Specification No. 1

High Output Tamping cum Stabilising Machine capable of 3500 sleepers per hour peak output for B.G. (1676mm)

Technical Specification for High Output Tamping cum Stabilizing Machine capable of 3500 sleepers per hour peak output for B.G. (1676mm).

1.0 General:

Due to increasing traffic on Indian Railways, the availability of time period (Traffic Block) for working of track maintenance machines is reducing. There is a need for high output machines with continuous operation so that even smaller traffic blocks can be effectively utilized for maintenance of track. Conventional tamping machines are used for levelling, tamping and lining work of track. These maintenance operations result in reduction in lateral stability of track thus rendering track unsuitable for high speeds immediately after maintenance, particularly if the temperature are high. With the increased quantum of traffic moving at high speeds, it is very essential to restore the stability of track as early as possible. Controlled consolidation of track by stabilization following the tamping would also lead to longer retention of maintenance work. Presently, separate stabilizing machine is used behind the tamping machines for the purpose. Need was felt to have a machine which would combine both these activities and simultaneously execute both the jobs in the same sequence. Some of the advantage expected of having combined machine for the purpose instead of two separate machines are:

a) Operation of shunting is reduced and time lost in entry /exit to and from yard to block section is reduced.

b) A combined machine improves safety in movement vis-à-vis two machines following each other.

c) Track possession is utilized optimally.

d) Reduces number of operating staff and also saves on fuel consumption thus lowering operational cost.

This specification is laid down for a robust and sturdy high output track lining, lifting , levelling and tamping cum stabilizing machine (hereinafter called the machine), which should be suitable for track geometry correction at maintenance and renewal/construction sites. The machine shall be capable of improving the track geometry up to mainline high-speed standards and continuous tamping and stabilizing operation for high and durable output.

1.2 The technical specifications have been drafted to reflect the performance and quality requirements of the machine in a neutral manner without bias to any specific manufacturer. Bidders are requested to carefully study the specification and ensure that their machines fully comply therewith. If a bidder feels that his machine can substantially meet the performance and quality requirements 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. The Bidder 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 model offered and furnish a detailed technical description of the same. 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 details 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 Photograph of the type of machine offered in work mode shall be enclosed with the offer. These shall also show the close ups of various working assemblies/systems. The tenderer shall furnish a compact disc or DVD or USB showing the working of machine in real time under field conditions.

2.0 Dimensional and operating requirements:

2.1 The machine shall be diesel powered vehicle which shall be robust, of latest design, reliable and suitable for working on plain track, transitions and curved tracks (up to 10^0) on the Broad Gauge (1676 mm) of Indian Railways. The design and dimensions of the machine and components shall be to metric standards. Quality assurance during manufacturing shall be as per ISO-9001.

2.2 The machine shall be self propelled bogie type vehicle.

2.3 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 Indian Railways schedule of Dimensions 1676mm Gauge (BG), revised 2004 with the latest corrigendum and up to date correction slips issued. The minimum and maximum moving dimensions are enclosed at Annexure-I. The tenderer shall submit the sketches of machine in plan and shall give calculation for moving dimension on 10^0 curves to show the extent of lateral shift at the ends, centre and any other relevant cross sections. It shall be ensured that the machine does not cause infringement while moving on a 10^0 curve.

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 Axle load shall be lesser than 20.32t with minimum axle spacing of 1.83m. Load per metre shall not exceed 7.67t.Axle loads upto 22.82t and lower axle spacing may be permitted provided the load combinations do not cause excessive stresses in the track and bridges of IR. Stresses in the track and bridges shall be calculated by IR/RDSO, based on design data submitted by the firm as per Annexure–II and decision of IR/RDSO shall be final in this regards.

2.6 It shall have a minimum wheel diameter of 914mm (new wheel profile). However, lesser diameter up to 730 mm (new wheel profile) can also be considered, provided it meets the condition laid down in clause 2.4 at its condemnation limit also rail wheel 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 50mm margin between new and permitted worn wheel diameter should be available, but this should not be less than 20mm.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 (tonne)	Minimum worn out wheel diameter
22.82	908mm
22.00	878mm
21.50	860mm
21.00	841mm
20.32	816mm
20.00	805mm
19.50	787mm
19.00	768mm
18.50	750mm
18.00	732mm
17.50	713mm
17.42	710.00

2.7 The wheel profile shall be as per Indian Railway standard wheel profile provided in Annexure-III

2.8 It shall be capable of negotiating curves up to 10 degree curvature (175m radius), super elevation up to 185 mm and gradients up to 3% in travel mode. The supplier shall specify the minimum attainable speed under the above limiting conditions, which in any case shall not be less than 40 Kmph.

2.9 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	:	0° to 55° C
Altitude	:	Sea level to 1750 m above mean sea level
Humidity	:	40 to 100%
Maximum rail temperature	:	70° C

2.10 During transfer from one station to another, it shall be capable of travelling on its own at a speed of 80 kmph and at a speed of 100 kmph when hauled in a train formation. Since the machine is likely to cover long distances on its 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 camping coach at a maximum speed of not less than 50kmph.

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

2.12 The machine or its any part shall not infringe the adjoining track as per "Indian Railways Schedule of Dimensions 1676mm gauge (BG), Revised 2004 with the latest corrigendum and up to date correction slips issued" while opening and closing the 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 centre to centre.

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

3.0 Working Mechanism

3.1 The machine shall consist of a tamping portion (main machine) and an integrated stabilization unit. The stabilizing unit shall be in the form of trailer linked by an articulated coupling. The machine shall be capable of carrying out automatic lifting, leveling, tamping, lining along with simultaneous stabilization of the tamped track, at the peak rate of 3500 sleepers per hour over a period of not less than 10 minutes and an average of not less than 2700 sleepers in an effective hour of working on all type of track structures in Indian Railways with uniform sleeper density which may vary from 55 to 75cm. The time shall be counted from start to finish of tamping work at work place. Stoppage of work not attributable to machine shall be discounted. The setting up time and winding uptime shall be measured and the total time taken by the two operations of setting up and winding up of the machine together shall not exceed 10 minutes. The tenderer shall furnish the full details of the working cycle of the machine, its timings and other operational details.

3.2 The machine shall be provided with automatic tamping equipment. Separate tamping units have to be provided for each rail. Each unit comprising of tamping tools, shall be operated hydraulically.

3.3 The work units for tamping, lifting and lining shall be positioned on an under-frame separate from the main frame capable of cyclic movement from sleeper to sleeper, independent of the main frame, to facilitate continuous working for high output so that the operator does not get undue fatigue due to acceleration pull, braking jolt in each tamping cycle.

3.4 The tamping below the sleepers, after the track geometry correction, shall be based on vibratory squeeze principle to achieve a durable compaction. The amplitude, vibration frequency and squeezing pressure to achieve a durable compaction shall be specified.

3.5 The ballast depth ranging from 300 mm to 350 mm shall be effectively compacted having zone of influence of tamping of approx. 150mm layer below the bottom of sleepers. The maximum depth of concrete sleeper is equal to 210mm. There should be provision for step-less adjustment of the depth of tamping tools to suit different types of sleepers.

3.6 Amplitude and vibration frequency of the tamping tools should be such that durable compaction under the sleeper is achieved.

3.7 The tamping tools should come to rest automatically after they encounter the resistance from the ballast to pre-selected squeezing pressure and hold the squeezing pressure for pre- set time. It shall be possible to vary the squeezing pressure holding time, to suit varying ballast conditions.

3.8 The lifting system shall be such that the track can be lifted without bearing on the ballast. The machine frame and the lifting system shall be strong enough to bear the track lifting forces for all types of track structures for 150 mm lifts in one go. The free rail length between the two bogies of the main machine shall be long enough to permit the track lifting up to 150 mm in one go, having 60 Kg rails on concrete sleepers without excessive stresses in the rail or on the lifting mechanism. The lifting system should hold the rail continuously rather than releasing and re-lifting the rail at every tamping cycle. However, the lifting/lining system and actual tamping should be so synchronized that the track is stiffly held in position and there is no movement in the track when the tamping tool is inserted for tamping. This is required to ensure that the lift and slew are not altered during the process while track is being tamped

3.9 The machine shall be provided with automatic levelling equipment which will permit correct levelling of the track including provision of super elevation along with tamping. Tolerance achievable shall be as follows:

Unevenness	:	$\pm$ 1 mm on 3.6 m Chord
Cross level	:	$\pm$ 1 mm
Alignment	:	$\pm$ 2 mm on 7.2m Chord
Twist	:	1 mm/m

3.10 The machine shall be fitted with automatic lining equipment capable of carrying out lining simultaneously with leveling**.** The machine shall also have the ability to slew 60 Kg concrete sleeper track up to 150 mm in one go for all type of track structures.

3.11 The machine shall be capable of tamping, lifting, lining and stabilization of track with up to 60 Kg long welded rails or short welded rails or fish-plated rails laid on pre-stressed concrete sleepers, steel trough sleepers, CST-9 and wooden sleepers. As the minimum clear distance between the joint sleepers is 50 mm, the machine should be able to tamp these two sleepers together. The normal sleeper spacing in different track structures on Indian Railways is 55 cm to 75 cm.

3.12 The working cabins of the machine shall be air-conditioned. The air-conditioning provided shall be of robust industrial design capable of operating in highly dust laden environment. However the electronic equipments should be so designed that the machine shall be able to work without air-conditioning under the climatic conditions described in para no.2.9.

3.13 The tenderer may be required to show working of his machine under field conditions, The tenderer shall indicate the name of the Railway system where the types of machines offered are working.

3.14 It shall be possible to control the target track geometry parameters, in infinitely variable steps from operators/front cabin. To suit this, suitable proportional /servo control systems shall be provided.

3.15 On Indian Railways, rail top to sleeper bottom depth may vary from 260mm to 420mm.

3.16 The machine shall be provided with a computerized unit for the overall control of its working system for all possible track geometry. The system shall be so designed that for working on tracks with pre-decided target geometry, the standard track geometry data as well as correction values can be entered prior to work either directly on system or viaUSB, CD or DVD. For working on tracks with unknown target geometry, it shall be possible to determine the correction values by making a measuring run and subsequent geometry compensation of the recorded data considering obligatory point and constrains of lifting and lining etc. Interactive processing of the target profile by the operator shall be possible. Track parameters shall be displayed in graphic as well as text form on a colour monitor. It shall be possible to guide the working system of the machine continuously and automatically by this unit. The software shall be Windows based. The hardware shall be sturdy for operations under conditions of shock, vibrations, dust, electromagnetic influences from outside and interruption of power supply. The unit shall have adequate memory to keep records of minimum 100 km of work performed, new track geometry obtained and enables transfer of the data via USB, CD or DVD as required.

3.17 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-IV.

3.18 The machine shall be capable of measuring and recording the unevenness, alignment and cross level in real time on a print out before and after the tamping and stabilization by the machine. It shall also record progress vis-a-vis time.

3.19 Permanently fitted to the main machine, the stabilizing unit shall be an integral part of the machine. It shall achieve effective and continuous

stabilization of the track and shall be able to match the working speed of the tamping portion without loss in stabilizing quality.

3.20 During the operation, the stabilizer unit shall be capable of lowering the track in a controlled manner, while maintaining the pre-stabilized geometry. Proper longitudinal and cross-level control mechanisms shall be provided to achieve this. The manufacturer shall clearly explain the mechanism in its offer. ?

3.21 The stabilizing unit shall be capable of continuous stabilization of track including typical Indian Railway heavy concrete sleeper track. To achieve a controlled settlement and a lasting consolidation of such heavy track, it shall be equipped with two independent stabilizing units, applying a maximum vertical load of 12 tonnes each.

3.22 The stabilizing unit shall be capable of pre loading the track. While pre loading the track by stabilizing unit, the driving wheels should provide adequate adhesion to avoid wheel slippage/loss of traction and risk of derailment.

3.23 The horizontal and vertical force and frequency of vibration shall be adjustable so as to carry out effective stabilization on various types of track structures.

3.24 The machine shall be equipped with suitable mechanism to control the degree of settlement of the track which shall copy the pre-stabilizing geometry by automatically increasing/relieving the vertical load on the stabilizing units. For optimum results, mechanism shall work independently for the left and right hand rail.

3.25 It shall be possible to steplessely preselect the frequency of stabilizer vibrations which shall be between 0-45 Hz for optimum adjustment to suite the various kinds track structure. During work near fixed structures like bridges, it shall be possible to pre-select a frequency within that range which is beyond the natural frequency of the structure. In this context, it is also essential that the vibrations be automatically cut off, when the machine stops.

3.26 The stabilizing unit shall be equipped with a frequency modulation measuring unit for optimum regulation of frequency. The machine shall be equipped with display units for monitoring vibration frequency, and degree of settlement on both rails.

3.27 To avoid damages on the rail surface by excess friction and force by the rollers and to achieve a force free resettlement of the ballast grains only lateral vibrations shall be permitted and those lateral vibrations by stabilizing unit shall be created without any vertical impact.

3.28 The tamping tool holding arrangement in tamping arm of tamping bank should be cylindrical compressible type with bolting and dowel arrangement

such that no hammering is normally required for fixing and removing the tamping tools.

3.29 The machine shall be warranted for 1200 working hours or 500000 tamping insertions with stabilization or 18 months from the date of commissioning and proving test of equipment or 24 months after delivery at ultimate destination in India which ever shall be earlier. Working hours for this purpose will be traffic block time during which machine is deployed for tamping work.

4.0 Diesel Engine:

4.1 The machine shall be powered by diesel engines preferably indigenous with proven record of service in tropical countries with wide 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 the specification elsewhere. High speed diesel oil to Indian standard specification shall normally be used. A minimum fuel tank capacity sufficient for continuous operation for 8 hrs will be desirable. Sight glass type fuel measuring gauge shall be provided on the fuel tank. 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 button start type.

4.2 The supplier should 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.

4.3 Since the engine is 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.

4.4 There is a likelihood of dust deposition over the engine body and surrounding area over the lubricants spills 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 along with the machine.

4.5 The engine parameter monitoring gauges like temperature, rpm, and 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 audiovisual warning (safety mechanism) to the operators in case of any of these parameters exceeding the safe limit and engine shut down circuit in case of operator's failure to respond.

4.6 Suitable and rugged mechanism should be provided to start the prime mover at no load and gradual loading after the start of the prime mover.

4.7 The engine power take off shall be coupled to the main gearbox through a flexible coupling. The engine shall be mounted on suitable Anti-Vibration Mountings.

5.0 Drive Mechanism:

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

5.2 The machine's driving system shall be through hydro dynamically coupled power/transmission arrangement capable of achieving full speeds in travel mode in both the directions. However, the system should be so designed that all the driving wheels work in synchronization and there is no slippage/skidding of the wheels during the work drive.

5.3 The driving mechanism, in working mode, shall be adequately designed to handle the acceleration and braking forces at each tamping cycle. A suitable synchronization circuit to control the synchronization of lifting/lining/tamping process with the machine drive/braking system in working mode shall be provided to prevent any damage to the machine systems on account of non-synchronisation.

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

5.5 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.

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

5.7 Adequate gauges and solenoid valves shall be provided near linkage assembly for indication, flow control and carrying out necessary adjustment in the field.

5.8 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-today maintenance schedules.

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

6.0 Cooling System:

6.1 The cooling system shall be efficient and designed for a maximum ambient temperature of 55°C. Supplier shall note that the machine shall be working

under extreme dusty conditions and the cooling mechanism shall be maintainable under these conditions.

6.2 Adequate heat transfer arrangement for the hydraulic system shall be designed and provided so that under extreme heat conditions as mentioned in Para 2.9 above, the system oil temperature does not go beyond 85°C.

7.0 Brakes:

7.1 The machine shall be fitted with compressed airbrake system applying brakes equally on all wheels and provision shall be made to connect air brake system of the machine to that of camping coach when the machine is hauling it. 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 brake shall not exceed 10 Kg. at the handle while applying by hand and 15 Kgs. on the pedal, when applied by foot.

7.2 Machine shall be equipped with suitable arrangement of braking so that while attached in train formation, machine can be braked by traction vehicle having compressed air braking system.

7.3 There should be provision of emergency brake application in the machine either travelling alone or coupled with the camp coach, 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 designed speed on a level track shall not be more than 600m. 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 V.

7.4 Mechanical brakes shall also be provided in addition for use as parking brakes.

7.5 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.

8.0 Horn, Hooters and safety switches:

8.1 The machine shall be provided with electric/pneumatic horns facing outwards at each end of the machine at suitable locations for use during travelling and to warn the workmen of any impending danger at the work spot. The horns shall be distinctly audible from a distance of at-least 400 m from the machine. These horns shall be operated by means of push buttons provided in the cabins.

8.2 Adequate numbers of safety stop switches should be provided all around so that in case of any danger to worker during working, the working can be stopped immediately.

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

8.4 Machine shall be provided with emergency backup system to wind up the machine quickly in the event of failure of prime mover or power transmission system of the machine.

8.5 Pneumatically operated 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.

9.0 Hooks and buffers:

9.1 The machine shall be fitted with hooks and buffers of IRS design on both ends for coupling it with camping coach or other vehicles and running in train formation and for attachment with the camping coach**.**

10.0 SUSPENSION SYSTEM:

10.1 The suspension system shall be preferably of two-stage type with suitable spring and damping arrangement. Spring for primary and secondary suspension shall be designed to cater for actual service conditions. Effective measure shall be adopted to minimize the weight transfer while starting, stopping and during runs.

11.0 Electric equipment and lighting:

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 latest twin beam headlight assembly conforming to RDSO specification No. ELRS/SPEC/PR/0024 revision-1 September, 2004 with the amendments 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 and with two front and rear parking lights, which can be switched to red or white according to the direction of the travel. Powerful swivelling flood light shall also be provided to illuminate the working area sufficiently bright for efficient working during night. The amber colour flasher lights shall be provided on the both ends of the machine to give indication to the train arriving on other line about any impending danger.

12.0 Chassis and under-frame:

The chassis shall be fabricated from 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 horizontal squeeze load of 102t at buffers i.e. 51t at each buffing point. The under frame shall be sufficiently robust for safe travel of the machine in train formation and not necessarily as the last vehicle.

13.0 Cabins:

13.1 The machine shall be equipped with fully enclosed air conditioned and pressurized cabins with safety glass window at both ends. 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 machine in both the directions from the cabins at either end. The cabin layout shall be such that, before leaving the machine, the operating staff has full view on both the sides, to avoid any danger to them from trains on the adjacent tracks. Additional driver's cabin shall be provided if the view while driving is not clear for safe travel in both directions.

13.2 The gauges, warning panel and controls shall be suitably located in the operator's cab so that they can be observed without undue fatigue to the operator. Screen wipers preferably operated by compressed air or electrically operated shall be provided on the wind screen.

13.3 Suitable number of fire extinguisher (dry chemical type) shall be provided in all the cabins.

13.4 The machine shall be provided with well designed space for keeping the tools and spares required for on site repairs of the machine to attend the breakdowns and other working requirements.

13.5 The operator's cabin shall be ergonomically designed to have easy access to all the controls. The operator shall have a full view of the working area from the operating seat to have full control over the work. The stabilizing unit shall also be controlled from the main machine.

14.0 Tools and Instruction Manuals:

14.1 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 tenderer shall along with his offer submit the list of tools to be supplied along with each machine. The list of tools to be provided shall 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 list can be modified to suit the purchaser's requirement, while examining the offer.

14.2 Detailed operating, maintenance and service manual shall be specifically prepared in English language and four copies of each of the same shall be supplied with each machine.

14.**3** The supplier 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 supplier shall provide dimension drawings with material description of items like rubber seals, washers, springs, bushes, metallic pins etc. Main features such as type, rpm & 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 copies of these shall be supplied with each machine.

14.4 While offering the machine for first inspection, the supplier shall submit one copy of complete technical literature in English language including operation, service and field maintenance manual/instructions and complete electrical, hydraulic & pneumatic circuit diagrams, trouble shooting charts, component drawings/ description and other relevant technical details as a reference documents for the inspecting officer.

14.5 One portable diesel operated D.C. welding generator of reputed make (preferably made in India) with a minimum 5 KVA capacity along with sufficient length of cable or lead shall be provided with the machine for day to day repairing of machine and its wearing parts.

14.6 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.

14.7 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.

15.0 Spare parts:

15.1 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 components shall be advised along with their condemning limits. The supplier shall be responsible for the subsequent availability of spare parts to ensure trouble free service for the life of the machine (15 years).

15.2 For indigenous parts and brought out components and assemblies, the relevant technical details shall be supplied while offering the first machine for inspection.

16.0 Maker's test certificates:

16.1 Copies of marker's certificate guaranteeing the performance of the machines should be supplied in duplicate along with the delivery of each machine.

17.0 Operators:

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

18.0 Service Engineers:

18.1 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.

18.2 During the warrantee period of the machine the supplier must ensure trouble free availability of the machine in good working condition for at least 90 % of the time and accordingly they must ensure availability of spares &services of competent service engineers at prompt disposal of user railways.

19.0 OPTIONAL EQUIPMENT

19.1 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 equipments are already in use on machines elsewhere indicating the user Railway system.

20.0 Inspection of the Machine:

20.1 While inspecting the machine before dispatch 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 /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.

21.0 **Guarantee:**

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

Should any design modification be made in any part of the equipment offered, the period of 24 months would commence from the date of the modified part is commissioned in service 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.

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 trials of the vehicle, which is a time taking process. Therefore, issue of provisional speed certificate for the vehicle becomes a necessity and based on the same the approval of running of the vehicle on Indian Railway track is taken from Commissioner of Railway Safety. For issue of provisional speed certificate, following actions are required to be taken by the suppliers.

a) Current supplier , whose models are approved :

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

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

As soon as the supplier completes the design of the machine as per specification, the technical details as per Annexure (VII and VIII) shall be supplied 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 and VIII) can also be asked for issue of provisional speed certificate for the machine. The firm will also submit the technical details as per performa placed at Annexure-II for NUCARS vehicle dynamic simulation.

c) New supplier, whose models are new:

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

23.0 Acceptance Test:

23.1 In addition to verification of the various items of specifications covered earlier 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.

23.2 The Dimensional check of loading gauge, i.e. maximum moving dimensions, buffer heights, clearances, length of machine bogie distance etc.

23.3 Testing for negotiability 10° curve and 1 in 8½ turnouts.

23.4 Running speed tests on the Indian Railway main line track on the first machine in accordance with procedure outlined in annexure- IX with the machine running upto speed 10% higher than the maximum speed mentioned in Para 2.10 above.

23.5 Construction and engineering of the machine and its ability to perform all the functions as laid down in the specifications above.

23.6 Actual output and performance test to be conducted on the first machine. These tests shall be conducted under field conditions on Indian Railway. An electrified section shall be chosen for this test.
The general conditions of tests and test parameters shall be as follows:

(a) Machine crew shall be either trained personnel of Indian Railways or the staff of the supplier.
(b) Dry weather, ambient temperature between +0°C to + 55°C.
(c) Plain Track or curve of radius not less than 1000m.
(d) Gradients up to 1/200.
(e) Rails and sleepers in good conditions and properly fastened.
(f) Concrete/wooden/steel sleepers.
(g) Clean ballast cushion up to 100mm in sufficient quantity below the bottom of the sleepers and generally not cemented.
(h) LWR track.
(i) Regular sleeper spacing of 60/65 cm with a tolerance of $\pm$ 3 cm on straight track.
(j) Formation good.
(k) Amount of lowering up to 20 mm by stabilizing unit maintaining track parameters within permissible range.
(l) General lift during working up to 20mm.
(m) lifting of track in non-working mode of 150 mm in one go to be conducted at manufacturer's premise/siding.
(n) Maximum slew during working up to $\pm$10 mm.
(o) Slewing of track in non-working mode of 150 mm in one go to be conducted at manufacturer's premise/siding.
(p) The machine shall be able to tamp and stabilize 2700 sleepers in one effective hour of working. The time shall be counted from start to finish of tamping work at work place. The machine shall also be able to achieve a peak tamping and stabilizing rate of 3500 sleepers per hour over a 10 minutes period. Stoppage of work not attributable to machine shall be discounted. The setting uptime and winding uptime shall be measured and the total time taken by the two operations of setting up and winding up of the Machine together shall not exceed 10 minutes.

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.

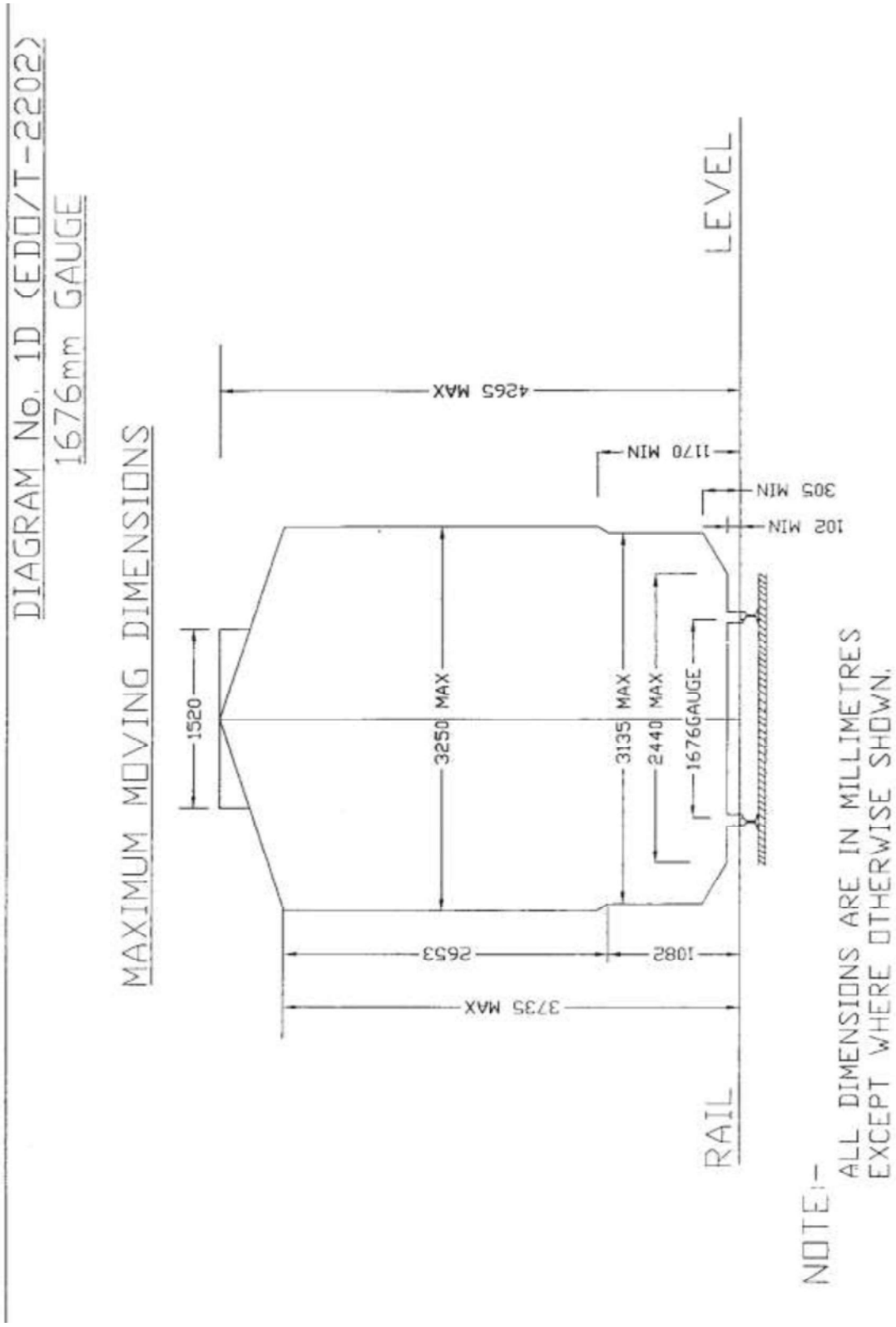


DIAGRAM No. 1D (EDO/T-2202)
1676mm GAUGE
MAXIMUM MOVING DIMENSIONS
LEVEL
4265 MAX
1170 MIN
305 MIN
102 MIN
1520
3250 MAX
3135 MAX
2440 MAX
1676GAUGE
2653
1082
3735 MAX
RAIL
NOTE:-
ALL DIMENSIONS ARE IN MILLIMETRES
EXCEPT WHERE OTHERWISE SHOWN.

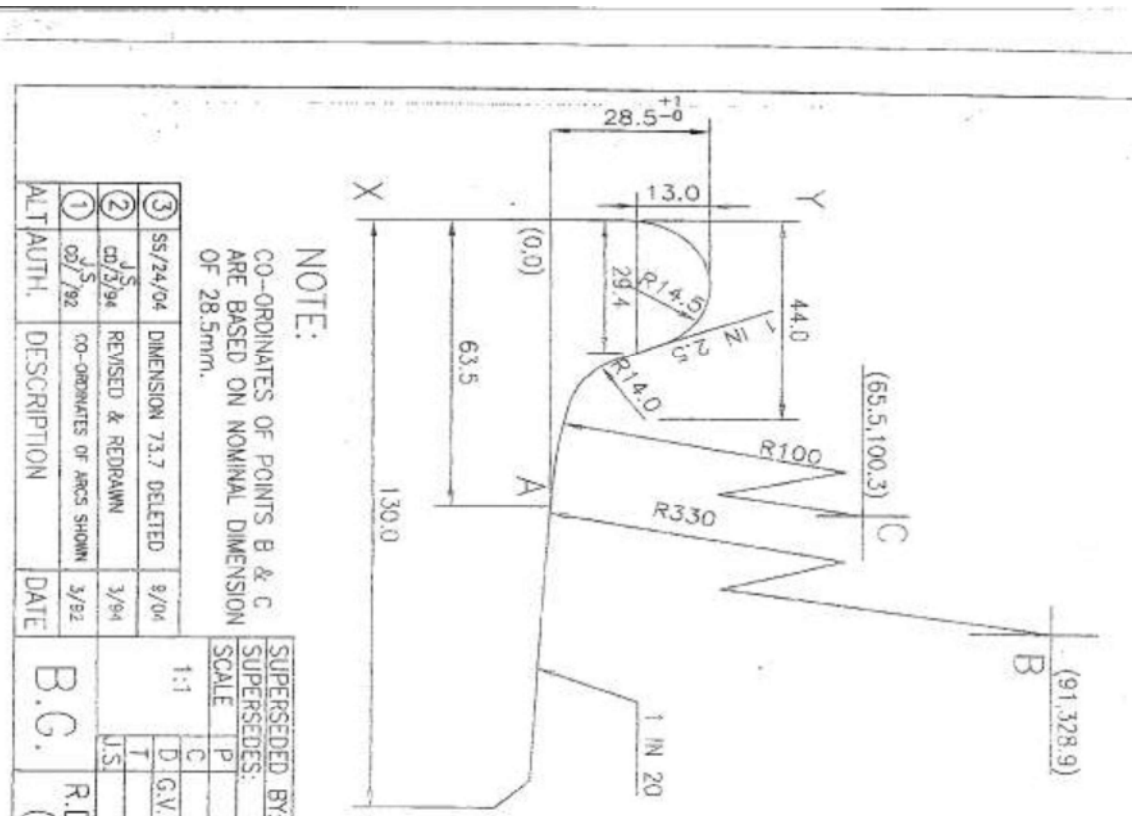
Annexure II

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

SL. N	Component's Name	Parameters required						
		C.G. of component in x, y, z direction from rail level in mm (Referenced 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							Total unsprung mass

	name per axle	1	2	3	4	5	6	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 (front bogie + rear bogie +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 s	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 abou vertical axis	Rotation about lateral axis	Rotation about longitudinal axis	

11.	Dimension of location 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 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 vehicle 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/192	CO-ORDINATES OF ARCS SHOWN	3/92
ALT	AUTH.	DESCRIPTION	DATE

SUPERSEDED BY:
SUPERSEDES:

SCALE		
1:1	C	
	D	G.V.RAMAN
	T	
	U.S	

B.G.

R.D.S.O. (C)

GROUP

WORN WHEEL PROFILE

SKETCH-99146

Annexure-IV

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

CPU	Intel Core i-5 processor ,speed 2.4 GHz or higher version
Operating System	Windows 7 professional or higher version
RAM	2 GB or more and expandable upto 8GB
Storage	Shock mounted flex connect hard drive with quick release 500 GB or More
Display	Minimum 13" high definition LED or better with anti reflective and anti glare treatment
Keyboard	Backlit 61 key QWERTY keyboard. Touchpad with virtical scrolling support.
Wireless	Integrated Gobi 2000 mobile broadband or better, Bluetooth V 4.0 or better.
Durability features	Product shall be durable and meet the latest MIL standard. Moisture and dust resistant screen, Key board and touch pad.
Pre Loaded Softwares	Antivirus software for 18 months validity Microsoft office 2007 complete bundle
Power supply	Long life Li-ion battery, minimum 5400 m AH
Warranty	3-year warranty

Annexure-V

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

Tare & gross weight of the machine in Kilograms
Brake power in Kilograms
Type of Brake blocks
Brake block area in Square Centimetres
Brake Rigging Diagram
Type of Brake system

ANNEXURE-VI

INSPECTION CERTIFICATE CERTIFICATE OF INSPECTION OF TRACK MACHINE ( ) BY INSPECTING OFFICIAL AND APPROVAL FOR DESPATCH OF MACHINES

(STRIKE OUT WHICHEVER NOT APPLICABLE)

This is to certify that I have inspected the machine (type)_____bearing Sl.No._____ from (date) _____to _____at (Place) _____ for its conformity/non-conformity with respect to the laid down Technical Specifications in contract Agreement No._____ dated_____between President of India through Director Track (Machines) and M/s. (Name of Supplier) _____ _____.

The detailed Inspection Note regarding its conformity/non-conformity to the laid specifications is enclosed along with as Annexure'A'. It is observed that (strike out whichever is not applicable):-

The Machine conforms to all the laid down specifications.

The machine 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:
_____
_____
_____

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

The machine is approved/not approved for despatch to _____ _____(Consignee) Indian Railway.

SIGNATURE AND DATE

For M/s._____
_____

INSPECTING OFFICIAL
(NAME AND DESIGNATION)
for and on Behalf of President of india

Annexure : VII

Particulars Required in Respect of the Rolling Stock Under Consideration

1. A diagram showing elevation salient dimensions :

a) Wheel spacing, Wheel diameter, bogie centres, and axle load.

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. Increase in the impact load during motion (Dynamic Augment)
9. Method of operation - Whether single only or coupling together is possible. If coupling is possible, the number which can be coupled and what is trailing load. :
10. Maximum tractive effort at start and at the speed of operation -
    i) at working drive at start :
       at operation speed :
    ii) at transfer drive at start :
       at maximum speed :

11. Maximumbraking force coming on to the rails per wheel
    at working axle :
    at transfer axle :
12. Drawing indicating suspension arrangement details of bogie and axle.
13. Height of centre of gravity from rail level
14. Height of floor from rail level
15. Type of coupler provided -Indian Railways Standard

    Coupling :

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

Annexure : VIII

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

S.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, 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 :- 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
10.	Technical specifications of Vehicle supplied.
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.

ANNEXURE-IX

1 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 and the following criteria satisfy for the same. For conducting the tests, a section of mainline track will be selected over which there is no temporary speed restrictions and which is considered by the Railway as being in a generally run down condition for mainline standards, but without speed restrictions. The vehicle will be tested generally for new and worn clearance conditions and where relevant for operation in the forward and backward directions. The vehicle selected for tests will be one in average condition for normal maintenance.

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 disturbances.

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 0.55 kg both in vertical and lateral directions. The peak values upto 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 movements of the bogie in straight and curved track and lateral force and derailment coefficient of accelerations as the case may be.

Specification No. 2

Ballast Regulating Machine for BG (1676mm Gauge)

SPECIFICATION FOR BALLAST REGULATING MACHINE FOR BG (1676 mm GAUGE)
(Specification No. TM/HM/BRM/369 Rev. 01 of 2016)

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 machine fully comply therewith. 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 system specification, he 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.

1.3 The bidder shall specify the model offered and furnish the detailed technical description of the machine same. 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. The welding standard followed for manufacturing of machine should be to ISO:3834, EN:15085 or any other equivalent standard. The manufacturer should specify the standard followed and certify that it meets the welding standard mentioned above.

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 as last vehicle shall be within the maximum moving dimensions shown in Indian Railways standard BG schedule of Dimensions (metric)-2004 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 10^0 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 20.32t with minimum axle spacing of 1.83 m. Load per meter shall not exceed 7.67t. 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. Axle load shall be calculated for hopper loaded with ballast of 12 m^3 taking total weight of ballast as 20 t.

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 condition laid down in clause 2.4 at its condemnation limit and rail wheel contact stresses for 72 UTS rails are within permissible limit. Forged wheels to Indian Railways profile shall be provided on the machine. It is desirable that 50mm margin between new and permitted worn wheel diameter should be available, but this should not be less than 20mm.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.

Maximum Axle load (tonne)	Minimum worn out wheel diameter (mm)
22.82	908
22.00	878
21.50	860
21.00	841
20.32	816
20.0	805
19.5	787
19.0	768
18.5	750
18.0	732
17.5	713

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 up to 10^0 curvature (176 m radius), super elevation up to 185 mm and gradients up to 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:

Ambient temperature	:	-5^0 to 55^0 c
Altitude	:	Sea level to 1750mm above MSL
Humidity	:	40% to 100%
Maximum rail temperature	:	70^0 C

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 running from one station to another, it shall be capable of travelling on its own power at a speed of 80 km/h and at a speed of 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 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 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 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 and also curved track of radius up to 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, brushes for fastenings and ballast hopper. Centre 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 Center plough and shoulder ploughs should 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.

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

3.5 Wherever required, 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 up to the angle of repose.

3.6 Wherever required, 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 up to 2675 mm from the centre 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 centre 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 have a system for picking up surplus ballast from track and 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 clips. 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 2000 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 conveyor for maximum use of its capacity during loading. Preferably it shall have an arrangement of foldable flaps (over and above the capacity of 10 M^3) to enable the capacity to increase to 12 M^3 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), electricals (charging/discharging rate, voltage etc.). All these data should be displayed on a monitor installed in working cabin. Arrangement for providing3G/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 but not less than 900 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 conditions, 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 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 3.18 above. It should also be possible to transfer these data on USB device.

4.10 In order to adhere to pollution Control norms, the diesel engine should be electronically controlled emmissionized engine with minimum compliance of tier 2 stage.

5.0 COOLING SYSTEM

5.1 The cooling system shall be efficient and designed for a maximum ambient temperature of 55ºC (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 2.8 above, the system oil temperature does not go beyond 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 airbrake system of the machine to that of the 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 55^0 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 parking.

6.2 The machine shall be equipped with suitable arrangement of braking so that while attached 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 the attached wagon or 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 machine shall be provided with dual tone (low tone & high tone) electric / pneumatic horns facing outwards at each end of the machine 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 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 cabin(s) 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 by remote switch 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.

8.3 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.

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

8.5 Suitable flow divider/throttling arrangement may be provided to equalize the tractive effort amongst different bogies.

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

8.7 Adequate gauges should be provided in working and driving cabins near operator's seat Solenoid valves shall be provided near linkage assembly, for indication, flow control and carrying out necessary adjustment in the field.

8.8 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-today maintenance schedules.

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

8.10 The machine shall be equipped with adequate safety circuit such that if any unit/part which may endanger the safety during movement of machine 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.

8.11 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 for attachment with the coach, locomotives and wagon.

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/TK/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 and rear 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. The umber 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 102 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 air-conditioned and pressurised cabin(s) 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 sides, to avoid any danger to them from trains on adjacent track.

12.2 The gauges, panels 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's 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 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 cabin(s).

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 cabin(s) shall have seating arrangement for at least six machine staff.

12.9 The machine shall be equipped with speed indicator and recording equipment of range between 0 - 200 km/h for recording the speed of the machine in real time basis. The recorded data should be retrievable on computer through memory card/pen drive. It should be provided in the 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.

13.0 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 prepared and in English language and four hard copies and soft copies 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 supplier 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 one copy 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 as reference document for the inspecting officer. All the above documents shall be available in English language 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 5 KVA capacity capable of welding up to 5 mm. electrode (dia) at 60% duty cycle shall be supplied. Sufficient cable or lead shall be provided with the welding plant 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.

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 equipmentare 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:

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 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

21.0 ACCEPTANCE TEST

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 10^0 curve and on1 in 8 &1/2 (eight & half) turnouts.
c) Construction and Engineering of the machine and its ability to perform all the functions as laid down in the specification.
d) 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.
e) Actual output and performance test to be conducted on the first machine.

21.2 Performance output 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 tested for regulating the ballast following a tamping machine at the rate of 1.5 track km in one hour of working in 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 2000 cum/hr.

21.3 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.

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.

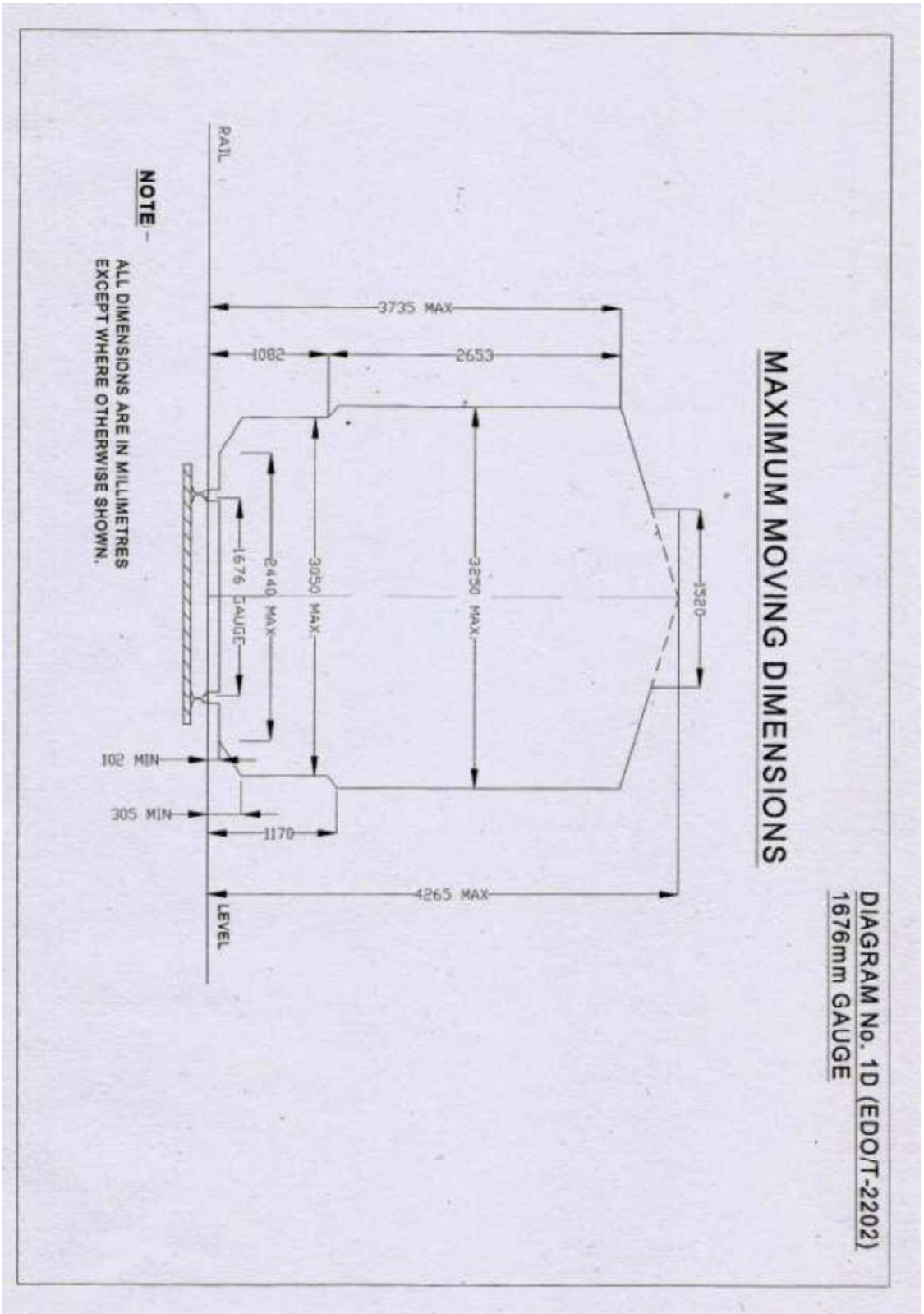
ii) On both side faces and below the Indian Railways logo, the text “INDIAN RAILWAYS” to be written in Bold and in Black colour of size equal to or slightly smaller than the size of logo but of size not less than 250 mm.

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.

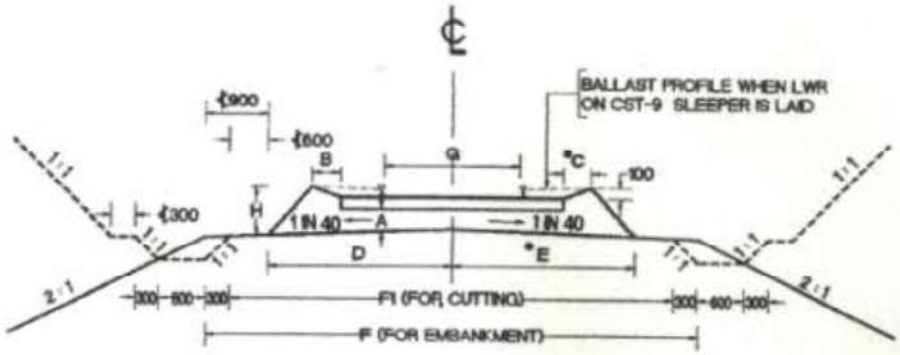
iv) If required, the Manufacturers Name may be written in size not more than 150 mm and should not be at more than four locations. Also the Manufacturers Logo may be provided at not more than two Locations and should be of size less than 200mm.

****

Annexure-I


MAXIMUM MOVING DIMENSIONS
DIAGRAM No. 1D (EDO/T-2202)
1676mm GAUGE
NOTE -
ALL DIMENSIONS ARE IN MILLIMETRES
EXCEPT WHERE OTHERWISE SHOWN.
RAIL
LEVEL
3735 MAX
1082
2653
1676 GAUGE
2440 MAX
3050 MAX.
3250 MAX.
1520
102 MIN
305 MIN
1170
4265 MAX

BALLAST PROFILE (SINGLE LINE BG) — Fig: 4.2.1(a)



G GAUGE	TYPE OF SLEEPER	A	B	*C	D	*E	F	F1	H
1676	WOODEN	250	350	500	2270	2420	6850	6250	540
		300	350	500	2270	2420	6850	6250	590
		200 OVER 150 SUB-BALLAST	350	500	2270	2420	6850	6250	640
	STEEL TROUGH	250	350	500	2280	2430	6850	6250	550
		300	350	500	2280	2430	6850	6250	600
		200 OVER 150 SUB-BALLAST	350	500	2280	2430	6850	6250	650
	PRC	250	350	500	2525	2675	6850	6250	640
		300	350	500	2525	2675	6850	6250	690
		200 OVER 150 SUB-BALLAST	350	500	2525	2675	6850	6250	740

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 $1/20^{th}$ 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 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.

.....

Annexure-IV

CERTIFICATE OF INSPECTION OF BRM (MODEL No.--------)
BY INSPECTION OFFICAL AND APPROVAL FOR DESPATCH OF BRM

(strike out whichever not applicable)

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

Annexure : VA

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

S.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, 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
10.	Technical specifications of Vehicle supplied.
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.
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.
28.5
13.0
(0,0)
63.5
29.4
R14.5
44.0
R14.0
(65.5,100.3)
R100
R330
(91,328.9)
130.0
1 IN 20
A
B
C
X
Y
SUPERSEDED BY:
SUPERSEDES:
SCALE 1:1
P
C
D G.V.RAMAN
T
M.S.
B.G.
R.D.S.O. (C)
GROUP
WORN WHEEL PROFILE
SKETCH-9114
③ SS/24/04 DIMENSION 73.7 DELETED 8/04
② JS 08/3/94 REVISED & REDRAWN 3/94
① JS 08/3/92 CO-ORDINATES OF ARCS SHOWN 3/92
ALT/AUTH. DESCRIPTION DATE

Annexure VII

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

CPU	Intel Core i-5 processo, speed 2.4 GHz or higher version
Operating System	Windows 7 professional or higher version
RAM	2 GB or more and expandable upto 8GB
Storage	Shock mounted flex connect hard drive with quick release 1000 GB or More
Display	Minimum 13" high definition LED or better with anti reflective and anti glare treatment
Keyboard	Backlit 61 key QWERTY keyboard. Touchpad with vertical scrolling support.
Wireless	Integrated Gobi 2000 mobile broadband or better, Bluetooth V 4.0 or better.
Durability features	Product shall be durable and meet the latest MIL standard. Moisture and dust resistant screen, Key board and touch pad.
Pre Loaded Software's	Antivirus software for 18 months validity Microsoft office 2007 complete bundle
Power supply	Long life Li-ion battery, minimum 5400 m AH
Warranty	3-year warranty

Annexure-VIII

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

Tare & gross weight of the machine in Kilograms
Brake power in Kilograms
Type of Brake blocks
Brake block area in Square Centimetres
Brake Rigging Diagram
Type of Brake system

ANNEXURE IX

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

SL. No.	Component's Name	Parameters required						
		C.G. of component in x, y, z direction from rail level in mm (Referenced 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	5	6	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 (front bogie + rear bogie + 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 s	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 direct	Longitudinal direction	Rotation abo vertical axis	Rotation about lateral axis	Rotation about longitudinal axis
11.	Dimension of location of suspension eleme	Detail of location of suspension springs and dampe 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 workir 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 vehicle bogie.					

Specification No. 3

Shoulder Ballast Cleaning Machine

TECHNICAL SPECIFICATION FOR SHOULDER BALLAST CLEANING MACHINE

1.0 GENERAL

1.1 These specifications are framed for a Shoulder Ballast Cleaning Machine (hereinafter called the machine), which should be capable of removing the ballast from the shoulder portion of the track, screen it, put back the screened ballast and profile it. The machine shall be robust, sturdy and capable of operating under the conditions prevailing on Indian Railways.

1.2 Technical Specifications have been drafted to reflect the performance and quality requirements of the machine in a neutral manner without bias to any specific manufacturer. Bidders are requested to carefully study the specification and assure that their equipment fully comply with these specifications. Thereafter, if a bidder feels that his equipment can substantially meet the performance and quality requirements of the machine but does not fully satisfy a particular system specification, he should mention the same in the statement of deviation from the technical specifications, giving the details how the functional requirements are going to be met with. The tenderer may seek clarifications, if any, from the purchaser prior to submission of the bids.

1.3 The bidder shall specify the model offered and furnish detailed Technical Description of the same. System/sub-systems of the working mechanisms of the machine shall be described in detail in the "Technical Description", along with the 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 close-ups of various working assemblies/systems and the full machine. The tenderer shall furnish a video CD showing the working of machine under field conditions.

2.0 DIMENSIONAL AND OPERATING REQUIREMENTS

2.1 The diesel-powered equipment shall be robust, reliable and suitable for working on Indian Railways. The design and dimensions of the machine components shall be to metric standards. Quality assurance during manufacturing of the machine shall be according to ISO-9001. The machine shall be suitable for working on straight, transition and curved tracks (upto 10 degree) on broad gauge (1676 mm) of Indian Railways.

2.2 The machine shall be a self propelled bogie type vehicle with minimum 4 axles (2 bogies).

2.3 The profile of the machine longitudinally and in cross section during movement as self-propelled vehicle or towed in train formation shall be within the minimum and maximum moving dimensions shown in the Indian Railways Standard BG schedule of Dimensions(metric)-Rev-2004. These dimensions are shown at Annexure-1/I. 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 any cross section.

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

2.5 Axle load shall be lesser than 20.32t with minimum axle spacing of 1.83 m. Load per metre shall not exceed 7.67 t. Axle loads upto 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-IV), and decision of IR/RDSO shall be final in this regard.

2.6 It shall have a desirable wheel diameter of 915 mm. However, lesser diameter can also be considered, provided it meets the speed and riding quality criteria as laid down. Forged wheels to Indian Railway Profile shall be provided on the machine. It shall have a minimum wheel diameter of 915 mm (new wheel profile). However, lesser diameter upto 730 mm (new wheel profile) can also be considered provided it meets the riding quality and speed criteria laid down in Clause 2.10 & 19.3 and rail wheel contact stresses for 72 UTS rails are within permissible limits. Forged wheels to Indian Railways profile shall be provided on the machine. The worn out wheel diameter based on the criteria of rail wheel contact stresses for various maximum axle loads are as under:

Maximum axle load tonne)	Minimum worn out wheel diameter (mm)
20.32	816
20.0	805
19.5	787
19.0	768
18.5	750
18.0	732
17.5	713
17.0	700
16.5	680

It should be able to meet the speed and riding quality criteria as given in clause 2.10 and 19.3 .

2.7 The wheel profile shall be as per Indian Railway standard wheel profile provided in annexure VII.

2.8 It shall be capable of negotiating curves upto 10^{o} 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 conditions which in any case shall not be less than 40 kmph.

2.9 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	:	0^{o} - 55°C
Altitude:	:	Sea level to 1700m
Humidity:	:	40% to 100%
Maximum rail temp.	:	70 ^{o} C

2.10 During transfer from one station to another, it shall be capable of travelling on its own and haul a camping coach (maximum trailing load of 70 tonnes on four axles & air brakes) at a speed of 75 kmph and at a speed of 80 kmph when hauled in a train formation. Since the machine is likely to cover long distances on its own power, the travel drive system should be robust to sustain these requirements during the life of the machine without significant break down/failure.

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

2.12 While working on double 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 4.265 m centre to centre. The machine or its any part shall not infringe the adjoining track while opening and closing of work as per Indian railways Schedule of Dimensions 1676mm gauge (BG), revised-2004 with the latest corrigendum and up to date correction slips issued, while opening and closing of work.

2.13 The machine shall be equipped with pneumatically operated block brakes acting on all wheels. The

machine shall 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 working on all types of track structures including long welded rails of 60Kg./52Kg./90-R sections laid on concrete/steel-trough/CST-9/wooden sleepers.

3.2 Since the machine is required to work in dusty environment, all the components including gear boxes, bearings, drive motors, 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.

3.3 The various assemblies and the machine as a whole should provide adequate safety to the workmen working close by in connection with the machine operations. Various mechanisms shall be so designed that the ballast pieces do not fall on persons standing nearby. The necessary safety equipments shall form a part of the machine's Tools & Plants. The tenderer shall supply these items as a part of the offer.

3.4 It shall be capable of excavating ballast on the sleeper shoulders upto distance of 2600 mm from the track centre and a depth of 900, below the rail top. The excavation depth shall be adjustable to suit the requirement at site.

3.5 The ballast shall be excavated upto the desired depth and width in one working pass.

3.6 It shall be possible to screen the ballast from either or both shoulders in one pass.

3.7 The machine shall be able to excavate ballast from the end of the sleepers to the toe of the ballast section (ref. Sketch at Annexure-I/II). The width of excavation, measured from the end of the sleeper, shall be adjustable from 500 mm to 1300 mm depending upon the site conditions.

3.8 The undercutting on shoulders shall be done at a cross slope of 1 to 30 towards outside of the track for good drainage (Ref. Annexure-I/II) on double line track the slope shall be in the same direction on both shoulders.

3.9 The excavating mechanism of the machine shall be retractable towards the track centre so as to avoid hitting of OHE mast foundations and at the same time, excavating the shoulder ballast from the area. The details of the OHE mast foundations are shown in the sketch enclosed along with as Annexure- I/II.

3.10 The machine shall have mechanism to excavate ballast from under the sleeper bottom upto 100 mm distance from the sleeper ends towards the track centre, to break the mud pockets. It shall be possible to use this mechanism only when considered necessary.

3.11 The excavation units shall be laterally adjustable for compensation of various sleeper lengths or for meeting certain other site conditions. The shift of the inner cutting face of the excavating mechanism shall vary from 1300mm to 1500mm, from the track centre, on either side of the track.

3.12 The machine shall be able to adjust the continuously variable speed from 0 to 1.5 kmph while in the work mode.

3.13 The screening unit shall be capable of screening the excavated ballast through a series of screens. The maximum and minimum sizes of the ballast retained shall be 65 mm and 25 mm respectively. The screening unit shall automatically remain in horizontal position laterally, even when working on curves upto a super elevation of 185 mm.

3.14 It shall be possible to dispose of the spoil (oversize as well as the under sized ballast and muck) on the cess at a distance of not less than 5 metres from the centre of the track, on either side of the machine. The spoil conveyor system shall be such that the spoil does not fall on the cleaned track. This feature is particularly relevant in the context of electrified sections where the spoil conveyor is required to clear the mast of over head wire which are placed at a close distance to the track (ref. Annexure- I/II). For this reason muck shall be unloaded to the front on yet to be screened track.

3.15 The tenderer shall also provide a suitable safety mechanism to ensure that the spoil conveyor does not hit the mast and cause damage even due to error of the operator like non-withdrawal of the spoil conveyor in time to by-pass the mast.

3.16 Loading of spoil into a muck wagon attached to the machine shall also be possible, when required, while working in yards, built up area or cuttings etc. Machine during its working mode shall be capable of hauling/pushing muck wagons attached with the machine. The maximum trailing load of muck wagons is 800 Tonnes approximately. The muck carrying wagons shall be air braked vehicles.

3.17 The machine shall deposit cleaned ballast on either or both shoulders as required. There shall be not too short deposit of the cleaned ballast or heaping up of the ballast at the beginning/end of the work or during any stoppage of the work.

3.18 The machine after putting the cleaned ballast into the track shall make the desired ballast profile on either or both the shoulders. The side ploughs shall be suitably designed for necessary adjustment to achieve the required width and slope of ballast on the shoulders. It shall be possible to suitably retract the side of ploughs near the mast or signal posts etc.

3.19 Top of the sleeper ends, fastening area and rails shall be cleaned of ballast pieces, using end ploughs and brooms.

3.20 After carrying out the work, the machine shall leave the track in a condition so as to permit trains at maximum sectional speed without tamping, while the temperature is in the working range.

3.21 The machine shall have suitable mechanism to retract the excavating, regulating and other mechanisms from their working position on the approaches of level crossings, bridges, turnouts, etc. It shall be possible to retract and lower these assemblies within about 1 metre of the level crossing, bridge, etc. so that there may be minimum loss of shoulder ballast cleaning operation.

3.22 Time required for starting the ballast excavation and screening after arrival at the site of work together with the time required between stopping of the screening work and the starting of the machine for return journey shall be less than 15 minutes. A lower setting up and winding up time shall be desirable. The purchaser attaches utmost importance to the effective utilisation of the traffic block made available for working of the machine.

3.23 The output of the machine in one hour of effective working shall not be less than screening of 500 m^3 (five hundred cubic metre)of ballast. The test conditions for this purpose have been spelt out in detail in clause 19 of these specifications.

3.24 The excavating and pick up mechanism shall be so designed that nearly all the excavated material is picked up for screening. Not more than 2% of the total material excavated. by volume shall be left behind by the picking up mechanism.

3.25 The efficiency of screening shall be judged by collecting 5 samples of the screened material as it falls from the machine before its deposition in the track. Not more than 4% of this material by volume shall pass through a 25 mm sieve (ISI standard).

3.26 In addition to the computer system provided on the machine for its own controls, The machine shall be provided with one additional Industrial quality shockproof & waterproof heavy duty Portable computer (laptop-toughbook) for keeping record of overall aspects of working, spares management and reporting. The software shall be window based. The hardware shall be sturdy for operation under conditions of shock, vibration, dust, electromagnetic influences from outside and interruption of power supply. The detailed specifications of the laptop are enclosed as annexure-IX.

4.0 DIESEL ENGINE AND DRIVE MECHANISM

4.1 The machine shall be powered by diesel engine preferably indigenous, with proven record of service in tropical countries. Robust construction and low maintenance cost are of particular importance. The manufacturer of the Engine shall have acquired quality assurance certification of ISO: 9001. Adequate allowance shall be made for de-rating of diesel engine under the most adverse climatic conditions mentioned in this specification elsewhere.

4.2 The supplier shall furnish the details of diesel engine and its controls to assess its conformity with the engines already operating on track machines on IR. 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.

4.3 High speed diesel oil to Indian Standard Specification shall be normally used. A minimum fuel capacity sufficient for continuous operation for 8 hrs will be desirable.

4.4 Sight glass type fuel measuring gauge shall be provided on the fuel tank.

4.5 For starting the engine, storage batteries of well known make shall be provided. The engine shall normally be push button start type.

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

4.7 There is a likelihood of dust deposition over the engine body and surrounding area where 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 along with the machine.

4.8 The engine parameter monitoring gauges like temperature, rpm, lub.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 circuit in case of operator's failure to respond.

4.9 Suitable and rugged mechanism should be provided to start the prime mover at no load and gradual loading after the start of the prime move.

4.10 The engine power take off shall be coupled to the main gear box through a flexible coupling. The engine shall be mounted on suitable Anti Vibration Mountings.

4.11 The machine should be provided with an efficient traction drive system for traction during the operation. The machine's driving system shall be through hydro dynamically/hydrostatic capable of achieving full speeds in travel mode in both the directions. The system should be so designed that all the driving wheels work in synchronization and there is no slippage / skidding of the wheels during the work drive.

4.12 The driving mechanism, in working mode, shall be adequately designed to handle the acceleration and braking forces.

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

4.14 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.

4.15 The supplier shall provide the necessary technical details including circuit diagrams and detailed technical specifications of all electrical/electronic parts to confirm the above requirements.

4.16 Adequate gauges (flow meter) and solenoid valves shall be provided near linkage assembly, for indication, flow control and carrying out necessary adjustment in the field. 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-today maintenance schedules.

5.0 COOLING SYSTEM

5.1 The cooling system shall be efficient and designed for a maximum ambient temperature of 55°C. Supplier may 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 2.9 above, the system oil temperature does not go beyond 85 degree centigrade.

6.0 BRAKES

6.1 The machine shall be fitted with the compressed air-brakes. Provision shall be made to brake the camping coach from the machine air-brake system, when these are hauled by the machine. 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 55^0 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. In addition, mechanical brakes shall also be provided for use in an eventuality of failure as well as for parking.

6.2 Machine shall be equipped with suitable air brake valves so that while working in train formation, machine can be braked by traction vehicle. In addition, the machine shall be equipped with suitable air brake system in the driving cabins so that the attached wagon or camping coach while being hauled by the machine, can be braked. The speed of machine while hauling a 8 wheeler coach should not be less than 50 kmph.

6.3 There should be provision of emergency brake application in the machine either travelling alone or coupled with the camp coach, in addition to the normal braking system of the machine, using the compressed air. The emergency braking distance (EBD) of the machine coupled with a camping coach on the Indian railway track at the maximum designed speed on a level track shall not be more

than 600m. In this regard necessary design calculations for the braking effort and EBD at the maximum design speed of the machine coupled with coach 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.

7.0 HORN AND SAFETY SWITCHES

7.1 The machine shall be provided with electric/pneumatic horns/hooters at suitable location facing outwards to warn the workman of any impending danger at the work spot or from on-coming train. The horns shall be distinctly audible from a distance of at least 400 m from the machine. The horns/hooters shall be operated by means of push buttons provided in the cabs .Adequate no. of safety stop switches should be provided all around so that in case of any danger to worker during working, the working shall be stopped immediately.

7.2 Safety equipments like jacks, 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.

7.3 Machine shall be provided with emergency back up system to wind up the machine in the event of failure of prime mover or power transmission system of the machine.

8.0 HOOKS AND BUFFERS

8.1 The machine shall be fitted with hooks and buffers of IR design on both ends for coupling it with other vehicles for running in train formation and for attachment with the camp coach/ muck wagons. IR currently uses Transition Centre Buffer Coupling for such applications.

9.0 SUSPENSION SYSTEM:

The suspension system shall be preferably of two-stage type with suitable spring and damping arrangement. Spring for primary and secondary suspension shall be designed to cater for actual service conditions. Effective measure shall be adopted minimize the weight transfer while starting, stopping and during runs.

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 Twin beam headlight assembly conforming to RDSO's specification No.ELRS/SPEC/PR/0024 Rev-1, Sept 2004 with latest amendments ensuring a light intensity of 3.2 lux at ground level at track centre at a distance of 305 mts. 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. The flasher lights at both ends shall be provided on the machine to give indication for the train arriving on other line.

11.0 CHASSIS & UNDER FRAME

11.1 The chassis shall be fabricated from 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 underframe shall be sufficiently robust for safe travel of the machine in train formation and not necessarily as the last vehicle.

12.0 CABINS

12.1 The machine shall be equipped with fully enclosed cabins with safety glass window at both the ends. It shall be possible to have a clear view of the track ahead while driving the machine in both the directions from the cabins at either end. The cabin layout shall be such that, before leaving the machine, the operating staff has full view on both the sides, to avoid any danger to them from trains on the adjacent tracks.

12.2 The working cabins of machine shall be air conditioned to provide dust free atmosphere inside the cabins. The air conditioning provided shall be of robust industrial design, capable of operating in highly dust-laden environment. However, the electronic equipment shall be so designed that they shall be capable of working without air conditioning under the climatic conditions described in para 2.6 2.9 above.

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

12.4 The operator's cabin shall be ergonomically designed so that the operator has easy access to all the controls. The operator shall have a full view of the working area from the operating seat to have a full control over the work.

12.5 One screen wiper shall be provided on each of the wind screens.

12.6 Fire extinguisher (dry chemical type) shall be provided in the cabins.

12.7 The machine shall be provided with adequate space for keeping the tools and spares required for on-site repair of the machine and other working requirements.

13.0 TOOLS AND INSTRUCTIONS 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 specialised equipment. All special tools shall be listed and catalogued illustrating the method of application.

13.2 Detailed operating manual, maintenance, service and assembly overhauling manuals shall be specifically prepared and four copies of these shall be supplied with each machine. These shall be specifically prepared in English language and four copies of these shall be supplied with each machine. One set of all the manuals and diagrams (one set for a group of similar machines) should be sent to the Principal/IRTMTC, Allahabad, ED/TMM directorate, RDSO, Lucknow and DTK(MC)/Railway Board.

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 additions, the supplier shall provide dimensioned drawings with material description of items like rubber seals, washers, springs, bushes, metallic pins etc. Main features of items like hydraulic pumps-motors and such other bought out items shall be furnished by the supplier. These shall be specifically prepared in English language and four copies of these shall be supplied with each machine.

13.4 The tenderer shall, alongwith his offer, submit the list of tools, manuals, circuit diagrams and other technical literature/drawings to be supplied alongwith each machine as above, for operation, servicing, maintenance, assembly overhauling, Periodical Overhauling of the machine and trouble shooting guides. 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 copies of complete technical literature including operation, service and field maintenance instructions and workshop manuals for overhauling of the assemblies and the machine, complete electrical, hydraulic and pneumatic circuit diagrams, trouble shooting charts, component drawings/description and other relevant technical details so as to maintain master copies of these documents in Indian Railway Institutions and a reference document for the inspecting officer.

13.6 One portable welding plant of reputed make with a minimum 11 KW/16 H.P capacity along with sufficient cable or lead shall be provided with the machine for day to day repairing of machine and its wearing parts.

13.7 The firm shall provide detailed technical drawings and specifications of wheels and axles used in the machine along with detailed code of procedure for ultrasonic testing of wheels and axles of all types. The above details shall be provided in four sets.

14.0 SPARE PARTS

14.1 The expected life of the components shall be advised along with their condemning limits. The machines shall be supplied with necessary spare parts for the operation and maintenance of the machine for a period of two years i.e working for about 2000 hrs.

14.2 The tenderer, alongwith the offer, shall furnish the required spare parts details in a separate list indicating description, part number, quantity, price, cost, whether imported or indigenous and their source of supply (OEM details).

14.3 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).

14.4 For indigenous parts and bought out components and assemblies, the source and other relevant technical details shall be supplied while offering the first machine for inspection.

15.0 MAKER'S TEST CERTIFICATE

15.1 Copies of the Maker's certificate guaranteeing the performance of the machines 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 machines under normal condition shall be indicated, specifying their duties and minimum qualifications.

17.0 OPTIONAL EQUIPMENTS

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

18.0 INSPECTION OF THE MACHINE

18.1 While inspecting the machine before despatch 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 machine's conformity/non-conformity with respect to each item shall be jointly recorded, before the issue of the "Inspection certificate and approval for despatch of the

machine" as per Annexure-III enclosed.

19.0 ACCEPTANCE TEST

19.1 In addition to verification of the various items of specifications covered earlier, the purchaser's nominee shall carry out the following tests in India at the purchaser's premises at the time of the 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.

Dimensional check of loading gauge, i.e. maximum moving dimensions, buffer heights, clearances etc.

19.2 Testing for negotiability of 10° curve and 1 in $8^{1/2}$ turnouts on the first machine.

19.3 Running speed tests on the Indian Railway mainline track on the first machine in accordance with the para 2 of Annexure-II.

19.4 Construction and engineering of the machine and its ability to perform all the functions as laid down in the specifications above.

.

19.5 Actual output and performance tests: These tests shall be conducted under field conditions on I.R. An electrified section shall be chosen for this test. The procedure shall be as follows:

a) The machine crew shall be either trained personnel of Indian Railways or the staff of the contractor.
b) Dry weather, ambient temperature between +10° C to 40° C.
c) Straight track or curve with radius minimum upto 1000 m.
d) Gradient upto 1 in 200
e) Rails fastened to all sleepers.
f) Concrete/wooden/metal sleepers.
g) Same type of sleepers, excepting case of fishplated track where joint sleepers could be of different type.
h) Variation in sleeper length + 50 mm from standard length.
i) No cutting into blanket or formation.
j) Screening of both shoulders simultaneously.
k) Cutting depth shall be atleast 200 mm below the bottom of the sleeper on both shoulders.
l) Generally, no ballast piece bigger than 150 mm. Over-size between 75 mm and 150 mm not exceed 1%. Size of ballast to be recovered between 25 mm and 75 mm. The ballast not generally cemented.
m) No water pockets, no mud pumping, grass in limited quantity.
n) Normal moisture content of permanent way.
o) Spoil below 25 mm size upto a maximum of 30% by volume for this purpose 4 representative samples shall be collected from the test length and screened at site for calculation of the spoil content. An average value shall be worked out which shall not exceed 30% by weight. While collecting the samples it shall be ensured that the entire section to be excavated and screened is picked up.

p) The formula for calculation of the output shall be as follows:

V (Output) = Total volume in M^3 excavated for screening Time in hours V represents the volume of the excavated ballast which shall not be less than 500 m3/hr. Time shall be measured in hours discounting the stoppages not attributable to machine failures.

19.6 Samples of the screened ballast shall be collected before it drops on the shoulder and shall be screened separately to assess the quantity of under size elements. Under size material upto 25 mm shall not exceed 4% by volume to the screened ballast. 5 Samples shall be collected and an average volume shall be worked out for the purpose of this test.

19.7 The setting up time and winding up time of the machine as described in the specifications elsewhere shall be measured and the total time taken by the two operations of setting up and winding up of the machine shall not exceed 15 minutes.

20.0 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, un-sprung mass and braking force coming on rails 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 (IV, V & VI) shall be supplied 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 IV, V & VI) 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.

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

Annexure-1/I

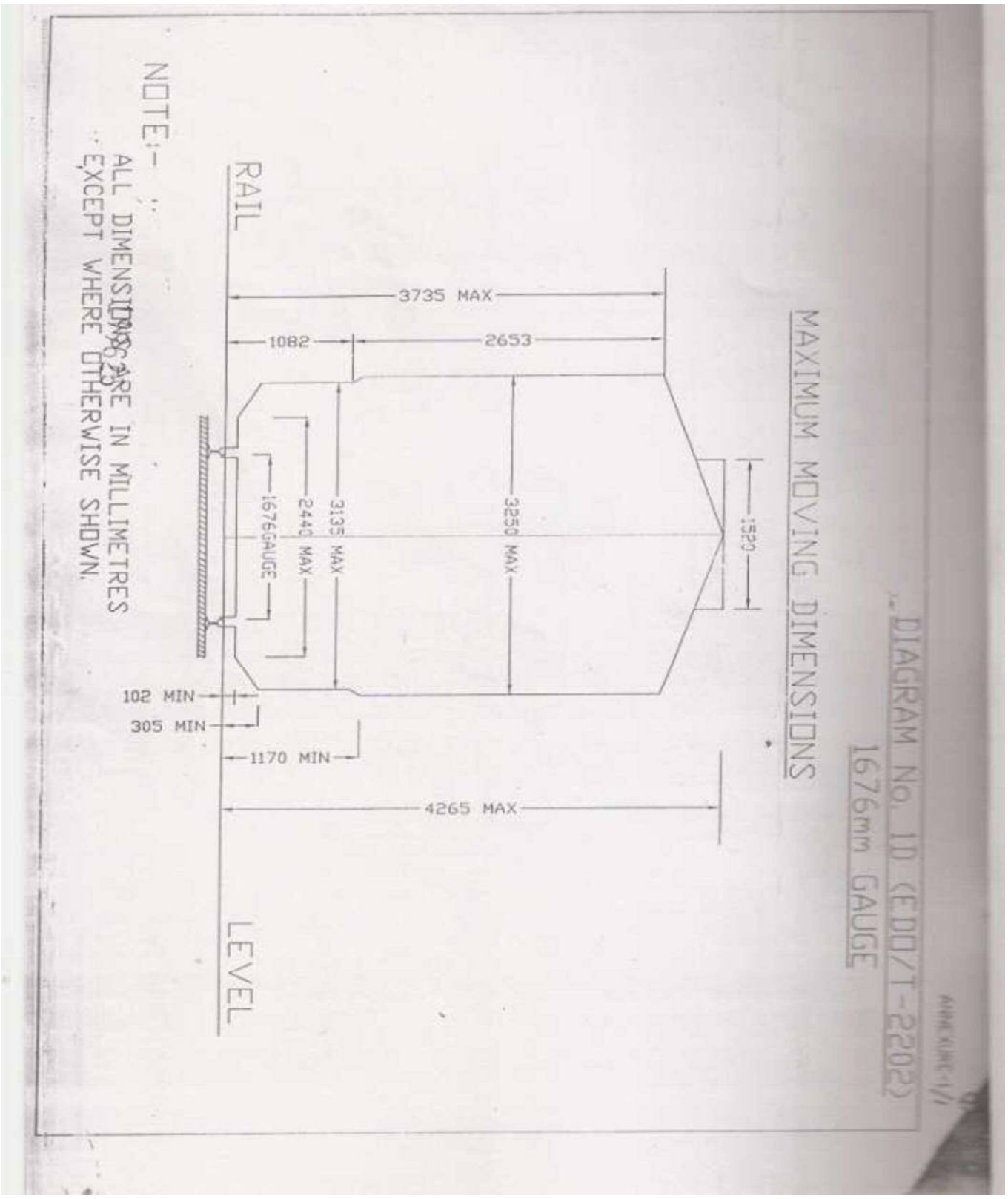
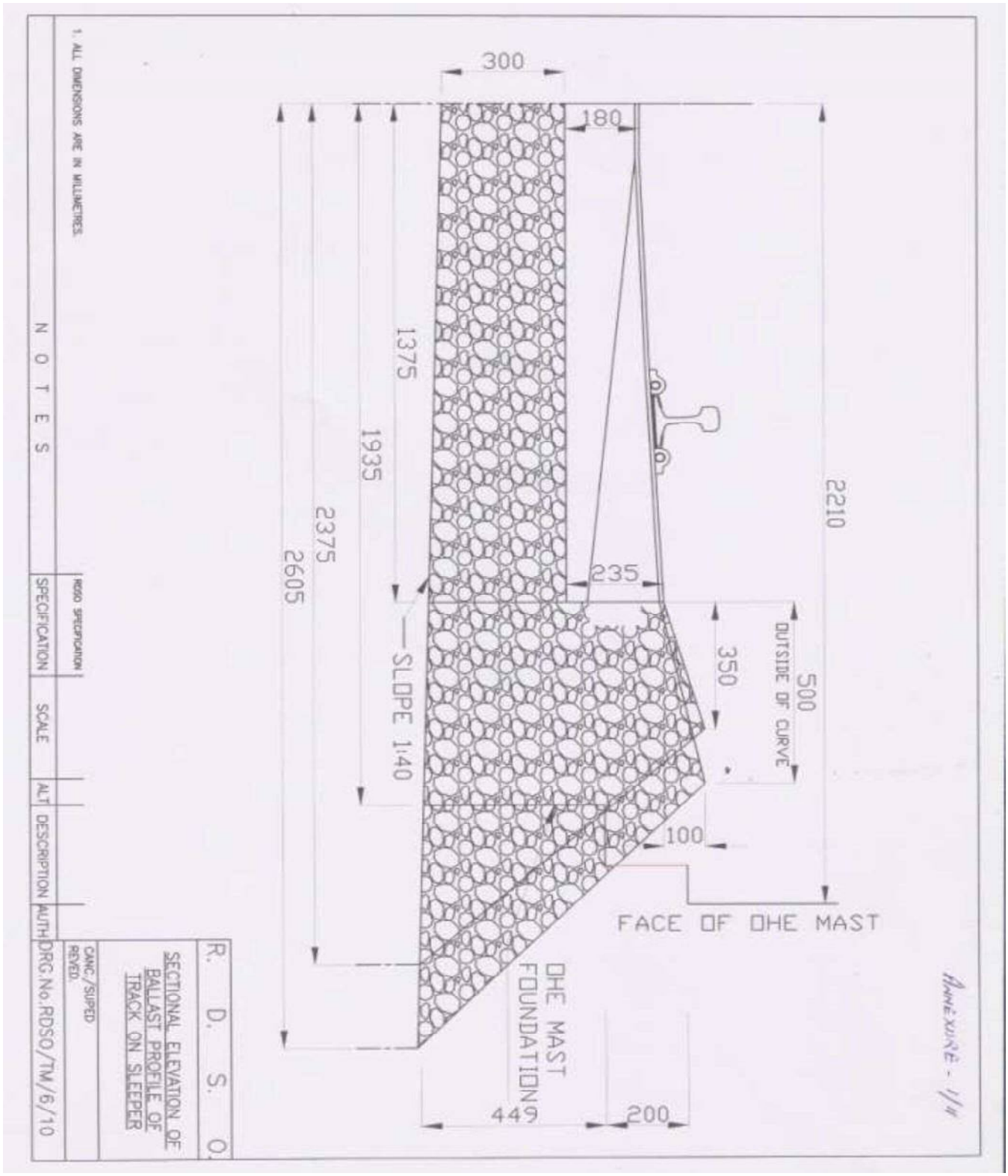


DIAGRAM No. ID (EDD/T-2202)
1676mm GAUGE
MAXIMUM MOVING DIMENSIONS
NOTE:-
ALL DIMENSIONS ARE IN MILLIMETRES
EXCEPT WHERE OTHERWISE SHOWN.
RAIL
LEVEL
3735 MAX
1082
2653
1676GAUGE
2440 MAX
3135 MAX
3250 MAX
1520
102 MIN
305 MIN
1170 MIN
4265 MAX

Annexure 1/II



ANNEXURE-II

1 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 and the following criteria satisfy for the same. For conducting the tests, a section of mainline track will be selected over which there is no temporary speed restrictions and which is considered by the Railway as being in a generally run down condition for mainline standards, but without speed restrictions. The vehicle will be tested generally for new and worn clearance conditions and where relevant for operation in the forward and backward directions. The vehicle selected for tests will be one in average condition for normal maintenance.

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 disturbances.

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 0.55 kg both in vertical and lateral directions. The peak values upto 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 movements of the bogie in straight and curved track and lateral force and derailment coefficient of accelerations as the case may be.

ANNEXURE-III

INSPECTION CERTIFICATE

CERTIFICATE OF INSPECTION OF TRACK MACHINE ( ) BY INSPECTING OFFICIAL AND APPROVAL FOR DESPATCH OF MACHINES

(STRIKE OUT WHICHEVER NOT APPLICABLE)

This is to certify that I have inspected the machine (type)_____bearing Sl.No._____ from (date) _____to _____at (Place) _____ for its conformity/non-conformity with respect to the laid down Technical Specifications in contract Agreement No._____ dated_____between President of India through Director Track (Machines) and M/s. (Name of Supplier) _____ _____.

The detailed Inspection Note regarding its conformity/non-conformity to the laid specifications is enclosed along with as Annexure ' -- '. It is observed that (strike out whichever is not applicable):-

The Machine conforms to all the laid down specifications.

The machine 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:

_____
_____
_____

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

The machine is approved/not approved for despatch to _____ _____(Consignee) Indian Railway.

SIGNATURE AND DATE

For M/s._____
_____

INSPECTING OFFICIAL
(NAME AND DESIGNATION)
for and on Behalf of President of India

Annexure : IV

Particulars Required in Respect of the Rolling Stock Under Consideration

A diagram showing elevation salient dimensions :

Wheel spacing, Wheel diameter, bogie centres, and axle load.

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. :

Wheel gauge dimension – :
(back to back of tyre flange).

4. Whether the stock is designed to be used as a general purpose or in a closed circuit in specified sections under defined conditions. :
5. Maximum design speed
i) Own Power :
ii) In train formation :
6. Unsprung weight per axle in tonnes
i) Driving axle :
ii) Running axle :
7. Expected lateral force in tonnes per axle :

At maximum design speed.

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

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

10. Maximum tractive effort at start and at the speed of operation -
    i) at working drive at start :
       at operation speed :
    ii) at transfer drive at start :
       at maximum speed :

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

at working axle :
at transfer axle :

Drawing indicating suspension arrangement details :
of bogie and axle.

13. Height of centre of gravity from rail level :
14. Height of floor from rail level :
15. Type of coupler provided -Indian Railways Standard
Coupling :
Buffer :
16. Any infringement to the moving dimensions :

Sketch provided in the Indian Railways Standard Schedule of Dimensions – Chapter IV (A).

Annexure : V

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

S.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, 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 :- 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
10.	Technical specifications of Vehicle supplied.
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.

Annexure VI

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

SL.	Component's Name	Parameters required						
		C.G. of component in x, y, z direction from rail level in mm (Referenced 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	5	6	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 (front bogie + rear bogie +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	Vertical stiff	Lateral stiff	Longitudinal stiff

				s t i f f			
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 direct ion	Lateral d ir e c ti o n	Longitu d i n a l d i r e c t i o n	Rotation abou t verti cal axis	Rotation abo ut late ral axis	Rotation about longitu dinal axis

11.	Dimension 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 vehicle bogie.	

Annexure-VII

Annexure - V.

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 A 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.

ALT	AUTH.	DESCRIPTION	DATE
(3)	SS/24/04	DIMENSION 73.7 DELETED	8/04
(2)	J.S. CD/5/94	REVISED & REDRAWN	3/94
(1)	J.S. CD/ /92	CO-ORDINATES OF ARCS SHOWN	3/92

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

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

WORN WHEEL PROFILE

SKETCH-91146

Annexure-VIII

BRAKE DESIGN DETAILS OF THE MACHINE for calculation of Emergency Braking Distance

Tare & gross weight of the machine in Kilograms
Brake power in Kilograms
Type of Brake blocks
Brake block area in Square Centimeters
Brake Rigging Diagram
Type of Brake system

Annexure- IX

Specifications of Heavy duty Industrial Quality Water proof & shock proof laptop (Toughbook)

CPU	Intel Core I-5 540 M at clock speed of 2.53 GHz or higher version
Operating System	Windows 7 professional or higher version
RAM	2 GB (DDR 3 1066 MHz) or more
Storage	Shock mounted flex connect hard drive with quick release 250 GB -540 M or More
Display	13.1" XGA touchscreen- LED backlit with Intel Graphics
Keyboard	Backlit 61 key QWERTY keyboard
Wireless	Integrated Gobi TM 2000 mobile broadband, Bluetooth
Durability features	MIL-STD-810G & IP65 certified (6' drop) MIL-STD-461F certified UL1604 certified model HDD heater Magnesium alloy w/handle Shock-mounted flex-connect HDD with quick-release Reinforced locking port covers
Additional fetures	Webcam
Pre Loaded Softwares	Antivirus software for 18 months validity Microsoft office 2007 complete bundle

Specification No. 4

Points & Crossing Tamping Machine

TECHNICAL SPECIFICATION FOR HEAVY DUTY ON TRACK TAMPERS FOR TAMPING PLAIN TRACK AND POINTS & CROSSING FOR BG (1676 mm Gauge)

1.0 GENERAL

1.1 These specifications are laid down for a machine for the tamping of concrete sleepers on turnouts which includes track tamping on turnout approaches along with lining and levelling. These specifications have been designed for such a turn out cum plain track tamping machine herein after called 'machine' which should be suitable for track geometry correction and tie tamping on turnouts and also on plain track. The machine shall be robust and sturdy to deal with the initial rough track geometry after the linking, and be capable of improving the track geometry up to main line high speed standard. As the machine may be required to work for a number of passes at a site to improve the track geometry, the machine should be capable of substantially high output, as laid down in the specifications below, while achieving highest quality of work.

1.2 The Specifications have been drafted to reflect the performance and quality requirements of the machine in a neutral manner without bias to any specific manufacturer. Bidders are requested to carefully study the specification 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 system specification, he 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.

1.3 The bidder shall specify the 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' in particular and all the items of the specifications in general shall be described in detail in the "Technical Description", along with the 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. This shall also show close-ups of various working assemblies/systems and the full machine. The tenderer shall furnish a video Compact Disk showing the working of machine in real time under field conditions.

2.0 DIMENSIONAL AND OPERATING REQUIREMENTS

2.1 The diesel-powered machine shall be robust, reliable and suitable for working on Indian Railways. The design and dimensions of the machine components shall be to metric standards. Quality assurance during manufacturing of the machine shall be according to ISO-9001. The machine shall be suitable for working on straight, transition and curved tracks (upto 10 degree) on broad gauge (1676 mm) of Indian Railways.

2.2 The machine shall be a self propelled bogie type vehicle with minimum 4 axles (2 bogies). The profile of the On track equipment longitudinally and in cross section during transfer as self-propelled vehicle or towed in train formation shall be within the Indian Railways Standard metric BG schedule of Dimensions (Rev-2004). The maximum moving dimensions are enclosed at Annexure-I. 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.

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

2.4 Axle load shall be lesser than 20.32t with minimum axle spacing of 1.83 m. Load per metre shall not exceed 7.67 t. Axle loads upto 22.82t and lower axle spacing may be permitted provided the load combinations do not cause excessive stresses in the track and bridges of IR. Stresses in the track and bridges shall be calculated by IR/RDSO based on design data submitted by the firm as per annexure –II and decision of IR/RDSO shall be final in this regards.

2.5 It shall have a desirable wheel diameter of 915 mm (New wheel profile). However, lesser diameter upto 730 mm (New wheel profile) can also be considered, provided it meets the speed and riding quality criteria as laid down in clause 2.9 and 21.4 and also rail wheel contact stresses for 72 UTS are within permissible limits. Forged wheels to Indian Railway Profile shall be provided on the machine. 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 tonne	Minimum worn out wheel diameter (mm)
20.32	816
20.0	805
19.5	787
19.0	768
18.5	750
18.0	732
17.5	713
17.0	700
16.5	680

2.6 The wheel profile shall be as per Indian Railway standard wheel profile provided in annexure - III.

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

2.8 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 : 0^{o} - 55°C
Altitude: : Sea level to 1750m
Humidity : 40% to 100%
Maximum rail temp. : 70 ^{o}C

2.9 During transfer from one station to another, it shall be capable of travelling on its

own at a speed of 80 kmph and a speed of 100 kmph when hauled in a train formation. Since the machine is likely to cover long distances on its own power, the travel drive system should be robust to sustain these requirements during the life of the machine without significant break down/failure. The speed of the machine while hauling a 8-wheeler coach should not be less than 50kmph.

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

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

2.12 The machine or its any part shall not infringe the adjoining track as per the Indian Railways schedule of Dimension 1676 gauge (BG) revised 2004 with latest correction slip issued, 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 centre to centre.

2.13 The machine shall be equipped with pneumatically operated block brakes acting on all wheels. The machine shall 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.

3.0 WORKING MECHANISM

3.1 Separate tamping unit shall be provided for each rail, each unit comprising of tamping tools operated hydraulically. It shall be possible to tamp all four rails of the turnout. For the same, four independent tamping units shall be provided with necessary arrangement for lateral shifting to adjust them on the rail of the turnout. Tamping unit shall also be adjustable from operators seat for tamping of slanting sleepers. Similarly it shall be possible to adjust the tamping tools in a manner so that all the accessible tamping zone on either side of the rails and sleepers are tamped effectively provided there is space for tamping tools to go into the ballast. It shall be possible to tamp longer sleeper in one operation.

3.2 Tamping action shall be based on vibratory squeeze principal with tamping tools operating under the same pressure but independent of one another. The amplitude, vibration frequency and squeezing pressure to achieve a durable compaction on different track structures as mentioned in para 3.1 shall be specified.

3.3 Amplitude, vibration frequency and squeezing pressure of tamping tools shall be such that durable compaction under the sleeper is achieved.

3.4 The tamping tools shall come to rest automatically after they encounter the resistance from the ballast to the pre-selected pressure. The pressure shall be variable so that, it can be adjusted according to ballast conditions. It shall be possible to vary the peak squeezing pressure exerted by the tamping tools, to suit the different type of track structure.

3.5 The lifting system shall be such that the track can be lifted without bearing on ballast shoulders outside the sleepers. The machine frame and lifting system shall be strong enough to withstand the track lifting forces for all type of track structure for 150mm lift in one go depending upon the requirement.

3.6 The free length between the two bogies should be long enough to permit the track lifting upto 150mm in one go, with 60kg rails on concrete structure, without excessive stresses in the rail or on the lifting mechanism.

3.7 The machine shall be provided with the automatic leveling equipment, which will permit correct leveling of the track and Point & Xing including provision of super elevation along with tamping.

3.8 While working on plain track, the lifting system should hold the rail continuously, rather than releasing and re lifting of rail at every tamping cycle.

3.9 The machine shall be fitted with automatic lining equipment capable of carrying out lining simultaneously with leveling. It shall be possible to adjust the lining unit longitudinally depending upon the position of the sleepers and fitting etc. in the turnout. The machine shall be able to slew the track up to at least 150mm in one go on all types of track structure.

3.10 The machine shall be able to achieve the following tolerances

Unevenness	$\pm$ 1mm on 3.6m cord
Cross level	$\pm$ 1mm
Alignment	$\pm$ 2mm on 7.2m chord
Twist	1mm/m

3.11 The machine shall be capable of carrying out on plain track, automatic lifting, levelling, tamping and lining of 1000 sleeper in an hour of working. When tamping turnout, it shall be capable of tamping two 1 in 12 turnouts complete with 10 sleepers on straight portion on the approaches of the turnouts in an hour of working.

3.12 The machine shall be capable of automatic leveling, lining and tamping of turnout with CMS and built up crossing of angles 1 in 8-1/2, 1 in 12 and 1 in 16 laid on wooden, steel or concrete sleepers without dismantling the turnout. The machine shall be provided with facility (computerized) of pre and post measurement of track parameter i.e. unevenness, cress level, alignment and twist and optimization of the same for corrections of above parameter along with conditions to be applied for taking obligatory points. All these parameters shall be displayed on the computer screen. The system should be windows compatible and it shall be able to transfer data through USB port (Pen drive etc.) directly in excel format. The system shall be so designed that while working on tracks with pre decided track geometry, the standard track geometry data as well as correction values can be entered prior to work directly on system via USB, Pen drive or CD ROM. For working on tracks with unknown track geometry, it shall be possible to determine the correction values by making the measuring run and subsequent geometry compensation of the recorded data considering obligatory points and constraints of lifting and lining etc. Interactive processing of the target profile by the operator shall be possible. The unit shall have adequate memory to keep records of work performed, new track geometry obtained and enables transfer of data via USB, Pen drive or CD ROM as required.

3.13 The machine shall also be capable of tamping, lifting and lining up to 60kg/m long welded rails, short welded rails and fish plated track with rails laid on concrete sleepers, steel trough sleepers, CST-9 or wooden sleeper as the minimum clear distance between the joint sleeper is 50 mm, the machine shall be able to tamp

these two sleepers together. The normal sleeper spacing in different track structure in IR is 50Cms to 75Cms.

3.14 The machine shall be capable of slewing of track if required, up to 150mm in one go on all types of track structures. The machine shall also be capable of lifting the track if required up to 150mm in one go on all type of track structures.

3.15 The machine's diving system shall be through hydro dynamically/ hydrostatically coupled power shift arrangement capable of achieving full speeds in travel mode in both the directions.

3.16 The tamping tools shall be capable of tamping ballast up to a depth of 150mm below the bottom of the sleepers. There shall be provision for step less adjustment of depth of tamping tools.

3.17 It shall be possible to control the target track geometry parameters infinitely variable steps, from the operators/front cabin. To suit this suitable proportional/ Servo control system shall be provided.

3.18 Considerable pull is applied on the rail while operating the machine from one line on the turnout for tamping or lifting. The other tracks on the turn out acts as an anchor and adds to the requirement of lifting force. This may results in overstressing of the fastenings of the track from which the machine is operating. The machine therefore shall have arrangement to lift the other track of the turnout also while the track on which the machine is working is lifted for tamping. Refer para 3.6 also. Proper mechanism shall be provided to ensure that the lifting of the other track is carried synchronously and the lifting operation is cut off automatically when desired or when the specified lift is reached.

3.19 The working cabins of machine shall be air conditioned. However electronic equipment shall be so designed that it shall be able to work without air conditioning under the climatic conditions, described in para 2.8.

3.20 On Indian Railways, rail top to sleeper bottom depth may vary from 260mm to 420mm. There shall be provision for step less adjustment of the penetration depth of tamping tools to suit different types of rail and sleepers.

3.21 In addition to the computer system provided on the machine for its own controls, the machine shall be provided with one additional industrial quality heavy duty portable computer (Laptop-tough book) for keeping record of overall aspects of working, spares management and reporting. The software shall be window based. The hardware shall be sturdy for operation under conditions of shock, vibrations, dust, electromagnetic influence from outside and interruption of power supply. The detailed specifications of the laptop are enclosed as annexure-IV.

3.22 The machine shall be warranted for 1200 effective working hours or 3,50,000 tamping insertions or 18 months from the date of commissioning and proving test of equipment or 24 months after delivery at ultimate destination in India which ever shall be earlier. Effective working hours will be traffic block time during which machine is deployed for tamping work.

4.0 DIESEL ENGINE

4.1 The machine shall be powered by diesel engine (s) preferably indigenous, with proven record of service in tropical countries with wide 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 The supplier shall furnish the details of diesel engine and its controls to assess its conformity with the engines already operating on track machines on IR. 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.

4.3 High speed diesel oil to Indian Standard Specification shall be normally used. A minimum fuel capacity sufficient for continuous operation for 8 hrs will be desirable.

4.4 Sight glass type fuel measuring gauge shall be provided on the fuel tank.

4.5 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 button start type.

4.6 Since the engine is 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.

4.7 There is a likelihood of dust deposition over the engine body and surrounding area where 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 along with the machine.

4.8 The engine parameter monitoring gauges like temperature, rpm, and 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 colored. 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 circuit in case of operator's failure to respond.

4.9 Suitable and rugged mechanism should be provided to start the prime mover at no 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.

4.10 The engine power take off shall be coupled to the main gear box through a flexible coupling. The engine shall be mounted on suitable Anti Vibration Mountings.

5.0 DRIVE MECHANISM

5.1 The machine should be provided with an efficient traction drive system for traction during the operation. The machine's driving system shall be through hydro dynamically/hydrostatic coupled power/transmission arrangement capable of achieving full speeds in travel mode in both the directions. The system should be so designed that all the driving wheels work in synchronization and there is no slippage / skidding of the wheels during the work drive.

5.2 The driving mechanism, in working mode, shall be adequately designed to handle the acceleration and braking forces at each tamping cycle. A suitable synchronization circuit to control the synchronization of lifting/lining/Tamping process with the machine drive/braking system in working mode shall be provided to prevent any damage to the machine systems on account of non-synchronization.

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

5.4 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.

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

5.6 Adequate gauges (flow meter) and solenoid valves shall be provided near linkage assembly, for indication, flow control and carrying out necessary adjustment in the field.

5.7 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-today maintenance schedules.

6.0 COOLING SYSTEM

6.1 The cooling system shall be efficient and designed for a maximum ambient temperature of 55^0C. Supplier shall note that the machine shall be working under extreme dusty conditions and the cooling mechanism should be maintainable under these conditions.

6.2 Adequate heat transfer arrangement for hydraulic system shall be designed and provided so that under extreme heat conditions as mentioned in para 2.8 above, the system oil temperature does not go beyond 85 degree centigrade.

7.0 BRAKES

7.1 The machine shall be fitted with the air-brakes system and provision shall be made to connect air brake system of the machine to that of camping coach when the machine is hauling it. 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 55^0 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. In addition, mechanical brakes shall also be provided for use in an eventuality of failure as well as for parking.

7.2 Machine shall be equipped with suitable air brake valves so that while working in train formation, machine can be braked by the traction vehicle. In addition, the machine shall be equipped with suitable air brake system in the driving cabins so that the camping coach while being hauled by the machine can be braked.

7.3 There should be provision of emergency brake application in the machine either travelling alone or coupled with the camp coach, 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 designed speed on a level track shall not be more than 600m. 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 should be provided by the supplier. Brake design details are to be submitted as per annexure V.

8.0 HORN AND SAFETY SWITCHES

8.1 The machine shall be provided with electric/pneumatic horns/hooters facing outwards at each end of the machine at suitable locations to warn the workman of any impending danger at the work spot or from on-coming train. The horns/hooters shall be distinctly audible from a distance of at least 400m from the machine. These electric horns/hooters shall be operated by means of push buttons provided in the cabs to warn the staff working on/around the machine about approaching train on adjoining track. Adequate nos. of safety stop switches should be provided all around, so that in case of any danger to the worker during work, the working can be stopped immediately.

8.2 Safety equipments like jacks, 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.

8.3 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.

9.0 HOOKS AND BUFFERS

9.1 The machine shall be fitted with hooks and buffers of IRS design on both ends for coupling it with other vehicles for running in train formation and for attachment with the camping coach.

10.0 SUSPENSION SYSTEM:

10.1 The suspension system shall be preferably of two-stage type with suitable spring and damping arrangement. Spring for primary and secondary suspension shall be designed to cater for actual service conditions. Effective measure shall be adopted to minimize the weight transfer while starting, stopping and during runs.

11.0 ELECTRIC EQUIPMENT AND LIGHTING

11.1 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 Twin beam headlight assembly conforming to RDSO's specification No.ELRS/SPEC/PR/0024 Rev-1, Sept 2004 with latest amendments ensuring a light intensity of 3.2 lux at ground level at track centre at a distance of 305 mts. 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. The amber colour flasher light shall be provided at both ends on the machine to give indication to the arriving train on other line about any impending danger.

12.0 CHASSIS & UNDER FRAME

12.1 The chassis shall be fabricated from 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 sections and/or plates & shall be designed to withstand maximum static squeeze test load of 200t 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.

13.0 CABINS

13.1 The machine shall be equipped with fully enclosed air conditioned and pressurized cabins with safety glass window at both the ends. It shall be possible to have a clear view of the track ahead while driving the machine in both the directions from the cabins at either end. The cabin layout shall be such that, before leaving the machine, the operating staff has full view on both the sides, to avoid any danger to them from trains on the adjacent tracks.

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

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

13.4 One screen wiper preferably operated by compressed air or electrically operated shall be provided on each of the wind screens.

13.5 Suitable numbers of fire extinguisher (dry chemical type) shall be provided in all the cabins.

13.6 The machine shall be provided with well designed space for keeping the tools and spares required for on-site repair of the machine to attend the break downs and other working requirements.

14.0 TOOLS AND INSTRUCTIONS MANUALS

14.1 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.

14.2 Detailed operating manual, maintenance and service manuals, user manual shall be specifically prepared and four copies of these shall be supplied with each machine.

14.3 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 additions, the supplier shall provide dimensioned 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 such other items shall be furnished

by the supplier. These shall be specially prepared in English language and four copies of these shall be supplied with each machine. The tenderer shall furnish the details of such other bought out components/assemblies.

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

14.5 While offering the machine for first inspection, the supplier shall submit three copies of complete technical literature including operation, service and maintenance manuals. Complete electrical, hydraulic and pneumatic circuit diagrams, trouble shooting charts, component drawings/description and other relevant technical details so as to maintain master copies of these documents in Indian Railway Institutions and a reference document for the inspecting officer. All the above documents shall be available in English language also.

14.6 One portable welding plant of reputed make (Preferably made in India) with a minimum 11 KW/16 H.P capacity along with sufficient cable or lead shall be provided with the machine for day to day repairing of machine and its wearing parts.

14.7 The firm shall provide detailed technical drawings and specifications of wheels and axles used in the machine along with detailed code of procedure for ultrasonic testing of wheels and axles of all types. The above details shall be provided in four sets.

14.8 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. 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.

15.0 SPARE PARTS

15.1 The expected life of the components shall be advised along with their condemning limits. The machine shall be supplied with necessary spare parts for the operation and maintenance of the machine for a period of two years i.e. working for about 2000 hrs. The spare parts required shall be detailed in a separate list indicating description, part no., quantity and weather imported or indigenous.

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

15.3 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.

16.0 MAKER'S TEST CERTIFICATE

16.1 Copies of the Maker's certificate guaranteeing the performance of the machines shall be supplied in duplicate along with the delivery of each machine

17.0 OPERATORS

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

18.0 OPTIONAL EQUIPMENTS

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

19.0 INSPECTION OF THE MACHINE

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

20.0 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, un-sprung mass and braking force coming on rails 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 (II,VII and VIII) shall be supplied 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 (II,VII and VIII) 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.

21.0 ACCEPTANCE TEST

21.1 In addition to verification of the various items of specifications covered earlier, the purchaser's nominee shall carry out the following tests in India at the purchaser's premises at the time of the 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.

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

21.3 Testing for negotiability of 10° curve and 1 in $8^{1/2}$ turnouts.

21.4 Running speed tests on the Indian Railway mainline track on the first machine in accordance with the para 2 of Annexure-IX with the machine running up to speed 10% higher than maximum speed mention in para 2.9 above.

21.5 Construction and engineering of the machine and its ability to perform all the functions as laid down in the specifications above.

21.6 Actual output and performance tests to be conducted on first machine.
These tests shall be conducted under field conditions on I.Rly. An electrified section shall be chosen for this test. The field conditions and tests to be conducted shall be as follows:

a) The machine crew shall be either trained personnel of Indian Railways or the staff of the contractor.

b) Dry weather, ambient temperature between 0^{o}C to + 55^{o} C.

c) Points and crossings on straight track or curve with radius minimum upto 1000 m.

d) Gradient upto 1/200.

e) Rails and sleepers in good conditions and properly fastened.

f) Concrete/wooden/metal sleepers.

g) Ballast upto 100mm below the bottom of sleeper and generally not cemented.

h) Good formation.

i) Regular sleeper spacing of 65cm or 60cm on straight track and 45.7cm to 68.5 cm. on turnouts with a tolerance of $\pm$ 3 cms.

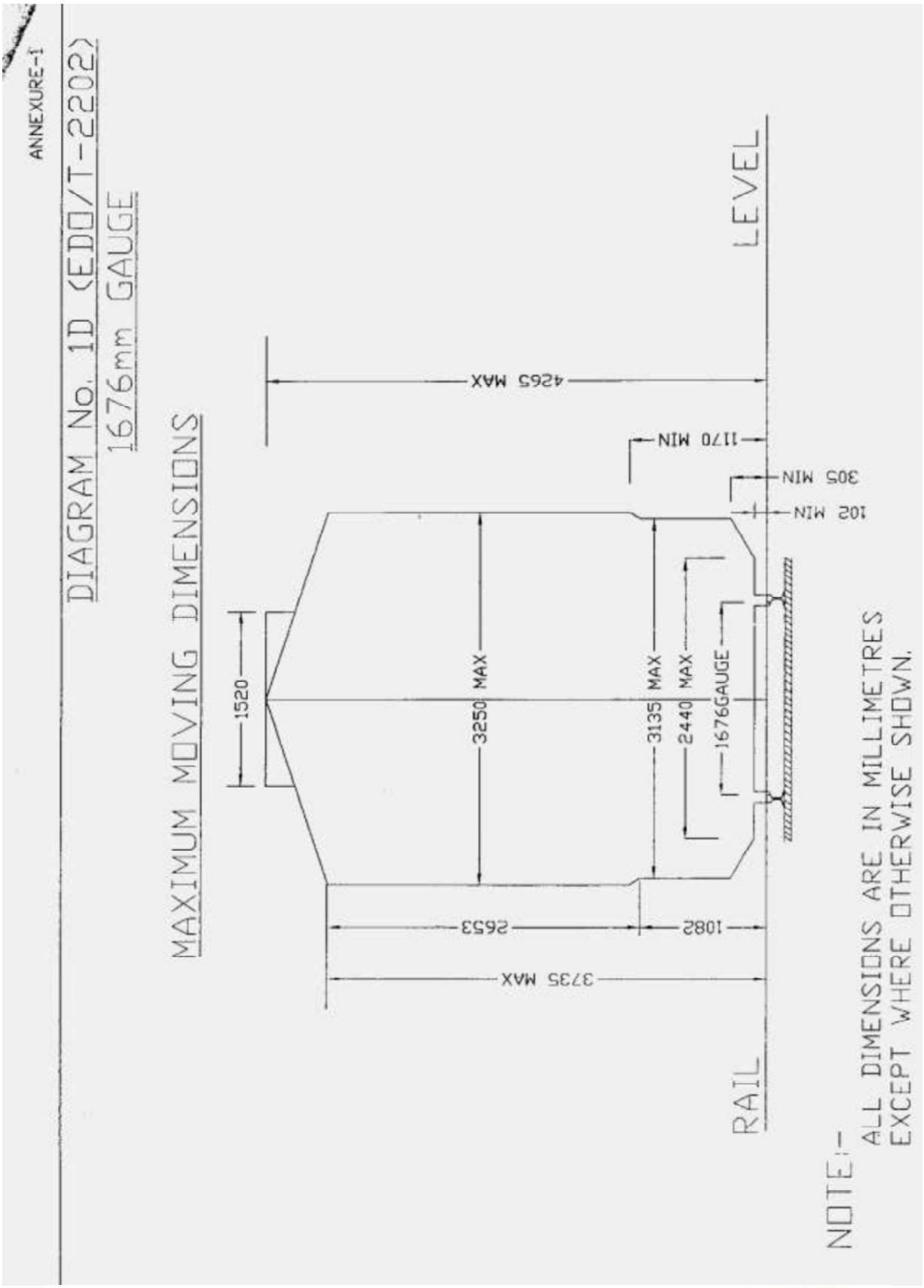
j) General lift during working upto 20mm and Lifting of tack/Points and crossing in non tamping mode of 150 mm in one go.

k) Maximum slew during working upto$\pm$10mm and Slewing of track/ Points and crossing in non tamping mode of $\pm$150mm in one go.

l) Stoppage of work is not attributable to machine shall be discounted

m) The machine shall be able to tamp 1000 sleepers in one hour of working in plain track. The machine shall also be able to tamp 2 nos. 1in 12 turnout including 10 sleepers on straight portion on each side in one hour of work. The time shall be counted from start to finish of tamping work at workplace

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


ANNEXURE-I
DIAGRAM No. 1D (EDO/T-2202)
1676mm GAUGE
MAXIMUM MOVING DIMENSIONS
4265 MAX
1170 MIN
305 MIN
102 MIN
1520
3250 MAX
3135 MAX
2440 MAX
1676GAUGE
2653
1082
3735 MAX
LEVEL
RAIL
NOTE:-
ALL DIMENSIONS ARE IN MILLIMETRES
EXCEPT WHERE OTHERWISE SHOWN.

Annexure II

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

SL. NO.	Component's Name	Parameters required						
		C.G. of component in x, y, z direction from rail level in mm (Referenced 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							

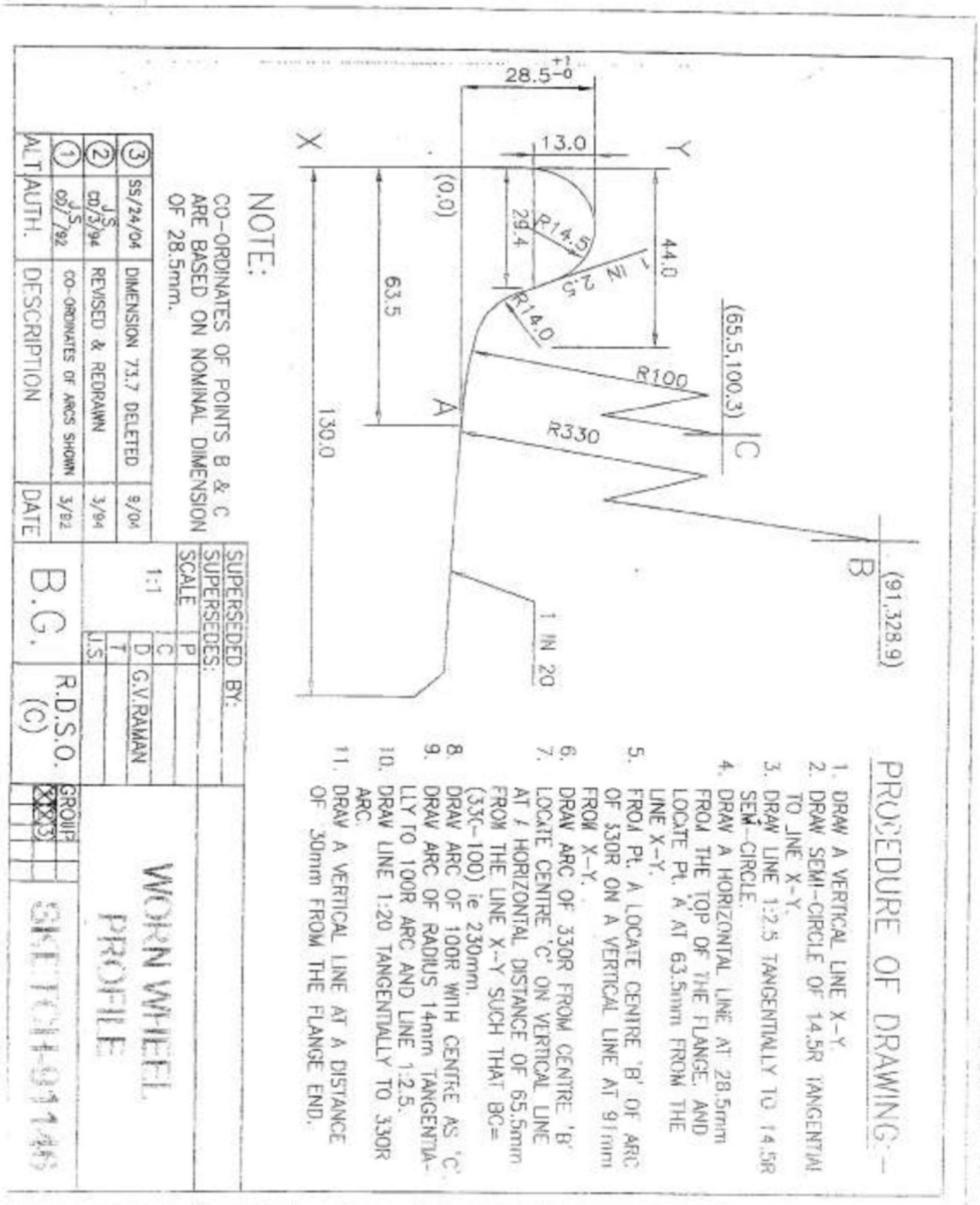
	unsprung mass							
6.	Mass of Items included in unsprung mass partially or fully along with their name per axle	1	2	3	4	5	6	Total unsprung mass in tonnes

7.	Total weight of components in tonnes	Front bogie full assembly	Rear bogie full assembly	Machine frame full structure	Full weight of vehicle (front bogie + rear bogie +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	Vertical direction	Lateral direction	Longitudinal direction	Rotation about vertical axis	Rotation about lateral axis	Rotation about longitudinal axis

	motion between bogie frame and machine frame for relative motion (motion stopper)						
11.	Dimension 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 vehicle 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.
28.5 +1 -0
13.0
X
Y
(0,0)
R14.5
29.4
44.0
1 IN 2.5
R14.0
63.5
(65.5,100.3)
R100
C
A
R330
130.0
B
(91,328.9)
1 IN 20
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 CD/3/94 REVISED & REDRAWN 3/94
1 CD/7/92 CO-ORDINATES OF ARCS SHOWN 3/92
ALT. AUTH. DESCRIPTION DATE
SUPERSEDED BY:
SUPERSEDES:
SCALE P
1:1 C
D G.V.RAMAN
T
J.S.
B.G.
R.D.S.O. (C)
GROUP XX03
WORN WHEEL PROFILE
SKETCH-91146

Specifications of Heavy duty Industrial Quality Water proof & shock proof laptop (Toughbook)

CPU	Intel Core I-5 540 M at clock speed of 2.53 GHz or highe version
Operating System	Windows 7 professional or higher version
RAM	2 GB (DDR 3 1066 MHz) or more
Storage	Shock mounted flex connect hard drive with quick release 250 GB -540 M or More
Display	13.1" XGA touch screen- LED backlit with Intel Graphics
Keyboard	Backlit 61 key QWERTY keyboard
Wireless	Integrated Gobi TM 2000 mobile broadband, Bluetooth
Durability features	MIL-STD-810G & IP65 certified (6' drop) MIL-STD-461F certified UL1604 certified model HDD heater Magnesium alloy w/handle Shock-mounted flex-connect HDD with quick-release Reinforced locking port covers
Additional fetures	Webcam
Pre LoadedSoftwares	Antivirus software for 18 months validity Microsoft office 2007 complete bundle

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

Tare & gross weight of the machine in Kilograms
Brake power in Kilograms
Type of Brake blocks
Brake block area in Square Centimetres
Brake Rigging Diagram
Type of Brake system

INSPECTION CERTIFICATE CERTIFICATE OF INSPECTION OF TRACK MACHINE ( ) BY INSPECTING OFFICIAL AND APPROVAL FOR DESPATCH OF MACHINES

(STRIKE OUT WHICHEVER NOT APPLICABLE)

This is to certify that I have inspected the machine (type)_____bearing Sl.No._____ from (date) _____to _____at (Place) _____ for its conformity/non-conformity with respect to the laid down Technical Specifications in contract Agreement No._____ dated_____between President of India through Director Track (Machines) and M/s. (Name of Supplier) _____ _____.

The detailed Inspection Note regarding its conformity/non-conformity to the laid specifications is enclosed along with as Annexure'A'. It is observed that (strike out whichever is not applicable):-

The Machine conforms to all the laid down specifications.

The machine 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:
_____
_____
_____

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

The machine is approved/not approved for despatch to _____ _____(Consignee) Indian Railway.

SIGNATURE AND DATE

For M/s._____ INSPECTING OFFICIAL
_____ (NAME AND DESIGNATION)
for and on Behalf of President of india

Annexure : VII

Particulars Required in Respect of the Rolling Stock Under Consideration

1. A diagram showing elevation salient dimensions :

a) Wheel spacing, Wheel diameter, bogie centres, and axle load.

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

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

10. Maximum tractive effort at start and at the speed of operation -
i) at working drive at start :
at operation speed :
ii) at transfer drive at start :
at maximum speed :

11. Maximumbraking force coming on to the rails per wheel
    at working axle :
    at transfer axle :
12. Drawing indicating suspension arrangement details of bogie and axle.
13. Height of centre of gravity from rail level
14. Height of floor from rail level
15. Type of coupler provided -Indian Railways Standard
    Coupling :
    Buffer :
16. Any infringement to the moving dimensions
    Sketch provided in the Indian Railways Standard Schedule of Dimensions – Chapter IV (A).

Annexure : VIII

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

S.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, 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 :- 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
10.	Technical specifications of Vehicle supplied.
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.

1 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 and the following criteria satisfy for the same. For conducting the tests, a section of mainline track will be selected over which there is no temporary speed restrictions and which is considered by the Railway as being in a generally run down condition for mainline standards, but without speed restrictions. The vehicle will be tested generally for new and worn clearance conditions and where relevant for operation in the forward and backward directions. The vehicle selected for tests will be one in average condition for normal maintenance.

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 disturbances.

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 0.55 kg both in vertical and lateral directions. The peak values upto 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 movements of the bogie in straight and curved track and lateral force and derailment coefficient of accelerations as the case may be.