SPECIFICATION FOR BALLAST REGULATING MACHINE FOR
BG (1676 mm GAUGE)
(Specification No. TM/HM/BRM/369 Rev. 01 of 2015)

1.0 GENERAL

1.1 Lateral and longitudinal stability of track can only be ensured by maintaining a predetermined ballast profile all the times. During various maintenance operations, ballasting and track renewals the ballast profile gets disturbed which needs to be restored quickly. These specifications have been drafted for an efficient and economical “On-Track Ballast Regulating Machine” hereinafter called machine.

1.2 The specifications have been drafted to reflect the performance and quality requirements of the equipment in a neutral manner without bias to any specific manufacturer. Bidders are requested to carefully go through the specifications and ensure that their equipment fully comply therewith. If a bidder feels that his equipment can substantially meet the performance and quality requirements of the equipment but does not fully satisfy a particular system specification, he should immediately seek clarification from the purchaser prior to submission of bids as to whether such deviation is substantive or not. If the tenderer should mention the same in the statement of deviation from the specifications, giving the details how the functional requirements are going to be met with. The bidder shall specify the model offered and furnish the detailed technical description of the same machine. Systems/sub-systems of the working mechanism of the machine as per para ‘3.0’ in particular and all the items of the specifications in general shall be described in detail in the “technical description” along with sketches to show the manner in which the requirements of the specifications are accomplished by the machine (model) offered.

1.4 Photographs of the type of machine in working mode shall be enclosed with the offer. The photographs shall also show the close-ups of various working assemblies/systems and the full machine. The tenderer shall furnish a compact disc or DVD or USB showing the working of the machine in real time 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 Railway officials.

2.0 DIMENSIONAL AND OPERATING REQUIREMENTS

2.1 The diesel-powered equipment shall be robust, reliable and suitable for working on broad gauge (1676 mm) of Indian Railways. The design and dimensions of the machine components shall be to metric standards. and should comply with provision of Indian Railways Schedule of Dimensions –1676 mm gauge (BG), revised, 2004 with latest corrigendum and up-dated correction slips issued. Quality assurance during manufacturing of the machine shall be according to ISO-9001, ISO 3834 and ISO 15085.

2.2 The machine shall be self-propelled bogie type vehicle. The profile of the machine longitudinally and in cross section during transfer as self-propelled vehicle or towed in train formation shall be within the maximum moving dimensions shown in Indian Railways standard BG schedule of Dimensions (metric)-2004 print with latest corrigendum and up-dated correction slips issued. The maximum moving dimensions are enclosed in Annexure-1. The tenderer shall provide sketches of the
machine in plan and shall give calculations to prove that the machine does not cause infringement while moving on a 10° curve at cross section.

2.3 In the past IR have condoned certain infringements to the Indian Railways Schedule of Dimensions – 1676 mm gauge (BG), revised, 2004 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 operation requirements of IR. 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 IR. Where an infringement to Indian Railways Standard BG schedule of Dimensions (metric)-2004 print 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 IR, the condonation of the same may be permitted by IR. However, only those infringements which are acceptable shall be permitted.

2.4 Adequate clearance shall be allowed so that no component infringes the minimum clearance of 102 mm from rail level while travelling.

2.5 Wherever applicable, axle load shall be lesser than 20.32 tonnes with minimum axle spacing of 1.83 m. Load per meter shall not exceed 7.67 t. Axle loads up to 22.82 tonnes and lower axle spacing may be permitted, provided the load combinations do not cause excessive stresses in the tracks & bridges of IR. Stresses in the tracks & bridges shall be calculated by IR/RDSO based on design data submitted by the firm as per (Annexure IX), and decision of IR/RDSO shall be final in this regard.

2.6 It shall have a minimum wheel diameter of 914 mm (new wheel profile). However, lesser diameter up to 730 mm (new wheel profile) can also be considered provided it meets the speed, condition laid down in clause 2.84 at its condemnation limit and rail wheel contact stresses for 72 UTS rail are within permissible limit. 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 should be available, but this should not be less than 20 mm. The worn out wheel diameter (condemning worn out diameter) based on the criteria of rail wheel contact stress for various maximum axle loads are as under.

<table>
<thead>
<tr>
<th>Maximum Axle load (tonne)</th>
<th>Minimum worn out wheel diameter (mm)</th>
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<tbody>
<tr>
<td>22.82</td>
<td>908</td>
</tr>
<tr>
<td>22.00</td>
<td>878</td>
</tr>
<tr>
<td>21.50</td>
<td>860</td>
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<tr>
<td>21.00</td>
<td>841</td>
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<tr>
<td>20.32</td>
<td>816</td>
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<tr>
<td>20.0</td>
<td>805</td>
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<tr>
<td>19.5</td>
<td>787</td>
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<td>768</td>
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<td>17.5</td>
<td>713</td>
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<tr>
<td>17.0</td>
<td>700</td>
</tr>
<tr>
<td>16.5</td>
<td>680</td>
</tr>
</tbody>
</table>
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. The new wheel profile in the machine shall be as per Indian Railway standard drawing attached as Annexure-VI which is titled as “WORN WHEEL PROFILE”

2.7 It shall be capable of continuous negotiating curves upto 10° curvature (176 m radius), super elevation upto 185 mm and gradients upto 3% in travel mode. The supplier shall specify the minimum attainable speed under the above limiting condition which in any case shall not be less than 40kmph.

2.8 It should be capable of continuous operation during the varying atmospheric and climatic conditions occurring throughout the year. The range of climate conditions is as follows:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature</td>
<td>0°C to 55°C</td>
</tr>
<tr>
<td>Altitude</td>
<td>Sea level to 700-1750mm above MSL</td>
</tr>
<tr>
<td>Humidity</td>
<td>40% to 100%</td>
</tr>
<tr>
<td>Maximum rail temperature</td>
<td>70°C</td>
</tr>
</tbody>
</table>

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

2.9 During transfer running from one station to another, it shall be capable of travelling on its own power at a speed of 75 to 80 km/h and at a speed of 90 to 100 km/h when hauled in train formation as last vehicle. Since the machine is likely to cover long distances on their own power, the travel drive system should be robust to sustain these requirements during the life of the machine. The machine should be capable of hauling an 8-wheeler coach/Wagon (90 ton approximately) at a maximum speed of not less than 50kmph. It should be able to negotiate steepest gradient of 1 in 33 prevailing on Indian Railways.

2.10 It shall be capable of working without requiring power block in electrified sections. 25 KVA current AC power supply is used for traction through an overhead wire at 5.5 m above the rail level. On bridges and tunnels, the height is restricted to 4.8 m.

2.11 The machine or its any part shall not infringe the adjoining track as per “Schedule of Dimensions of Indian Railways" while opening and closing of work. During working also 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 4.265 m 4265 mm centre to centre.

2.12 For optimum traction, the machine shall be equipped with hydrostatic/hydrodynamic/electric drive for running and hydrostatic/hydrodynamic drive for working, acting on all axles during work and transfer.

2.13 The machine shall be equipped with pneumatically operated block brakes acting on all wheels. The machine shall also be equipped with a mechanically operated...
parking brake. All operations for work and travel shall be controlled from a spacious fully enclosed cabin permitting unobstructed view in both directions.

2.14 It shall be possible to drive the machine in both directions at the same speed.

3.0 WORKING MECHANISM

3.1 The machine shall be capable of making ballast profile on straight track as well as turnouts and also curved track of radius upto 176 m with super elevation. A typical ballast section is given at Annexure-II. However, the ballast slopes between two tracks may not be well defined due to excess ballast. The machine shall be capable of working up-to a nominal ballast size of 65 mm or below on various types of sleepers like wooden, CST-9, Steel trough and concrete.

3.2 The machine shall be equipped with all essential working unit like center plough, shoulder ploughs, sweeper/broom units, and brushes for fastenings and ballast hopper. Center plough, shoulder ploughs, sweeper/broom units and brushes for fastenings shall be integral part of machine. For utmost versatility and running quality of the machine all these units should preferably be mounted centrally i.e. between front and rear running gear.

3.3 The center plough and shoulder ploughs shall be capable of moving the ballast longitudinally along the track or across it for establishing the desired ballast profile in both directions-sides.

3.4 The plough shall be made of suitable material capable of moving the ballast without showing any stress.

3.5 The ploughs shall be hydraulically adjustable both vertically and horizontally and shall allow step-less variation so as to adopt required height or any shoulder angle upto the angle of repose.

3.6 Individual height adjustment of the blades shall be possible to allow dosage of the ballast at the required location. The machine shall also be capable of quickly adopting to the changing circumstances and ballast distribution on the ground without the operator having to leave the cabin.

3.7 The shoulder ploughs shall be capable of avoiding obstacles like km posts, OHE installation, signal posts etc. in such a manner as to prevent ballast from heaping up and still keeping the shoulder ballast slope at the same angle. The safety device shall be provided to restrict the movement of shoulder plough upto 2665-2675 mm from the center line of the track on which the machine is working at any stage, to avoid any infringement to moving dimensions on the other track.

3.8 The shoulder ploughs shall be capable of working independent of each other and in both directions.

3.9 Along with center plough, the shoulder plough shall be capable of forming a mobile ballast box to enable some quantities of ballast to be transported along the track.

3.10 The machine shall be equipped with sturdy metallic inverted troughs to cover the rail and fitting area to avoid flooding of rail area with ballast at any stage of working.

3.11 The sweeper pick up unit (broom) shall be capable of picking up the ballast and depositing the same on either or both the shoulders by means like transverse
conveyor belts. It should also be able to picking up the surplus ballast and to place it on a conveyer belt for transporting it to the ballast hopper.

3.12 The machine shall have separate arrangement (brooms/brushes) to clean the rail fitting area or any ballast / small clip. The arrangement may preferably consist of wheel shaped brushes (two for each rail) which remove the ballast by rotating motion. Any variation shall be brought out by the tenderer.

3.13 The machine shall be able to carry out the following jobs in one working pass in normal situations.

a) Shifting of ballast from left to right shoulder or right to left shoulder of track.

b) Ploughing of excess ballast from the centre to desired one or both shoulders or from the shoulders to the centre.

c) Individual height adjustment of the blades shall be possible to allow dosage of the ballast at the required location.

d) Making the desired ballast profile.

e) Sweeping / brooming the excess ballast from top of sleepers and depositing it on shoulders.

f) Brushing away fine chips / ballast from the fastening area.

g) Collection of surplus ballast and conveying it to ballast hopper and discharging it on shoulders and tamping area.

3.14 The machine shall be capable of regulating ballast at least up to 5000 M$^3$ per hour of working. It shall also be able to regulate the ballast at the rate of 1.5 track km per hour in one or more working passes following a tamping machine.

3.15 In addition to the computer system provided on the machine for its own controls, the machine shall be provided with an industrial quality heavy duty portable computer (Laptop-tough book) for keeping record of overall aspects of working, spares management and reporting. The detailed specifications of the laptop are enclosed as Annexure-VII.

3.16 The time required for starting the work after arrival of machine at the site together with time for winding up the machine and starting back from site after stoppage of work shall not be more than 6 minutes.

3.17 In addition to all the above mentioned provisions, the machine shall have a hopper of capacity not less than 10 M$^3$. The hopper should be equipped with a floor conveyer for maximum use of its capacity during loading. Preferably it shall have an arrangement of foldable flaps (over and above the capacity of 10 M3) to enable the capacity to increase to 12 M3 with flaps in open position. The hopper shall be equipped with proper ballast loading into hopper and unloading / discharging arrangements with chutes for distributing the ballast on shoulders and tamping area.

3.18 The machine should be equipped with a centralised computer based control and monitoring system which shall monitor the health of machine working system such as engine (lube oil pressure, temperature, rpm etc.), hydraulics (hydraulic pressure in different units, temperature, oil level in tank etc), pneumatic (pressure of different units), electicals (charging/discharging rate, voltage etc.). All these data should be displayed on a monitor installed in working cabin. Arrangement for providing
3G/4G internet connection for sending data in soft format directly from the computer should also be available.

4.0 DIESEL ENGINE

4.1 The machine shall be powered by a diesel engine(s) preferably indigenous, with proven record of service in tropical countries with vide service network in India. Robust construction and low maintenance cost are of particular importance. Adequate allowance shall be made for de-rating of diesel engine under the most adverse climatic conditions mentioned in this specification elsewhere.

4.2 High-speed diesel oil to Indian Standard specifications shall be normally used. A minimum fuel tank capacity sufficient for continuous operation for eight hours will be desirable but not be less than 1200 litres shall be provided.

4.3 Sight glass type fuel measuring gauge preferably of full height shall be provided on the fuel tank.

4.4 For starting the engine, storage batteries of well-known make shall be provided. The engine shall normally be push/pull button start type or key type.

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

4.6 There is likelihood of dust deposition over the engine body and surrounding area over the lubricants spill-over. These should be easy to access for daily cleaning and routine maintenance. 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 alongwith.

4.7 The engine parameter monitoring gauges like temperature, rpm, lube oil pressure shall be direct reading type mounted on the engine, backed up by electrical/mechanical gauges in the operator’s cabin showing the absolute readings along-with safe limits suitably coloured. There shall be audio-visual warning (safety mechanism) to the operators in case of any of these parameters exceeding the safe limit and engine shut down automatically circuit in case of operator’s failure to respond.

4.8 Suitable and rugged mechanism should be provided to start the prime mover at minimum/no load and gradual loading after the start of the prime mover. The engine shall be mounted on suitable Anti-Vibration Mountings.

4.9 The engine should have Electronic Control Module (ECM) or similar arrangement for taking out operating parameters on real time basis such as RPM, load, fuel consumption, temperature, pressure maintenance and diagnostic data as well as trip and historical data. These data should be displayable on a centralized computer based control and monitoring system as mentioned in para 3.27 above. It should also be possible to transfer these data on USB device.
5.0 COOLING SYSTEM

5.1 The cooling system shall be efficient and designed for a maximum ambient temperature of 55°C (as per clause 2.8). Supplier shall note that the machine shall be working under extreme dusty conditions and the cooling mechanism should be maintainable under these conditions.

5.2 Adequate heat transfer arrangement shall be designed and provided so that under extreme heat conditions as mentioned in para 2.7 above, the system oil temperature does not go beyond 85°C specified range of the engine.

6.0 BRAKES

6.1 The machine shall be fitted with compressed air brakes applying brakes equally on all wheels and provision shall be made to connect air brake system of the machine to that of camping coach/wagons hauled by the machine. Fail safe braking mechanism system shall be provided so that in case of any failure of brake circuit will result in 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 lining shall be suitable for high ambient temperature of 55°C. The force required for operating the brakes shall not exceed 10 kg at the handle while applying by hand and 15 kg on the pedal, when applied by foot. In addition, mechanical brake shall also be provided for use in an eventuality of failure as well as for parking.

6.2 The machine shall be equipped with suitable arrangement of braking air brake valves so that while attached working in train formation, machine can be braked by the traction vehicle having compressed air braking system. In addition, the machine shall also be equipped with suitable air brake system in the driving cabin so that attached wagon or camping coach compatible with IR system while being hauled by the machine can be braked.

6.3 There should be provision of emergency brake application in the machine either travelling alone or coupled with the coach/wagons, in addition to the normal braking system of the machine, using the compressed air. The emergency braking distance (EBD) of the machine on the Indian Railway Track, at the maximum design speed on level track shall not be more than 600 m. 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 should be provided by the supplier. Brake design details are to be submitted as per Annexure VIII.

6.4 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 to alert the operator of machine following this machine when the machines are working in groups.

7.0 HORN, HOOTER AND SAFETY SWITCHES

7.1 The equipment machine shall be provided with dual tone (low tone & high tone) electric / pneumatic horns/hooters facing outwards at each end of the machine at suitable locations for use during travelling to warn the workmen of any impending danger at the work spot or from oncoming train. Control shall be provided in close
proximity to the driver permitting the driver to operate either horn individually or both horns simultaneously. These electric horns/hooters shall be operated either by means of push buttons provided in the cabs and also should have remote control operation so that the Lookout man standing around 150 m away from the machine can operate the electric horn/hooters to warn the staff working on/around the machine about approaching train on adjoining track. 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 at a distance of 5 meter from horn (source of sound). The higher tone horn shall have fundamental frequency of 370 ±15 hertz.

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

7.3 Safety equipments like jacks, pullers terfers and other such equipments specific to the machine for restoring failed units of the machine during working, shall be provided on the machine.

7.4 Machine shall be provided with emergency backup system to wind up the machine in the event of failure of prime mover or power transmission system of the machine. The emergency backup system should be able to be operated manually also.

7.5 Pneumatically/electrically operated hooters capable of producing intensity of sound between 105-110 dB at a distance of 5 meter (when measured in still air in a closed room) and variation in intensity of sound shall not be more than 5 dB. The hooter 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 operatable from remote point at a distance of at least 300 m from the hooter.

7.6 Adequate numbers of safety stop/switches 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 signalling cable, joggle fish plate etc. during work, so that the operator can be warned or the machine can be stopped immediately.

8.0 DRIVE MECHANISM

8.1 The machine should be provided with an efficient traction drive system for traction during the operation.

8.2 The driving mechanism for travel drive should be rugged to perform satisfactorily during the life cycle of the machine. The machine’s driving system shall be through hydro-dynamically/hydro-statically/electrically (for running) and hydro-dynamically/hydrostatically (for working), coupled power transmission arrangement capable of achieving full speed in both directions. The system should be so designed that all the driving wheels work in synchronization and there is no slippage/skidding of the wheel during the work drive.
8.2 The driving mechanism, in work mode shall be adequately designed to handle the acceleration and the braking force. A suitable synchronization circuit to control the synchronization of ballast regulating process with the machine drive/braking system in the working mode shall be provided to prevent any damage to machine system on account of non-synchronization.

8.3 Suitable differential systems may be provided between coupled wheels on the same bogie.

8.4 Suitable flow divider/throttling arrangement may be provided to equalize the tractive effort amongst different bogies. Adequate gauges shall be provided to indicate the power sharing among different driving bogies to prevent overstressing of any traction bogie or its components.

8.5 The supplier tenderer shall provide the necessary technical details including circuit diagrams to confirm the above requirements.

8.6 Adequate gauges should be provided in working and driving cabins near operator’s seat (flow meter) and solenoid valves shall be provided near linkage assembly, for indication, flow control and carrying out necessary adjustment in the field.

8.7 To the extent possible hydraulic and pneumatic component/assembly should be fixed at suitable location preferably on the side frame of the machine so as to avoid the need of going on top of the machine for day-to-day maintenance schedules.

8.8 The pneumatic circuit should be provided with air dryer for the smooth working of pneumatic components.

8.9 The machine shall be equipped with adequate safety circuit such that if any unit/part which may endanger the safety is unlocked, the machine shall not move during run drive. The indication of locking and unlocking of all units should be displayed in the cabin.

8.10 Onboard system for online filtration and monitoring the quality of hydraulic oil in hydraulic circuit should be provided. The gauge should clearly indicate if the hydraulic oil is contaminated beyond the permissible limits and requires immediate replacement.

9.0 HOOKS AND BUFFERS

9.1 The machine shall be fitted with hooks and buffers of IR design on both ends for coupling it with other vehicles for running it in train formation and for attachment with the coach, locomotives and wagon. The coupler and under frame should withstand 100t of tensile load without any permanent distortion.

10.0 ELECTRIC EQUIPMENT AND LIGHTING

10.1 The electrical equipment to be provided shall conform to relevant standard specifications and shall be suitable for Indian climatic conditions. The machine shall be equipped with headlight, confirming to RDSO’s specification no. EL/TG/41 ensuring a light intensity of 3.2 lux at ground level at track centre at a distance of
305 metres away on a clear dark night at each end with and with two front parking lights which can be switched to red or white according to the direction of the travel. Powerful swivelling 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. Theumber colour LED based flasher light producing not less than 500 lux at 1 meter and 55 lux at 3 meter in line measurement in axial direction from flasher light shall be provided at both ends in the machine to give indication to the train arriving on other line about any impending danger at both ends. Preferably electric power of 24 V(maximum up to 110 V) shall be used for operation of any electrical circuit.

11.0 CHASSIS AND UNDERFRAME

11.1 The chassis shall be of standard welded steel sections and of steel sheets so as to permit transportation of the machine in train formation without endangering safety of the train. The under frame shall be constructed with rolled steel section and/or plates and shall be designed to withstand a maximum static squeeze test load of 200102 t i.e. 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 last vehicle.

12.0 CABINS

12.1 The machine shall be equipped with fully enclosed, sound and heat insulated airconditioned and pressurised cabins with safety glass windows at both the ends. In view of the high ambient temperature prevailing in India, special attention shall be paid to free circulation of air and ventilation in the driver’s cabin. However, the electronic equipments shall be so designed that it shall be able to work without air conditioning under the climatic conditions described in Para 2.8. It shall be possible to have a clear view of the track ahead while driving the machine in both directions from the cabin. The cabin layout shall be such that, before leaving the machine the operating staff has full view on both the side to avoid any danger to them from trains on adjacent track.

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

12.3 The operator cabin shall be ergonomically designed to have easy access to all controls. The operator shall have a full view of the working area from the operating seat to have a full control over the work.

12.4 One Screen wipers preferably operated by compressed air or electrically operated shall be provided on the windscreens.

12.5 Suitable no. of fire extinguisher (dry chemical type) shall be provided in the cabs.

12.6 The machine shall be provided with well-designed space for keeping the tools and spares required for onsite repair of the machine to attend the breakdowns and other working requirements.
12.7 If more than one cabin is used, necessary inter-communication system shall be provided inter-connecting all the cabins and should be so oriented that the operator, seating on the seat of either cabins/working cabin, can distinctly hear the conversation.

12.8 The cabins shall have seating arrangement for at least six machine staff.

13.0 TOOLS AND INSTRUCTION MANUALS

13.1 Each machine shall be supplied with a complete kit of tools required by the operator in emergency and for normal working of the machine. The list of tools to be provided shall also include all tools necessary for maintenance and repair of the entire machine including specialized equipment. All special tools shall be listed and catalogued illustrating the method of application. The tenderer shall along with his offer submit the list of tools to be supplied along with each machine. The list can be modified to suit the purchaser’s requirement, while examining the offer.

13.2 Detailed operating manual, maintenance and service manual, user manual indicating capabilities of the machine shall be specially prepared in English language and three four hard copies and soft copies of these of each of the same shall be supplied with each machine.

13.3 The manufacturer shall also supply circuit diagrams of electrical, hydraulic, pneumatic and electronic circuits used on the machine. Trouble shooting diagram/table shall also be supplied. In addition, the tenderer shall provide dimensional drawings with material description of items like rubber seals, washers, springs, bushes, metallic pins etc., main features such as type, discharge etc. of items like, hydraulic pumps, motors and the tenderer shall furnish the details of such other bought out components/assemblies. These shall be specially prepared in English language and four copies of these shall be provided with each machine.

13.4 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 guidelines/manual. The list can be modified to suit the purchaser’s requirement, while examining the offer.

13.5 While offering the machine for first inspection, the supplier shall submit three one copies of complete technical literature including operation, service and maintenance manual, complete electrical, electronic, hydraulic and pneumatic circuit diagram, trouble shooting charts, component drawing/ description and other relevant details so as to maintenance master copies of these documents in Indian Railway institution and the reference document as reference document for the inspecting officer. All the above documents shall be available in English also.

13.6 One portable diesel operated D.C. welding plant (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 11 KW/16 H.P 5 KVA capacity capable of welding upto 5 mm. electrode (dia) at 60% duty cycle shall be supplied along with sufficient cable or lead shall be provided with the welding plant machine for day to day repairing of
machine and its wearing parts. The diesel tank capacity shall be not less than 15 litre.

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

13.8 A draft copy of all documents to be supplied with the machine should 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 should be carried out and compliance should be reported to RDSO as well as the Inspecting officer of the first machine.

13.9 The firm shall provide detailed technical drawings and specifications of wheels and axles used in the machine. The above details shall be provided in four sets with each machine.

14.0 SPARE PARTS

14.1 The tenderer should quote, apart from main equipment, separately for the mandatory spares as well as for recommended spares required for two years of operation along with description, part number, quantity, cost, whether imported or indigenous. The expected life of the components/ spare parts shall be advised along with their condemning limits. Necessary list of recommended spare parts for the operation and maintenance of the machine for a period of two years, i.e. working for about 2000 hours may be included in the offer. The spare parts required shall be detailed in a separate list indicating description, part number, quantity and whether imported or indigenous.

14.2 The manufacturer shall be responsible for the subsequent availability of spare parts to ensure trouble free service for the life of the machine (15 years).

14.3 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 machine for inspection.

15.0 MAKER’S TEST CERTIFICATE

Copies of maker’s certificate guaranteeing the performance of the machine shall be supplied in duplicate along with the delivery of each machine.

16.0 OPERATORS

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

17.0 Optional Equipment:

Tenderer is expected to quote for optional equipment separately for each item giving the advantages/functions of such optional equipment. Tenderer shall also indicate whether such equipment are already in use on machines elsewhere indicating the user Railway system.
18.0 Warranty:

In addition to the special conditions of contract dealing with warranty, the following will apply.

The machine shall be warranted for 1200 effective working hours or 18 months from date of commissioning and proving test of equipment 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 machine is deployed for ballast regulating work. Should any design modification be made in any part of the equipment offered, the warranty period of 18 months would commence from the date of commissioning and proving test of equipment 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 should be borne by the supplier.

19.0 Service Engineers:

19.1 The contractor shall provide at his own expense the services of competent engineers during the warrantee period for warrantee related issues. The service engineers shall be available for the commissioning of the machine for regular service, and for training to the operating, repairing and maintenance staff of the machine. 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 machines.

20.0 Inspection of the Machine:

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

20.2 Following arrangements shall be made by the supplier/Manufacturer at the inspection premises for carrying out inspection of the machine by inspecting officials:

- Machine to be stabled on straight & level BG track. The length of the track should be at least 10 m more than buffer to buffer length of machine.
- In order to check Maximum Moving dimensions in cross section, a Sturdy frame of IR Max Moving Dimensions shall be provided by the manufacturer and passed over the machine holding it perpendicular to track, centre aligned with track centre. Adequate arrangements shall be made to the satisfaction of inspecting official.

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

i) One copy of complete technical literature mentioned in clause 14, in English language, including operation, service and field maintenance manuals/instructions and complete electrical, hydraulic and pneumatic circuit diagrams, trouble shooting charts, component drawings/ description and other
relevant technical details as a reference documents in soft & hard copies for the inspecting officer.

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

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

<table>
<thead>
<tr>
<th>Clause</th>
<th>Clause no.</th>
<th>Comments of Supplier/manufacturer</th>
<th>Comments of Inspecting Officer</th>
</tr>
</thead>
</table>

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 to be provided to IO, containing serial number wherever applicable.

vi) Draft Inspection Report to 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 keeping in view the Inspecting Officer’s comments, if any.

20.4 List of documents to be annexed in the draft Inspection Report should include:

i. Maker’s Test Certificate.
ii. Manufacturer’s Internal Quality Inspection Report
iii. Quality Certificates of Bought out assemblies/sub-assemblies
iv. Cross section of the machine super imposed on the IR MMD
v. Vogel’s diagram
vi. List of spare parts to be dispatched along with the machine
vii. List of tools to be dispatched along with the machine
viii. List of Manuals, Drawings, Spare Parts Catalogues, etc. to be dispatched along with the machine, duly indicating the number of sets of each.

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

17.0 21.0 ACCEPTANCE TEST

17.21.1 In addition to verification of the various items of specifications the purchaser’s nominee shall carry out the following tests in India at the purchaser’s premises at the time of commissioning of the machine. 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.
The acceptance test shall consist of –

a) Dimensional check of loading gauge i.e. maximum moving dimension, buffer heights, clearance etc.
b) Testing for negotiability of 10° curve and on 1 in 81/2 (eight & half) turnouts.
e) Train running speed tests on the Indian Railways mainline track to be conducted on the first machine in accordance with the procedure laid down in Annexure-III.
d) Construction and Engineering of the machine and its ability to perform all the functions as laid down in the specification.
e) The setting up time and winding up time of the machine as described in the specifications elsewhere shall be measured and total time taken in two operations of setting up and winding up shall not be more than 6 minutes.
f) Actual output and performance test to be conducted on the first machine.

22.0 ACTUAL OUTPUT AND PERFORMANCE OF THE MACHINE

Acceptance tests shall be conducted under following conditions:

a) Machine crew shall be either trained personnel of Indian Railways or the staff of the supplier.
b) Dry weather, ambient temperature between +5°C to + 40°C
c) Track on straight or on curve of minimum 1000m radius.
d) Straight track with gradient up to 1 in 200.
e) Rails and sleepers in good conditions and properly fastened.
f) Concrete/wooden/steel sleepers.
g) Clean ballast cushion up to 100 mm and ballast in the track is sufficient to achieve required ballast profile for LWR track as shown in Annexure-II.
h) LWR track.
i) Regular sleeper spacing of 60/65 cm with a tolerance of + 2 cm on straight track.
j) Formation good.

Test to be conducted:

The output and performance tests shall be conducted in India on the first machine. The machine shall be able to carry out the operations prescribed in the specifications.

i. The machine shall be capable of work for regulating the ballast of 1.5 km length at a stretch of generally regulating the ballast following a tamping machine at the rate of 1.5 track km in one hour of working in one single or more passes.

ii. Cross section of ballast shall be taken at every 10 m or at low/high profile peaks of cross section and excess of over mean value shall be calculated. The machine shall be able to regulate in a distance of 250 m at the rate of 5000 cum/hr.

Should any modification be found necessary as a result of test, the same shall be carried out by the supplier at his own expenses.
21.4 Running speed tests shall be carried out on the Indian Railway main line track on any of the machine in accordance with procedure outlined in Annexure-III. This test shall be conducted preferably within warranty period of that machine.

20.0 The tenderer is expected to quote for optional equipment 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.

21.22.0 Issue of Provisional Speed certificate

Whenever a new rolling stock is introduced in Indian Railways, a provisional speed certificate is issued by RDSO based on certain design parameters of the vehicle. Final speed clearance of the vehicle is given after conducting detailed oscillation trial of the vehicle, which is a time taking process. Therefore, issue of provisional speed certificate for the vehicle becomes a necessity and based on the same the approval of running of the vehicle on Indian Railway track is taken from Commissioner of Railway Safety. For issue of provisional speed certificate, 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 Railway, details of speed certificate issued etc. The supplier shall certify that no change has taken place in the model being offered with respect to design of under carriage i.e. suspension system/arrangement, wheel & axle assembly, bogie, braking arrangement loading pattern of the vehicle etc. and the distribution of axle loads, lateral forces, unsprung mass and braking force coming on rail is the same. If, there is any change in above respect, the action shall be taken as detailed in para (b) below:

b) **Current 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 (V- A & V-B), which in no case should be more than six months from signing of contract, shall be supplied to Track Machine and Monitoring Directorate of RDSO for processing of provisional speed certificate for the machine so that it can be permitted to move on track. On case-to-case basis, more technical details (other than mentioned in Annexure V-A & V-B) can also be asked for issue of provisional speed certificate for the machine.

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

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

23.0 **MARKING & COLOUR OF MACHINE:**

23.1 The machine body shall be painted in golden yellow colour,

23.2 Following should be written in black on the machine at appropriate location in English & Hindi as per direction of Indian Railway official.
i) India Railways logo of height between 300 mm to 600 mm as suitable on all four faces of the machine.

ii) 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 200 mm 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 Manufacturers Logo may be provided at not more than two Locations and should be of size less than 200mm.

*******************
NOTE:-
ALL DIMENSIONS ARE IN MILLIMETRES
EXCEPT WHERE OTHERWISE SHOWN.
Annexure-II

**BALLAST PROFILE (SINGLE LINE BG)**

***Fig: 4.2.1(a)***

<table>
<thead>
<tr>
<th>Gauge Type</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>F1</th>
<th>H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wooden</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200 OVER</td>
<td>250</td>
<td>350</td>
<td>500</td>
<td>2270</td>
<td>2420</td>
<td>6850</td>
<td>6250</td>
<td>540</td>
</tr>
<tr>
<td>150 SUB-BALLAST</td>
<td>350</td>
<td>500</td>
<td>2270</td>
<td>2420</td>
<td>6850</td>
<td>6250</td>
<td>590</td>
<td></td>
</tr>
<tr>
<td>Steel Trough</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200 OVER</td>
<td>250</td>
<td>350</td>
<td>500</td>
<td>2280</td>
<td>2430</td>
<td>6850</td>
<td>6250</td>
<td>550</td>
</tr>
<tr>
<td>150 SUB-BALLAST</td>
<td>350</td>
<td>500</td>
<td>2280</td>
<td>2430</td>
<td>6850</td>
<td>6250</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>PRC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200 OVER</td>
<td>250</td>
<td>350</td>
<td>500</td>
<td>2525</td>
<td>2675</td>
<td>6850</td>
<td>6250</td>
<td>640</td>
</tr>
<tr>
<td>150 SUB-BALLAST</td>
<td>350</td>
<td>500</td>
<td>2525</td>
<td>2675</td>
<td>6850</td>
<td>6250</td>
<td>690</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:**

1. The minimum clean stone ballast cushion below the bottom of sleeper ie A = 250 mm.
2. For routes where speeds are to be more than 130 kmph, A = 300 mm or 200 mm along with 150 mm of sub-ballast.
3. * On outer side of curves only.
4. Suitable slope shall be given for side slope of ballast profile.
5. Dimensions for formation width (F and F1) are given for straight portion only. This should be suitably increased taking into account extra ballast shoulder on outside of curves and for super-elevation.
6. All dimensions are in millimetres.
ANNEXURE-III

The speed potential of the machine offered by the firm should be established based upon oscillation trials conducted in India. The tests will be conducted at speed usually 10% higher than the maximum speed potential indicated by the firm for the machine under consideration satisfying the following criteria. For conducting the tests, a section of mainline track will be selected over which there is no temporary speed restriction 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 will be as follows:

i) A lateral force lasting more than 2 metres should not exceed the Prud Homme’s limit of 0.85 (1+P/3) where P is the axle load.

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 1/20th 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 Para 2 (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 and lateral force and derailment coefficient of accelerations as the case may be.
CERTIFICATE OF INSPECTION OF BRM (MODEL No.--------)
BY INSPECTION OFFICIAL AND APPROVAL FOR DESPATCH OF BRM

This is to certify that I have inspected the BRM --------bearing SL No.--------from (date) -------- to--------- (at place) --------- for its conformity/non-conformity with respect to the laid down Technical Specifications in contract Agreement NO.-------- ---- dated --------- between President of India through Executive Director /Railway Board and M/s (Name of contractor)--------------------.

The detailed inspection note regarding its conformity/non-conformity to the laid specifications is enclosed alongwith an Annexure‘A’. It is observed that (strike out whichever is not applicable):-

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

1.________________________________________
2.________________________________________
3.________________________________________

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

The BRM is approved/not approved for despatch to __________________________ (consignee) Indian Railway.

SIGNATURE AND DATE

For M/s __________________
________________________

INSPECTION OFFICIAL
(NAME AND DESIGNATION)
For and on behalf of President of India
Particulars Required in Respect of the Rolling Stock Under Consideration

1. A diagram showing elevation salient dimensions:
   Wheel spacing, Wheel diameter, bogie centres, and axle load.

   a) i) Over all length of the vehicle
   ii) Length over head stock
   iii) Length over buffers
   iv) Distance apart for Centre of buffers
   v) Max./Min. height of centers of buffers above rail level

   b) i) Wheel base
   ii) Axle load (max)
   iii) Bogie Centres

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

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

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

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

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

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

8. 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.

9. 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:

10. Maximum braking force coming on to the rails per wheel:
    a) at working axle:
    b) at transfer axle:

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

12. Height of centre of gravity from rail level:

13. Height of floor from rail level:

14. Type of coupler provided - Indian Railways Standard:
   Coupling:
   Buffer:

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

Following information as detailed below is also required along with the information required as per Annexure ‘A’ for processing the case for issue of provisional speed certificate for new vehicle

<table>
<thead>
<tr>
<th>S.no</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. a)</td>
<td>Brake System details</td>
</tr>
<tr>
<td>1. b)</td>
<td>Gross Braking Ratio</td>
</tr>
<tr>
<td>2.</td>
<td>Brake rigging arrangement drawing and calculation of braking force</td>
</tr>
</tbody>
</table>
| 3. | Maximum Braking Effort. at start and at the speed of operation -  
   a) at working drive  
   b) at transfer drive |
| 4. | Characteristics of springs used in suspension indicating free 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 are lateral clearance of axle box / horn, wheel flange/rail and other locations for the negotiability of the vehicle on curve and turn out (enclose Vogels Diagram for negotiability on maximum degree of curve and turn out permitted on Indian Railways) of new and worn out wheel. |
| 8. | Wheel and axle assembly drawings |
| 9. | Calculation for flange force |
| 11. | Calculation of natural frequency |
| 12. | Calculation of spring characteristics and critical speed of the vehicle. |
| 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. |
Procedure of Drawing:
1. Draw a vertical line X-Y at 90° to the plane of the drawing
2. Draw a horizontal line X-Z parallel to the plane of the drawing
3. Draw a horizontal line X-Y parallel to the plane of the drawing
4. Draw a horizontal line X-Z parallel to the plane of the drawing
5. Draw a horizontal line X-Z parallel to the plane of the drawing
6. Draw a horizontal line X-Z parallel to the plane of the drawing
7. Draw a horizontal line X-Z parallel to the plane of the drawing
8. Draw a horizontal line X-Z parallel to the plane of the drawing
9. Draw a horizontal line X-Z parallel to the plane of the drawing
10. Draw a vertical line X-Z parallel to the plane of the drawing
## Annexure VII

### Specifications of Heavy duty Industrial Quality Water proof & shock proof Laptop (Tough book)

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CPU</strong></td>
<td>Intel Core i-5 processo, speed 2.4 GHz or higher version</td>
</tr>
<tr>
<td><strong>Operating System</strong></td>
<td>Windows 7 professional or higher version</td>
</tr>
<tr>
<td><strong>RAM</strong></td>
<td>2 GB or more and expandable upto 8GB</td>
</tr>
<tr>
<td><strong>Storage</strong></td>
<td>Shock mounted flex connect hard drive with quick release 1000 GB or More</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>Minimum 13” high definition LED or better with anti reflective and anti glare treatment</td>
</tr>
<tr>
<td><strong>Keyboard</strong></td>
<td>Backlit 61 key QWERTY keyboard. Touchpad with vertical scrolling support.</td>
</tr>
<tr>
<td><strong>Wireless</strong></td>
<td>Integrated Gobi 2000 mobile broadband or better, Bluetooth V 4.0 or better.</td>
</tr>
<tr>
<td><strong>Durability features</strong></td>
<td>Product shall be durable and meet the latest MIL standard. Moisture and dust resistant screen, Key board and touch pad.</td>
</tr>
<tr>
<td><strong>Pre Loaded Softwares</strong></td>
<td>Antivirus software for 18 months validity Microsoft office 2007 complete bundle</td>
</tr>
<tr>
<td><strong>Power supply</strong></td>
<td>Long life Li-ion battery, minimum 5400 m AH</td>
</tr>
<tr>
<td><strong>Warranty</strong></td>
<td>3-year warranty</td>
</tr>
</tbody>
</table>
# BRAKE DESIGN DETAILS OF THE MACHINE FOR CALCULATION OF EMERGENCY BRAKING DISTANCE

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tare &amp; gross weight of the machine in Kilograms</td>
</tr>
<tr>
<td>Brake power in Kilograms</td>
</tr>
<tr>
<td>Type of Brake blocks</td>
</tr>
<tr>
<td>Brake block area in Square Centimetres</td>
</tr>
<tr>
<td>Brake Rigging Diagram</td>
</tr>
<tr>
<td>Type of Brake system</td>
</tr>
</tbody>
</table>

---
## ANNEXURE IX

Machine details required for simulation of machine on NUCARS or similar Track-vehicle simulation software

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>Component’s Name</th>
<th>Parameters required</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>C.G. of component in x, y, z direction from rail level in mm (Referenced point 1\textsuperscript{st} axle)</td>
<td>X</td>
<td>Y</td>
<td>Z</td>
<td>Mass</td>
</tr>
<tr>
<td>1.</td>
<td>Super structure with vehicle frame (machine structure kept on secondary suspension of front and rear bogie)</td>
<td>Mass in Kg and Mass moment of inertias in Kg- m\textsuperscript{2} of component in three dimension space about their C.G</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Front Bogie frame including brake rigging</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Rear Bogie frame including brake rigging</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Transmission system device (hydraulic, Mechanical or electrical traction motors)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Wheel axle set including axle boxes which constitute the unsprung mass</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Mass of Items included in unsprung mass partially or fully along with their name per axle</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7.</td>
<td>Total weight of components in tonnes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Front bogie full assembly  
Rear bogie full assembly  
Machine frame full structure  
Full weight of vehicle (front bogie + rear bogie + vehicle car body or super structure)
<table>
<thead>
<tr>
<th></th>
<th>8. Suspension stiffness details in Kg/mm</th>
<th>Primary suspension element stiffness per axle box between bogie and axle box</th>
<th>Secondary suspension element stiffness per side between bogie and machine frame</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vertical stiff</td>
<td>Lateral stiff</td>
<td>Longitudinal stiff</td>
</tr>
<tr>
<td></td>
<td>Vertical stiff</td>
<td>Lateral stiff</td>
<td>Longitudinal stiff</td>
</tr>
<tr>
<td></td>
<td>9. Damping force details (If hydraulic damper used give there rating force per meter/second)</td>
<td>Vertical direction</td>
<td>Lateral direction</td>
</tr>
<tr>
<td></td>
<td>Vertical direction</td>
<td>Lateral direction</td>
<td>Longitudinal direction</td>
</tr>
<tr>
<td></td>
<td>Vertical direction</td>
<td>Lateral direction</td>
<td>Longitudinal direction</td>
</tr>
<tr>
<td></td>
<td>Dimension of location of suspension elements</td>
<td>Detail of location of suspension springs and dampers and shock absorbers with support drawing</td>
<td>Detail of location of suspension springs and dampers and shock absorbers with support drawing</td>
</tr>
<tr>
<td></td>
<td>Details of centre pivot arrangement and location</td>
<td>Provide detail arrangement drawing and description</td>
<td>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 vehicle bogie.</td>
</tr>
</tbody>
</table>