle to the consignee Railways, minimum 1000 liter of HSD oil from manufacture's workshop/port will have to be supplied by firm along with vehicle.

15.11 First aid box with medicines & other items shall be supplied with each machine and shall be mounted at an appropriate place.

16.0 SPARE PARTS:

16.1 The tenderer shall quote, apart from main equipment, separately for the mandatory spares as well as for recommended spares required for two years i.e., working for about 2000 hrs of operation along with description, part number, quantity, cost, whether imported or indigenous. The expected life of components/spare parts shall be advised along with their condemning limits.

16.2 The manufacturer shall be responsible for the subsequent availability of spare parts to ensure trouble free service the life of the RBMV (25 years). It is preferred that the spares shall be stored in India and will be available at short notice say maximum within a month.

16.3 For indigenous parts and bought out components and assemblies, the source (original equipment manufacturer's reference and part no.) and other relevant technical details shall be supplied while offering the first RBMV for inspection.

16.4 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.

17.0 OPTIONAL EQUIPMENT:

17.1 Tenderer is expected to quote for optional equipment if any separately for each item giving the advantages/functions of such optional equipment. Tenderer shall also indicate whether such equipment are already in use on machine elsewhere indicating the user railway system.

18.0 MAKER'S TEST CERTIFICATE:

18.1 Copies of the Maker's certificate guaranteeing the performance of the RBMV shall be supplied in duplicate along with the delivery of each RBMV.

19.0 OPERATORS:

19.1 The number of operators and allied staff for working of the RBMV under normal condition shall be indicated, specifying their duties and minimum qualifications.

20.0 INSPECTION OF THE MACHINE:

20.1 While inspecting the machine before dispatch from the supplier's premises, the inspecting officer to be nominated by the purchaser shall verify the conformity of the machine with respect to individual specification as above. The conformity/non- conformity with respect to each item shall be jointly recorded before issue of the Inspection certificate and approval for dispatch of the machine as per Annexure–VI enclosed.

20.2 Following arrangements shall be made by the supplier/manufacturer at the inspection premises for carrying out inspection of the RBMV by inspecting official:

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

- In order to check maximum moving dimensions in cross section, a sturdy frame of Indian Railways 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.

20.3 The following documents shall be provided to the Inspecting Officer at least 30 days in advance of the date of inspection.

i) One copy of complete technical literature mentioned in clause 15, in English language, including operation, service and field maintenance manuals/instructions, user manual and complete electrical, hydraulic and pneumatic circuit diagrams, troubleshooting 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 machine super imposed on Indian Railways maximum moving dimensions envelope.

iii) Clause by clause comments of the manufacturer for review. Comments should state manufacturer's conformity of compliance of each of the requirement stated in each clause of the specification, elaborating where necessary the details/manner in which the requirement has been complied. The pro-forma for the clause-wise comments is given below:

Clause no.	Clause	Comments of Supplier/manufacturer	Comments of Inspecting Officer

iv) Manufacturer's internal quality inspection report of the machine.

v) Manufacturer's quality certificate and/or test reports for bought out assemblies/sub-assemblies with serial number wherever applicable.

vi) Draft inspection report shall be prepared by the manufacturer, containing all annexure mentioned at para 20.4.

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 (IO) keeping in view the Inspecting Officer's comments, if any.

20.4 List of documents to be annexed in the draft Inspection report shall 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 machine super imposed on the Indian Railways maximum moving dimensions (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 standard followed for design of wheels and axles against clause 2.9 to 2.11.

These above documents in soft & hardcopies shall be part of final inspection report.

21.0 TRAINING & SERVICE ENGINEERS:

21.1 The contractor shall provide at his own expense the service of competent engineers during the warrantee period for warranty related issues. The service engineers shall be available for the commissioning of the RBMV for regular service. E-Learning Courses shall be arranged for imparting training to Railways operators. In addition the service engineer shall provide hands on training to Railways staff in calibration, operation, repairing and maintenance of the RBMV in field to make them fully conversant with the RBMV. The engineers shall also advise the Railways on appropriate maintenance, testing, operating, repair and staff training facilities that are necessary for the efficient performance of the machine.

22.0 SPEED CERTIFICATE:

22.1 PROVISIONAL SPEED CERTIFICATE:

Whenever a new rolling stock is introduced in Indian Railways, a provisional speed certificate is issued by Research, Design and Standards Organization (RDSO) of Indian Railways at Lucknow, based on certain design parameters of the machine. Final speed certificate of the machine shall be after conducting detailed oscillation trial of the machine, which shall be a time taking process. Therefore, issue of provisional speed certificate for the machine becomes a necessity and based on the same, the approval of running of the machine on Indian Railways track is taken from commissioner of Railways safety.

For issue of provisional speed certificate, the following actions are required to be taken by the suppliers:

a. Current suppliers, whose models are approved:

The supplier shall give details of the model, year of introduction in Indian Railways, 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-frame i.e. suspension system/arrangement, wheel & axle assembly, bogie, braking arrangement, loading pattern of the machine etc. and the distribution of axle loads, lateral forces, un-

sprung mass, tractive effort and braking force coming on rails and they remain the same. If, there is any of the above parameters action shall be taken as detailed in para (b) below:

b. Current suppliers, whose models are not approved/or new:

As soon as the supplier completes the design of the machine as per specifications, the technical details as per Annexure-(VII & VIII) 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 of Indian Railways at Lucknow, 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-VII & VIII) can also be asked for issue of provisional speed certificate for the machine. The firm will also submit the technical details as per pro-forma placed at Annexure-II. The supplier shall submit the dynamic simulation report of the machine on professional track vehicle simulation software. The machine shall have to fulfil the acceptance criteria specified at Annexure-IX.

c. New suppliers, whose models are new:

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

22.2 **FINAL SPEED CERTIFICATE**

Final speed certificate of the machine shall be given after conducting detailed oscillation trials of the machine. For this purpose Railways shall conduct running speed tests on the Indian Railways main line track on one of the machines supplied to them preferably with in warranty, in accordance with procedure outlined in Annexure- IX with the machine running up to speed 10% higher than the maximum speed mentioned in clause 2.15 above.

23.0 ACCEPTANCE TEST:

23.1 **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. 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.

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

23.1.2 Performance of crane as per para 4.0.

23.1.3 Testing for negotiability on 10^0 curves and 1 in 8½ turnouts.

23.1.4 Construction and engineering of the RBMV and its ability to perform all the functions as laid down in the specifications.

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

25.0 WARRANTY:

The RBMV shall be warranted for 1200 effective working hours or 18 months from the date of commissioning and proving test of machine or 24 months from date of delivery at ultimate destination in India whichever shall be earlier. Effective working hours for this purpose will be traffic block time during which RBMV is deployed for work.

Should any design modification be made in any part of the machine offered, the warranty period of 18 months would commence from the date of commissioning and proving test of the RBMV for the purpose of that part and those parts which may get damaged due to defects in the new replaced part. The cost of such modification shall be borne by the supplier.

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 on the machine at appropriate location in Hindi & English as per direction of Indian Railways official:-

i) Indian Railways logo of height between 300 mm to 600 mm as suitable on all four faces of the machine.
ii) On both side faces and below the Indian Railways logo, the text “INDIAN RAILWAYS” to 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.
iii) Below the text “INDIAN RAILWAYS” mentioned above, machine model and manufacturing year should be written in black colour and in letter of size less than the size in which Indian Railways is written but not less than 200mm in any case.
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 manufacturer’s logo may be provided at not more than two locations and should be of size less than 200 mm.
v) Suitable signage to warn the operator and machine working staff against the 25 KV OHE shall be stencilled on the machine.

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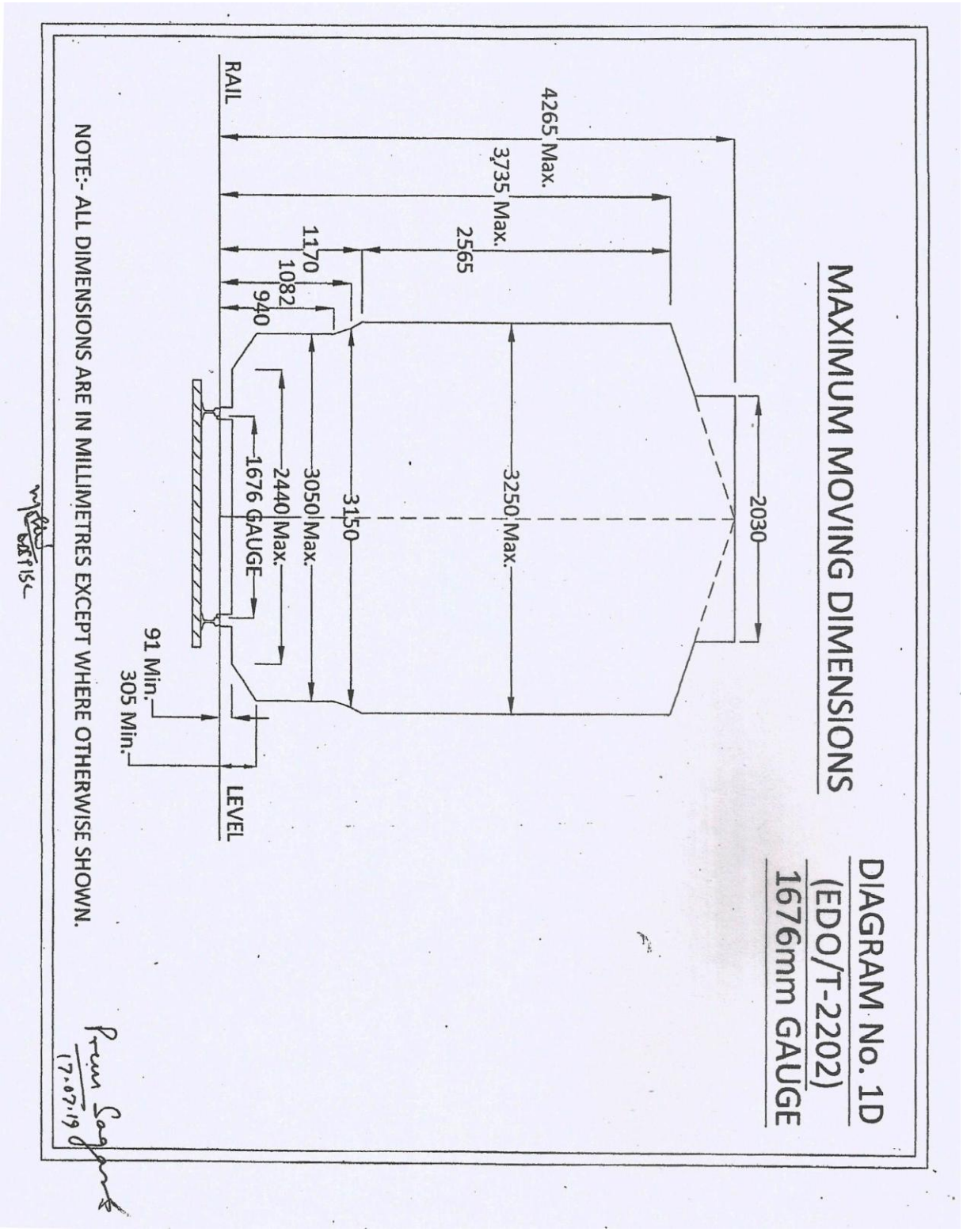


DIAGRAM No. 1D
(EDO/T-2202)
1676mm GAUGE
MAXIMUM MOVING DIMENSIONS
4265 Max.
3735 Max.
2565
1170
1082
940
RAIL
2030
3250 Max.
3150
3050 Max.
2440 Max.
1676 GAUGE
91 Min.
305 Min.
LEVEL
NOTE:- ALL DIMENSIONS ARE IN MILLIMETRES EXCEPT WHERE OTHERWISE SHOWN.
17.07.19

Annexure-II

Machine data to be submitted along with dynamic simulation report of the machine

S. No.	Component's Name	Parameters required						
		C.G. of component in x, y, z direction from rail level in mm (reference point 1st axle)			Mass in kg and mass moment of inertias in kg. m^2 of component in three dimension space about their C.G.			
		X	Y	Z	Mass	Ixx	Iyy	Izz
1.	Super structure with vehicle frame (Machine structure kept on secondary suspension of front and rear bogie)							
2.	Front Bogie frame including brake rigging							
3.	Rear Bogie frame including brake rigging							
4.	Transmission system device (hydraulic. Mechanical or electrical traction motors							
5.	Wheel axle set including axle boxes which constitute the unsprung mass							
6.	Mass of Items included in unsprung mass partially or fully along with their name per axle	1	2	3		4		Total unsprung mass in tonnes
7.	Total weight of components in tonnes	Front bogie full assembly		Rear bogie full assembly		Machine frame full structure		Full weight of vehicle (All bogies + vehicle car body or super structure)
8.	Suspension stiffness details in kg/mm	Primary suspension element stiffness per axle box between bogie and axle box			Secondary suspension element stiffness per side between bogie and machine frame			
		Vertical stiff	Lateral stiff	Longitudinal stiff	Vertical stiff	Lateral stiff	Longitudinal stiff	

9.	Damping force details (If hydraulic damper used give there rating force per meter/second)						
10.	Clearance in mm or radian provided for motion between bogie frame and machine frame for relative motion (motion stopper)	Vertical direction	Lateral direction	Longitudinal direction	Rotation about vertical axis	Rotation about Lateral axis	Rotation about Longitudinal axis
11.	Detail of location of suspension elements	Detail of location of suspension springs and dampers and shock absorbers with support drawing			Detail of location of suspension springs and dampers and shock absorbers with support drawing		
12.	Details of centre pivot arrangement working and location	Provide detail arrangement drawing and description					
13.	Set of drawings and design description	Concerning with general arrangement of vehicle, bogie general arrangement, suspension arrangement details, suspension clearances drawing, detail written description of configuration and loading pattern accompanies design particular of machine bogie.					

PROCEDURE OF DRAWING:-

1. DRAW A VERTICAL LINE X-Y.
2. DRAW SEMI-CIRCLE OF 14.5R TANGENTIAL TO LINE X-Y.
3. DRAW LINE 1:2.5 TANGENTIALLY TO 14.5R SEMI-CIRCLE.
4. DRAW A HORIZONTAL LINE AT 28.5mm FROM THE TOP OF THE FLANGE. AND LOCATE Pt. 'A' AT 63.5mm FROM THE LINE X-Y.
5. FROM Pt. A LOCATE CENTRE 'B' OF ARC OF 330R ON A VERTICAL LINE AT 91mm FROM X-Y.
6. DRAW ARC OF 330R FROM CENTRE 'B'
7. LOCATE CENTRE 'C' ON VERTICAL LINE AT / HORIZONTAL DISTANCE OF 65.5mm FROM THE LINE X-Y SUCH THAT BC= (330-100) ie 230mm.
8. DRAW ARC OF 100R WITH CENTRE AS 'C'
9. DRAW ARC OF RADIUS 14mm TANGENTIALLY TO 100R ARC AND LINE 1:2.5.
10. DRAW LINE 1:20 TANGENTIALLY TO 330R ARC.
11. DRAW A VERTICAL LINE AT A DISTANCE OF 30mm FROM THE FLANGE END.

NOTE:

CO-ORDINATES OF POINTS B & C ARE BASED ON NOMINAL DIMENSION OF 28.5mm.

③	SS/24/04	DIMENSION 73.7 DELETED	9/04
②	JS CD/3/94	REVISED & REDRAWN	3/94
①	JS CD/ /92	CO-ORDINATES OF ARCS SHOWN	3/92
ALT	AUTH.	DESCRIPTION	DATE

SUPERSEDED BY:
SUPERSEDES:
SCALE 1:1
P C D G.V.RAMAN T J.S.

B.G. R.D.S.O. (C)

GROUP XXX3

WORN WHEEL PROFILE

SKETCH-91185

Annexure-IV A

Sizes and Weight of Some of the P-way Materials and Small Track Machines to be normally loaded on RBMV platform

Sl. No.	Description	Length (mm)	Width (mm)	Height (mm)	Weight (kg.) (approx.)
1.	Normal Concrete Sleeper	2750	150	220	300
2.	Wider Concrete Sleeper	2750	285	235	350
3.	Wooden Sleeper	2750	250	130	100
4.	Steel Trough Sleeper	2680	257	106	79
5.	60 kg Rail (2 nos.)	6500	150	172	785
6.	52 kg Rail	6500	136	156	676
7.	60kg 1in 12 CMS crossing	4350	521	172	980
8.	60kg 1in 16 CMS crossing	5400	496	172	-
9.	Abrasive rail Cutter	1070	420	950	30
10.	Rail Drilling Machine	1030	450	570	60
11	Rail Tensor	1700	400	300	700

Annexure-IV B

Sizes and Weight of Some of the P-way Materials to be loaded on Attached Flat Wagon

Sl. No.	Description	Approx. Length (mm)	Weight of half set (switches) including all fittings(kg) (approx.)
1.	Over Riding Switch (curved) 52 Kg (1 in 12)	Tounge-12356 Stock-13000	2410
2.	Over Riding Switch (curved) 60 Kg (1 in 12)	Tounge -12356 Stock- 13000	2700
3.	Over Riding Switch (curved) 60 Kg (1 in16)	Tounge -12935 Stock- 13000	2800
4.	Rail Length 60 kg	13000	780
5.	Rail Length 52 kg	13000	676

Annexure-V

BRAKE DESIGN DETAILS OF THE MACHINE FOR CALCULATION OF EMERGENCY BRAKING DISTANCE

1.	Tare & gross weight of the machine in Kilograms	
2.	Brake power in Kilograms	
3.	Type of Brake blocks	
4.	Brake block area in Square Centimeters	
5.	Brake Rigging Diagram	
6.	Type of Brake system	

Annexure-VI

INSPECTION CERTIFICATE

CERTIFICATE OF INSPECTION OF RBMV (MODEL No.....)
BY INSPECTING OFFICIAL AND APPROVAL FOR DESPATCH OF RBMV.(STRIKE OUT WHICHEVER NOT APPLICABLE)

This is to certify that I have inspected the RBMV_____bearingSr.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 (MC) /Railway Board and M/s. (Name of Supplier) _____ _____.

The detailed inspection note regarding its conformity/non-conformity to the laid specifications is enclosed along with this certificate. It is observed that (strike out whichever is not applicable):-

- The RBMV conforms to all the laid down specifications.
- 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 machine:

1. _____
2. _____
3. _____

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

The RBMV is approved/not approved for dispatch to _____ _____(Consignee) Indian Railways.

For M/s._____
_____

Signature and Date
Inspecting Official
(Name and Designation)
For and on behalf of President of India

Annexure-VII

Particulars Required in Respect of the Rolling Stock under Consideration

1. A diagram showing elevation with 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 center of buffers :
   V. Max./Min. height of centers of buffers (above rail level) :

   b) I. Wheel base :
   II. Axle load (max) :
   III. Weight of each bogie :
   IV. Weight of each bolster :
   V. 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 Railways 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. Sprung weight per axle in tonnes
   I. Driving axle :
   II. Running axle :

8. Sprung mass on primary suspension :

9. Stiffness of suspension coil spring/magi spring :

10. Rate of deflection of primary spring :

11. Number of springs per nest :

12. Expected lateral force in tonnes per axle at maximum design speed. :

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

14. 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. :

15. 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	:

16. Maximum braking force coming on to the rails per wheel

	at working axle	:
	at transfer axle	:

17. Drawing indicating suspension arrangement details of bogie and axle. :

18. Height of centre of gravity from rail level. :

19. Height of floor from rail level. :

20. Type of coupler provided -Indian Railways Standard

I.	Coupling	:
II.	Buffer	:

21. Engine Make, Model, Power Rating etc.

22. Any infringement to the moving dimensions :
(Sketch provided in the Indian Railways Standard Schedule of Dimensions – Chapter IV (A)).

Annexure-VIII

Following information as detailed below is required for processing the case for issue of provisional speed certificate for new machine

Name of the machine _____ Model_____

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

Annexure-IX

ACCEPTANCE CRITERIA DURING OSCILLATION TRIALS

1. The speed potential of the machine offered by the supplier should be established based upon oscillation trials conducted in India. The tests will be conducted at speed usually 10% higher than the maximum speed potential indicated by the supplier 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 as per Third Report of the Standing Criteria Committee, Revision-1: Criteria for assessment of stability/riding of rolling stock, (Document No. TG-CR-4.2.3-2, March 2013) with latest amendment over which there are 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.

2. The criteria applicable for establishing speed potential as per Third Report of the Standing Criteria Committee as applicable on date (21.04.2022) is given below for general information purpose which may be amended from time to time:

i) A lateral force lasting over a length of more than 2 m should not exceed the Prud-Homme's limit of k (1+P/3) tones. Where P is the axle load in tones, k=0.85 for wooden sleepers and k=1 for concrete sleepers.

ii) ii) Isolated peak values exceeding the above limit are permissible provided the record shows establishing characteristics of the vehicle subsequent to the disturbance.

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

iv) 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 four wheelers) shall be limited to 0.55g both in vertical and lateral directions. The peak values up-to 0.6 g may be permitted if the records do not indicate a resonant tendency in the region of peak value.

v) In the case of such vehicles where measurement of forces is not possible, the evaluation shall be in terms of ride index based on the accelerations measured as detailed in Para2 (iv) above which shall not be greater than 4.5 but a limit of 4.25 is preferred.

vi) A general indication of stable running characteristics of the vehicle as evidenced by the movement of the bogie in straight and curved track with cant deficiency as prescribed in IRPWM-June, 2020 with latest amendment and lateral force and derailment coefficient of accelerations as the case may be.

3. SELECTION OF TEST TRACK (Third report of the standing criteria committee, revision-1: Criteria for assessment of stability/riding of rolling stock, (Document No. TG-CR-4.2.3-2March-2013) with latest amendment**:**

3.1. Oscillation trials shall be conducted over a section containing the following:

(i) A Tangent (straight) track - of about 1 km length. Efforts shall be made to conduct trials over two such stretches.

(ii) A Station Yard having facing/trailing points, and

(iii) A curved track having about 2ºcurves of length about 700-800 m. Normally, above criteria shall be applicable. However, in case of non-availability of 2ºcurves fit for requisite speed, following shall be applicable:

- For C&M I Vol I Standard Track: A curved track having 1.75º to 2.2ºcurve of about700-800 m and a curved track having 0.5º to 1ºcurve of length about 700-800 m.

- For other than C&M I Vol I Standard Track: A curved track having $1.75^0$to 2.2^0 curve of about 700-800 m and a curve track having $1^0$to 1.5^0curve of length about 700-800 m.

3.2. Indian Railways track is classified in two categories:

- Main line track - fit for operation less than 110 Kmph,
- High Speed (C&M I Volume I) track, permitting operation upto 160 kmph.

3.3. Since main line standard track permits speeds less than 110 kmph, in case the test vehicle is designed to run at speeds 110 kmph and beyond, its Oscillation trials become necessary on High-Speed track also.

3.4. A vehicle suspension should be so designed that it should be able to run freely on all Indian Railways tracks (in certain cases, it may become necessary to place a restriction in running of vehicle on some track structures due to various reasons). Since Oscillation trials cannot be conducted all over the Railway system, the section chosen for detailed Oscillation trials should be a representative 'run down' section. The section should generally be such that 90% of Indian Railways track should be better than this section - the philosophy being that if a vehicle manages to run satisfactorily on this track stretch, it will be able to run satisfactorily anywhere else on Indian Railways.

3.5. At present, the track geometry parameters are 'peak based' and not Standard Deviation based. Subject to fulfilment of stipulations of 2.4 above, the parameters of the selected track should be as per the following:

Parameters	**Main line Standard (Speeds below 110 kmph)**
Unevenness	B or C
Twist	B or C or D
Gauge	B or C
Alignment	B or C

Parameters	**Category**	**Extent of irregularities**
Broad Gauge		
(1) Unevenness (3.6 M chord).	A B C D	0-6 mm. (inclusive) 6 mm. (exclusive) to 10 mm. (inclusive) 10 mm. (exclusive) to 15 mm. (inclusive) Above 15 mm
(2) Twist (3.6 M base)	A B	0-5.0 mm. on chart (up-to and inclusive of 1.39

Note- 1 mm./M = 3.6 mm. on chart	C D	mm./M) 5-7.5 mm. on chart (1.39 mm./M to 2.08 mm./M inclusive) 7.5-10.0 mm. on chart (2.08 mm./M to 2.78 mm./M inclusive) Above 10.00 mm. on chart (above 2.78 mm./M.)
(3) Gauge	A B C	Up-to and ±3 mm. (inclusive) ±3 mm to & ±6 mm. (inclusive) Above ±6 mm
(4) Alignment (7.2 M. chord)	A B C	Up-to 3mm. versine (inclusive) More than 3 mm. and less than 5 mm. versine. 5 mm. versine and above.

For certain trials only limited sections can be available due to constraints of axle load, speeds, bridges, signaling, structures etc. For such limited sections, if test stretches are not available as per above criteria, stretches should generally be selected such that 90% of the track of these limited sections should be better than the stretch chosen for conduct of trials for issue of speed certificate. However, the limitation of trial shall be clearly indicated in speed certificate issued subsequent to such trials.

3.6. After detailed oscillation trials have been completed and the safe speed thereby determined, a 'Long Confirmatory Run' should be conducted in each of the configurations as per requirement. The basic idea of the 'long run' is to confirm that the values of parameters are in general conformity with the values found in the detailed trial section.

(a) Cover a long distance (say, 10-50 kms) at the maximum speed determined by oscillation trials of the configuration.
(b) Cover a few 'hard spots' like level crossings, culverts and bridges as far as possible. Riding of the vehicle over such points (resonance or amplitude build up) will be specially mentioned in the trial report.

Annexure-X/A

List of Equipment & Tools to be kept on RBMV

S.No.	Description of items to be kept on RBMV	Length (cm)	Width (cm)	Height (cm)	Qty.	Unit Weight (Kg)	Total weight (Kg)
1.	Walkie Talkie (04 sets in a box)				4 sets	500 gm (max)	
2.	Abrasive Rail cutter	As per RDSO Specification no. TM/SM/01 (Rev 02 of 2020) or latest revision			1	32 kg (max)	32 kg (max)
3.	Rail cutting machine (Saw type)	As per RDSO Specification no. TM/SM/04 (Rev 01 of 2020) or latest revision			1	70 kg (max)	70 kg (max)
4.	Rail drilling machine	As per RDSO Specification no. TM/SM/03 (Rev 01 of 2020) or latest revision			1	65 kg (max)	65 kg (max)
5.	Chamfering kit (Torque wrench, chamfering unit, box wrench etc. in a box).	As per RDSO Specification no. TM/SM/53 (Rev 03 of 2022) or latest revision			1		
6.	Rail welding equipment	As per RDSO Specification no.IRST-19-2012 (Incorporating A&C Slip No. 1 of April' 2013) or latest revision			1 set		
7.	Weld Trimmer Power-Pack Trimmer-	As per RDSO Specification no. TM/SM/09 (Rev 02 of 2022) or latest revision			1		
8.	Rail profile weld grinder	As per RDSO Specification no. TM/SM/10 (Rev 01 of 2020) or latest revision			1	80 kg (max)	80 Kg (max)
9.	4 no. off-track hand-held tamper with 2 generators Generator Set – Tools (brief case) -	As per RDSO Specification no. TM/SM/OTT/320 (Rev 01 of 2020) or latest revision			2 set		
10.	Lifting jack- Hydraulic Track Jack 8 t Cap. (mechanical)	As per RDSO Specification no. TM/SM/17 (Rev 02 of 2022) or latest revision			2		
11.	Lifting jack-Hydraulic Track Jack 15 t Cap	As per RDSO Specification no. TM/SM/31 (Rev 02 of 2022) or latest revision			2	-	-
12.	Lifting cum slewing device- TRALIS	As per RDSO Specification no.TM/SM/TRALIS/220 (Rev 02 of 2022) or latest revision			2	125 kg (max)	250 kg (max)
13.	De-stressing items (complete set for de-stressing 3 km LWR)						
13.1	Hydraulic Rail Tensor (non-Infringing) 70 t	As per RDSO Specification no. TM/SM/32 (Rev 01 of			2 sets	375 Kg (max)	750 Kg (max)

	Cap	2020) or latest revision					
13.2	600 rollers, (one roller @ 10 m) (in a box) (for 3 km)- (for 1 km)-				1 set		
13.3	wooden mallets				30		
14.	PWI Inspection kit including vernier, micrometer, rail thermometer, etc, having 26 items				1		
15.	Gauge-cum-level				1		
16.	Rail dolly				2		
17	Rail (mono) cum road trolley	As per RDSO Specification no. TM/SM/16 (Rev 02 of 2022) or latest revision			2	20 Kg (max)	40 Kg (max)
18.1	Red banner flag				2	-	-
18.2	Tri colour torch				3	-	-
18.4	Detonator (In a Box)				1 box	-	-
18.5	Remote control hooter				1		
19.	Gas cutting equipment with accessories				1		

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 5 t 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.

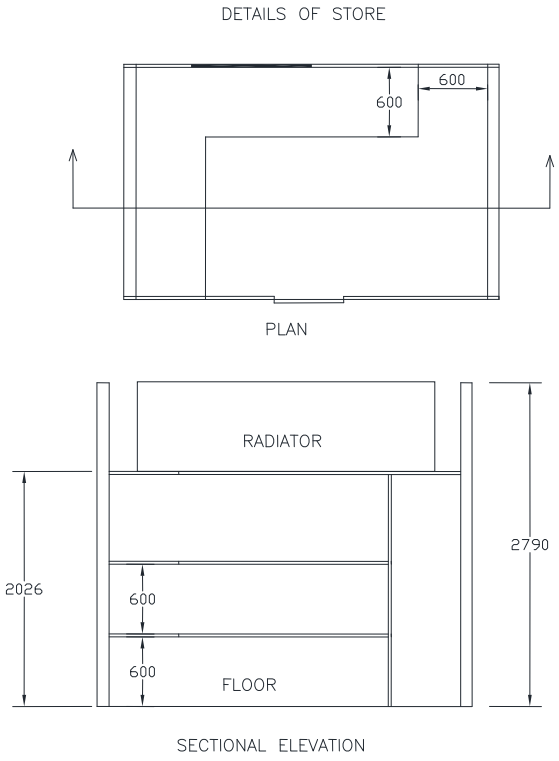
Annexure-X/B

ADDITIONAL LIST OF EQUIPMENT, TOOLS & MANPOWER NORMALLY REQUIRED FOR MMU-1

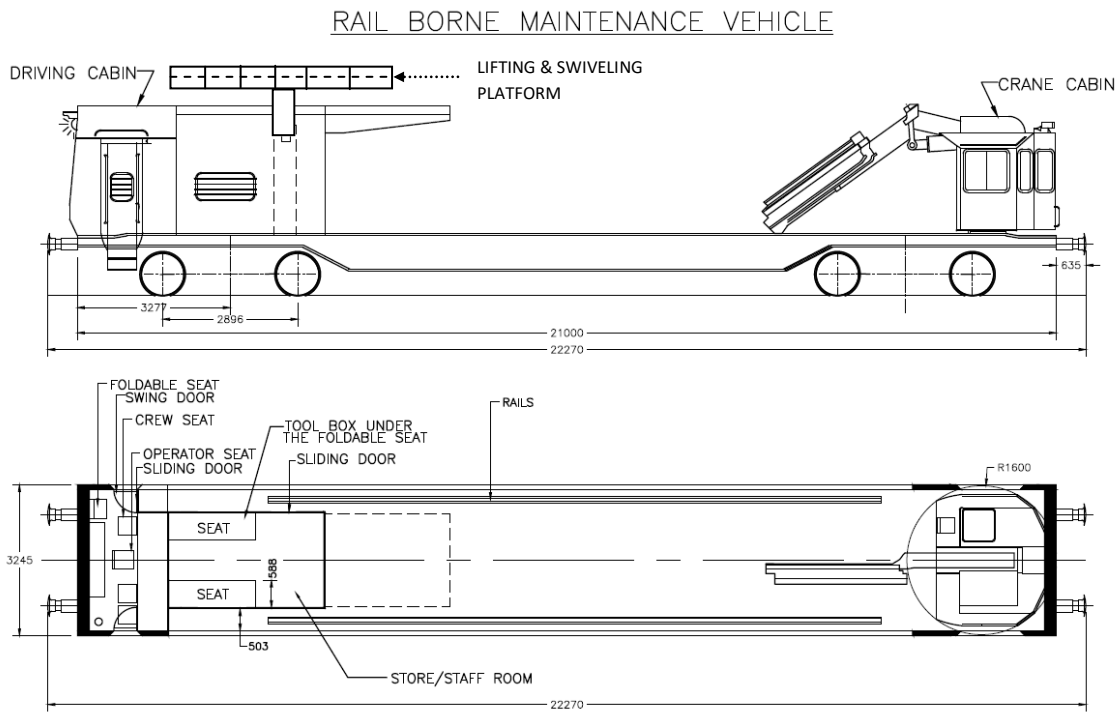
ALONG WITH THEIR WEIGHT TO BE LOADED ON RAIL BORNE MAINTENANCE VEHICLE (RBMV)

S. No.	Description of items to be kept on RBMV	Length (cm)	Width (cm)	Height (cm)	Qty.	Unit Weight (Kg)	Total weight (Kg)
1.0	Manpower	-	-	-	15	65 (approx)	975 (approx)
2.0	First-Aid Box				1		
3.0	60 kg rails of 6.5 m length/Glued joints				2	390	780
4.0	**Gang tools**						
4.1	Crow bar				2		
4.2	Rail tongs				4		
4.3	Beater				6	5	10
4.4	Hand Claw				2	1	2
4.5	Rail Shunt-Cable (Jumper)				4		
4.6	Hammer				2		
5.0	**Fastening**						
5.1	ERC, Steel/GFN liners, rubber pads				5 each	1.4	7
5.2	SEJ bolt				1	1	1
5.3	130 mm size bolts	30	30	20	4	1	4
5.4	Stretcher bar bolt				1	5	5
5.5	Wooden block + clamps	30	25	20	2+2	15	60
5.6	Joggle fish-plate (One pair 60 kg + one pair 52 kg)	64	4	12	1+1	32	64
5.7	One meter long fish-plate (One pair 60 kg + one pair 52 kg)	100	4	12	1+1	40	80

Tentative Layout of Store Rake



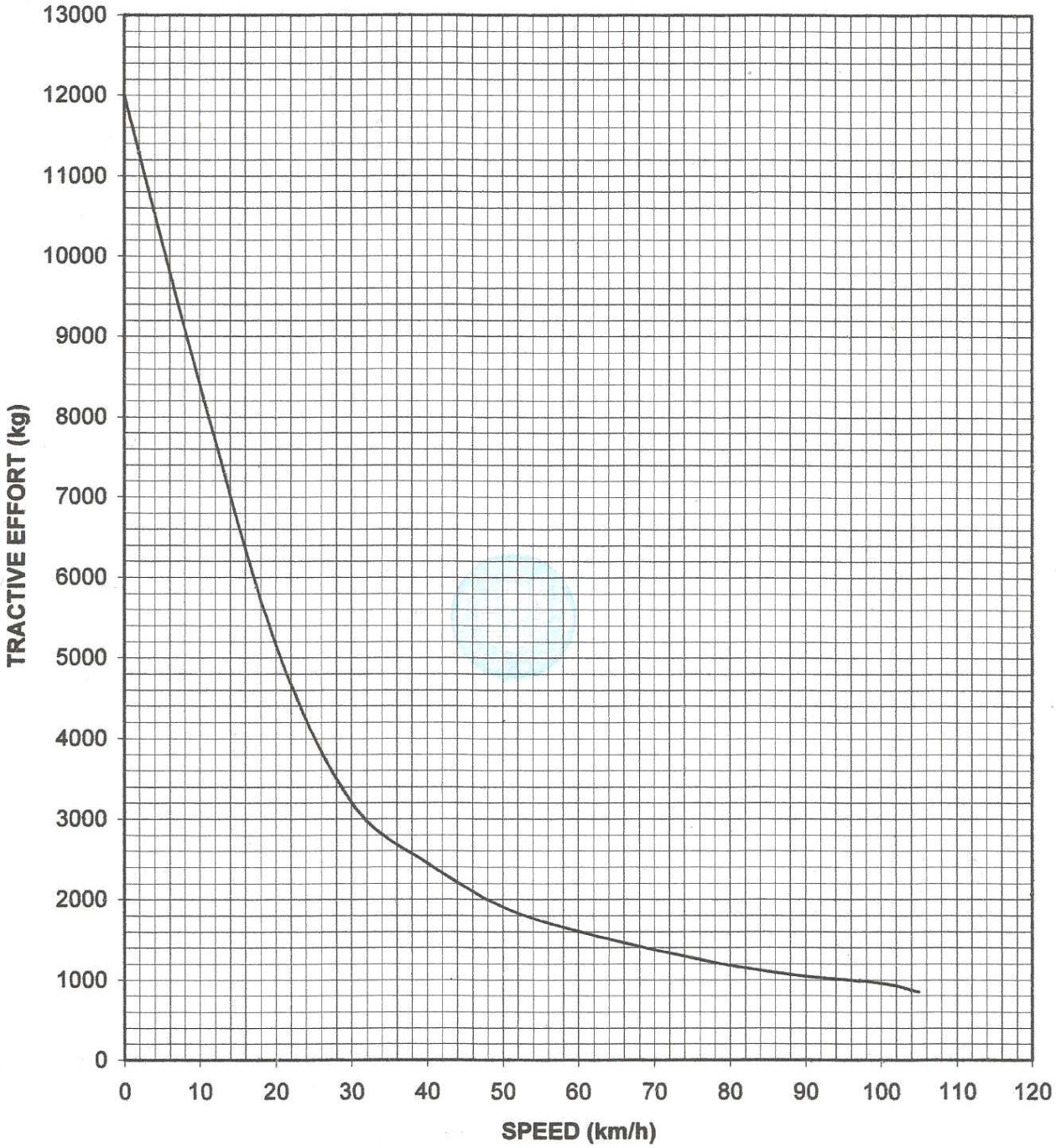
Tentative Layout of RBMV



ALL DIMENSIONS ARE IN MILLIMETRES

Annexure-XIII

TRACTIVE EFFORT Vs SPEED CURVE FOR RAIL BORNE MAINTENANCE VEHICLE



Annexure-XIV

Salient features of the Braking System of the Machine of the RBMV

1. RBMV vehicle Braking System

Vehicle should be equipped with proper braking system to ensure safety and controls the machine in case of an emergency as well as in routine operation while moving in travel, working and train formation mode.

1.1. The vehicle shall be fitted with the compressed air brakes system which shall apply brake equally on all wheels and provision shall be made to connect the Indian Railways standard locomotives.

2. Vehicle should have provision of following braking mechanism.

2.1. Direct Brakes:

Vehicle should have provision of direct braking system to be operated by compressed air. The pneumatic valve should be provided to operate at system pressure of 7 kgf/cm^{2}with dual type pressure gauge, Air regulator and Reservoir. SA-9 Brake system with hand lever being used in Indian Railways may also be used. Effective braking distance certificate should be submitted at ruling gradient of 1 in 33, 1 in 60 and for flat locations. This system is applicable for machine braking only. This system should be provided in both cabins.

2.2. Indirect Brake:

Indirect Brake should be capable to stop the vehicle in case of pressure drop and should be compatible to connect with Indian Railways standard locomotives. This indirect braking system should have separate Air reservoir, KE valve and Air charging valve with through connected steel Brake pipes to connect Locomotives in travel mode during pulling of vehicle in train formation. System may have existing braking A-9 type of valve being used in Indian Railways. Manufacture design should have compatibility to connect Locomotive of Indian Railways train brake system. This system should be provided in both cabins.

2.3. Emergency Brakes:

This system should be connected with indirect braking system for sudden braking in emergency. This system shall be equipped with Pneumatic valve. Operation of Pneumatic valve should be with hand lever. This emergency system shall be connected with BP of machine and shall be operative through indirect braking system. This system should be provided in both cabins.

2.4. Mechanical Parking brake:

Vehicle should be equipped with wheel operated system connected to braking lever with rigid chain link arrangement. This system should be capable to stop the machine in rolling condition during emergency. This shall also be used after parking of machine to prevent rolling of machine in standstill condition. This system should be provided in one cabin only.

2.5. Parking brake:

Vehicle should be equipped with spring loaded pneumatically operated parking brake system. In this system, braking of one bogie is to be carried out with spring loaded Pneumatic Cylinder. Brake should automatically be applied on wheels if air pressure falls below 3 bar or by application of knob after parking of vehicle.