Specification No. 5

Dynamic Track Stabilizer

TECHNICAL SPECIFICATION FOR DYNAMIC TRACK STABILIZER

1.0 GENERAL

1.1 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. With the increased quantum of traffic moving at high speeds, it is very essential to restore the stability of track as early as possible. This specification has been drafted for on track stabilising machine which can be put to work behind tamping machines to achieve desired consolidation of track and to obviate the need to impose speed restrictions immediately after maintenance tamping as also for faster relaxation of speed restrictions after Track renewal/deep screening.

1.2 The Technical Specifications have been drafted to reflect the performance and quality requirements of the equipment in a neutral manner without bias to any specific manufacturer. The tenderers are requested to carefully study the specification and assure that their equipment fully comply with these specifications. Thereafter, if a tenderer feels that his equipment can substantially meet the performance and quality requirements of the equipment but does not fully satisfy a particular specification, the tenderer should immediately seek clarification from the purchaser prior to submission of bids as to whether such deviation is substantive or not.The tenderer 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 tenderer 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”, alongwith 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 offered in work 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 cassette showing the working of machine in real time 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. 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 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, Revision -2004. The minimum and maximum moving dimensions are enclosed in **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 at any cross section.

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 metre shall not exceed 7.67 t.

2.6 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 2.9 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

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% 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.

2.8 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 -700m above Mean sea level
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 at a speed of 100 kmph when hauled in a train formation. Since the machines are 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 without much break down/failure.

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 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. The machine or its any part shall not infringe the adjoining track as per Schedule of Dimensions of Indian Railways, Revised –2004 while opening and closing the work.

2.12 The machine shall be equipped with pneumatically operated brake blocks 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.

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

3.0 WORKING MECHANISM

3.1 The Dynamic Track Stabilizer shall be put to work behind tamping machines. It shall be capable of working at varying speeds to achieve effective and continuous stabilisation of the track. It shall be capable of stabilizing not less than 2.5 km. of track in one hour of effective working. The stabilizing speed shall be adjustable infinitely at speeds

from 0 – 2500 mts./hr.

3.2 During the operation, the machine 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.

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

3.4 To achieve a controlled lowering of the track, the stabilizing unit shall be capable of pre loading the track as mentioned in above clauses. While pre loading the track by stabilizing unit, the driving wheels should provide adequate adhesion to avoid wheel slippage/loss of traction. To ensure sufficient traction and avoid the risk of derailment, the total weight of the machine shall be at least 2.5 times the maximum possible vertical stabilizing load.

3.5 The machine shall be capable of operation on various types of track structures like 90 R/52 Kg./60 kg. Long welded rails/short welded/fishplated rails laid on prestressed concrete/steel-trough /CST-9/ wooden sleepers with 100 mm to 300 mm ballast cushion. 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

3.6 The machine shall be equipped with suitable mechanism to control the degree of settlement of the track. For this purpose, a proportional servo controlled levelling system, automatically controlling the degree of settlement of track shall be provided. This installation shall copy the pre-stabilizing geometry by automatically increasing/relieving the vertical load on the stabilizing units. For optimum results, levelling system shall work independently for the left and right hand rail.

3.7 It shall be possible to steplessly preselect the frequency of 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.

3.8 The machine 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, amplitude of vibration and degree of settlement on both rails.

3.9 To avoid damages on the rail surface by excess friction and force by

the rollers, the lateral vibrations shall be created without any vertical impact.

3.10 It shall be able to work on single and double track sections as well as on platform lines.

3.11 It shall also be capable of working on points and crossing of 1 in 8.5, 1 in 12 and 1 in 16 crossing angles and laid on wooden/steel through/concrete/CST-9 sleepers.

3.12 It shall be capable of carrying out stabilization work in both directions. The machine's driving system shall be through hydro-dynamically-coupled power shift arrangement, capable of achieving full speeds in travel mode in both the directions.

3.13 The tenderer shall indicate the name of the Railway system where the types of machines offered are working.

4.0 DIESEL ENGINE

4.1 The machine shall be powered by indigenous diesel engine, with proven record of service in tropical countries. Robust construction and low maintenance cost are of particular importance. Adequate allowance shall be made for derating 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. The engine should be of such design /brand which are being manufactured indigenously and/or such designs whose after sale service facilities are available in India.

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 air intake system.

4.7 There is a likelihood of dust deposition over the engine body and surrounding areas 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 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 mover. A fail-safe clutch mechanism should 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/hydrostatically coupled power shift 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. A suitable synchronization circuit to control the synchronization of lifting/lining 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.

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

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

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

5.6 Adequate gauges (flow meters) and solenoid valves shall be provided near linkage assembly, for indication, flow control and carrying out necessary adjustments 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- to- day maintenance schedules.

6.0 COOLING SYSTEM

6.1 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.

6.2 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 85 degree centigrade.

7.0 BRAKES

7.1 The machine shall be fitted with the airbrakes 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 kgs 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 valves so that while working in train formation, machine can be braked by the tractive vehicle . In addition, the machine shall be equipped with suitable air-brake systems in the driving cabins so that the attached wagons or camping coach while being overhauled by the machine can be braked. The speed of the machine while hauling a 8 wheeler coach should not be less than 80 kmph.

7.3 The emergency braking distance (EBD) of the machine on the Indian Railway Track, at the maximum design speed shall not be more than approximately 600m. In this regard necessary design calculations for the braking effort and EBD at the maximum design speed of the machine should be provided by the supplier.

8.0 HORN AND SAFETY SWITCHES

8.1 The equipment shall be provided with electric horns facing outwards at each end of the machine at suitable location to warn the workman

of any impending danger at the work spot or from on-coming trains. The horns shall be distinctly audible from a distance of atleast 400 mts. from the machine. These electric/pneumatic horns /hooters shall be operated by means of push buttons provided in the cabins and also should have remote control operation so that look out man standing at a distance of 150 m. away from the machine can operate the electric horn/ hooter to warn the staff working on/around the machine about the approaching train on the adjacent line. Adequate nos. of safety stop switches shall be provided all around so that in case of any danger to worker during working, 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. The emergency backup system should also use a manual hydraulic power pack in addition to the emergency generator/battery based electric hydraulic systems.

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 in train formation.

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' 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 swivelling flood lights 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 the other line.

11.0 CHASSIS & UNDER FRAME

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

12.0 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 to minimize the weight transfer while starting, stopping and during runs.

13.0 CABINS

13.1 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.

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 The working cabins of the machine shall be air-conditioned for dust free atmosphere. 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 work without air-conditioning under the climatic conditions described in Para 2.8.

13.5 On- screen wiper preferably operated by compressed air shall be provided on the wind screens.

13.6 Fire extinguisher (dry chemical type) shall be provided in the cars.

13.7 The machine shall be provided with adequate space for keeping the tools and spares required for on site repair of the machine to attend the breakdowns 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 specialised equipment. All special tools shall be listed and catalogued illustrating the method of application.

14.2 Detailed operating manual, maintenance and service manual shall be specifically prepared and three copies of these shall be supplied with each machine. These shall be prepared in English language.

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 dimension drawings with material description of items like rubber seals, washers, springs, bushes, metallic pins etc., main features 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 these shall be supplied with each machine.

14.4 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, periodic overhauling and trouble shooting guides/manual.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. These shall be prepared in English language. One set of documents to be submitted to TMM directorate, RDSO & one set to IRTMTC-Allahabad.

14.6 One portable welding plant of reputed make(preferably manufactured in India) with a minimum 11KW/16 HP capacity alongwith 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 three sets.

15.0 SPARE PARTS

15.1 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. The spare parts required shall be detailed in a separate list indicating description, part number, quantity and whether imported or indigenous and their source of supply (OEM details).

15.2 The manufacturer shall be responsible for the subsequent availability of spare parts (In India with payment in Indian Rs) to ensure trouble free service for the life of the machine (15 years). It is preferred that the spares are stored in India and are available at short notice say maximum within a month.

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 Service Engineers:

a) 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.

b) 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 EQUIPMENTS

19.1 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.

20.0 INSPECTION OF THE MACHINE

20.1 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 "**I**nspection certificate and approval for despatch of the machine" as per **Annexure-II** enclosed.

21.0 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 f 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) 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) 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.

22.0 ACCEPTANCE TEST

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

22.2 The dimensional check of loading gauge, i.e. maximum moving dimensions, buffer heights, clearances etc.

22.3 Testing for negotiability of 10° curve and 1 in 8 1\2 turnouts.

22.4 Running speed test on the Indian Railway mainline track on the first machine in accordance with the procedure outlined at **Annexure-III**.

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

22.6 Actual output and performance tests: This test shall be conducted on the first machine, the general conditions of the test 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^{o} C to 40 ^{o} C.

(c) Plain track or curve minimum 1000 meter radius.

(d) Gradient upto 1/200.

(e) Rails fastened to all sleepers.

(f) Concrete/wooden/metal sleepers.

(g) Ballast clean up to 100 mm in sufficient quantity below the bottom of sleepers and generally not cemented.

(h) LWR track

(i) Formation good

(j) Regular sleeper spacing of 65 cm or 60 cm with a tolerance of + 3 cm.

(k) Amount of lowering up to 20 mm.

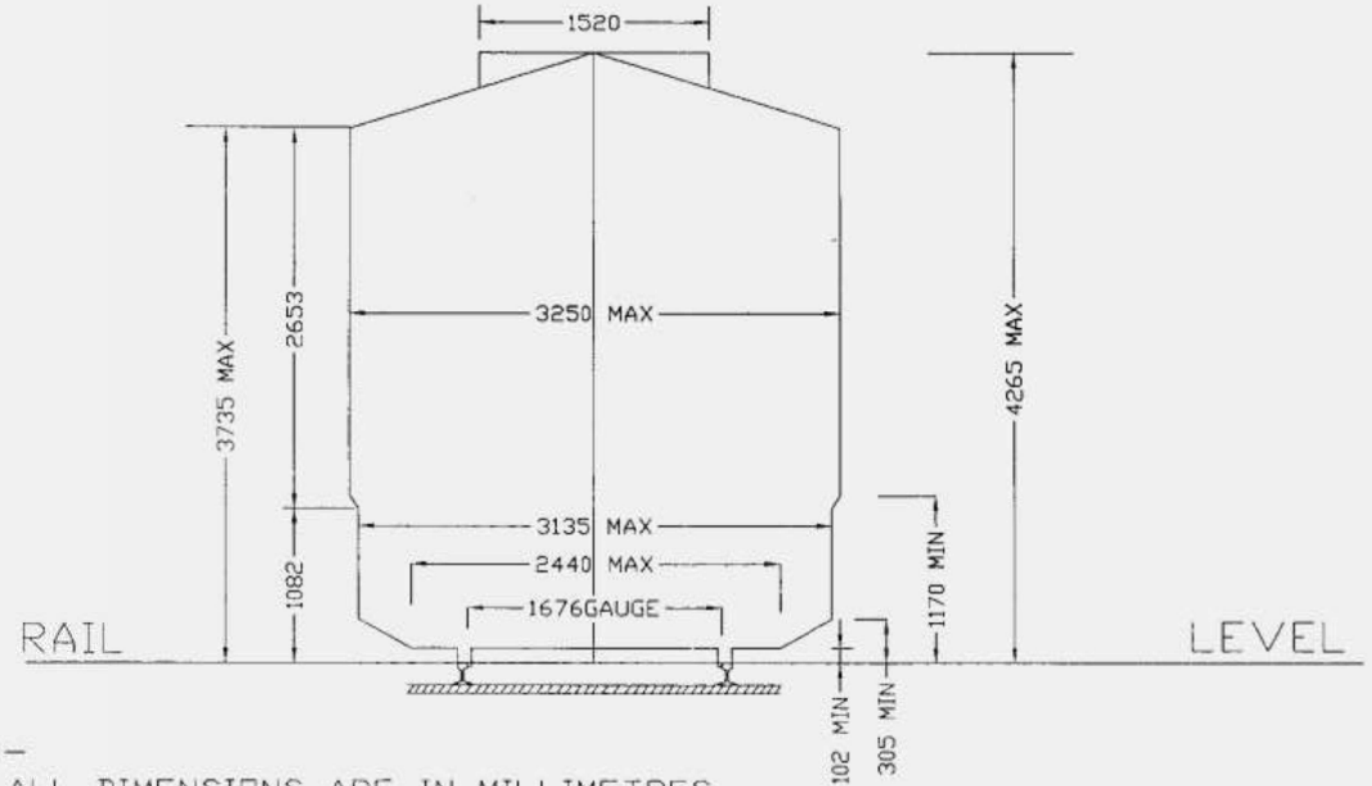
22.7 The setting up time and winding up time of the machine shall be measured, and the total time taken by the two operations of setting up and winding up of the Machine together shall not exceed 10 minutes.

22.8 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-I

DIAGRAM No. 1D (EDO/T-2202)
1676mm GAUGE

MAXIMUM MOVING DIMENSIONS



NOTE:-

ALL DIMENSIONS ARE IN MILLIMETRES
EXCEPT WHERE OTHERWISE SHOWN.

Annexure-II

CERTIFICATE OF INSPECTION OF DYNAMIC TRACK STABILIZER (MODEL No.--------) BY INSPECTION OFFICAL AND APPROVAL FOR DESPATCH OF DYNAMIC TRACK STABILIZER

(strike out whichever not applicable)

This is to certify that I have inspected the **DYNAMIC TRACK STABILIZER** ----------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 **DYNAMIC TRACK STABILIZER** conforms to all laid down specifications.
- The **DYNAMIC TRACK STABILIZER** 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 **DYNAMIC TRACK STABILIZER** is certified/not certified to be conforming to the specifications.

The **DYNAMIC TRACK STABILIZER** 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-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.

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Annexure : IV

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 : V

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.

Specification No. 6

High Output Tie Tamping Machine Capable of 2600 Sleepers Per Hour Peak Output for Broadgauge (1676mm)

SPECIFICATION FOR HIGH OUTPUT TIE TAMPING MACHINE CAPABLE OF 2600 SLEEPERS PER HOUR PEAK OUTPUT FOR BROADGAUGE (1676 mm)

1.0 GENERAL:

1.1 These specifications are laid down for a robust and sturdy track tamping/lining, lifting and levelling high output machine (hereinafter called the machine), which should be suitable for track geometry correction and tie tamping on track for maintenance and renewal/construction sites. The machine shall be capable of improving the track geometry up to mainline high-speed standards and continuous tamping operation for high output. Considering the limited availability of traffic block on the Indian Railways, high output tamping machines are required to give substantially increased output economically and quantitatively as given in the subsequent paras.

1.2 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 giving substantially high output, as laid down in the specifications below, while achieving the highest quality of work.

1.3 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 assure that their machine fully comply with these specifications. There after, if a bidder feels that his machine can substantially meet the performance and quality requirements of the specifications 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.

1.4 The bidder shall specify the model offered and furnish a detailed technical description of the same. System/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 the sketches to show the manner in which the requirements of the specifications are accomplished by the machine (model) offered.

1.5 Photographs of the type of machine offered in working mode shall be enclosed with the offer. This shall also show close-ups of various working assemblies/systems of the machine. The tenderer shall also furnish a compact disc (computer enabled) or DVD or USB showing the working of machine in real time under field conditions.

2.0 DIMENSIONAL AND OPERATING REQUIREMENTS:

2.1 The diesel powered self propelled tamping machine shall be of the latest design, extremely reliable with minimum of four or more axles and suitable for working on the Indian Railway plain track, transition and curved track (upto 10°) on the Broad Gauge (1676 mm). 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 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 maximum moving dimensions are shown in Annexure-I. The tenderer shall submit sketches of the machine in plan and shall give calculations for moving dimensions on 10° curve 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° curve.

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

2.4 The axle load of the machine shall be less than 20.32t with minimum axle spacing of 1.83m. Load per meter 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 minimum wheel diameter of 914 mm (new wheel profile). However, lesser diameter up to 730 mm for new wheel profile can be permitted provided it meets the condition laid down in clause 2.3 at its condemnation limit as per design. 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
22.82	908.00
22.00	878.00
21.50	860.00
21.00	841.00
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

2.6 It shall be capable of negotiating curves upto 10° curvature (175 m radius), super elevation upto 185mm 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. The machine shall be able to work on single/multiple lines as well as between platforms without infringing the traffic movement on the adjoining tracks.

2.7 The machine should be capable of continuous operation during the varying atmospheric and climatic conditions encountered throughout the year in India. The range of climatic conditions is as follows:

Ambient temperature - 0º C to 55º C
Altitude - sea level to 1750m above mean sea level
Humidity - 40 to 100 %
Maximum rail temperature - 70º C

2.8 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.

2.9 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.

2.10 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 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 4.265m centre to centre.

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

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

3.0 Working Mechanism

3.1 The machine shall be capable of carrying out automatic lifting, levelling, lining and tamping of track to achieve the laid down track geometry standards, with proper packing for various kind of track structures, and at laid down minimum progress rate as stated below. 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 via USB, DVD or CD ROM. 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 constraints 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 lifting and lining system of the machines continuously and automatically by this unit. The software shall be Windows based. The hardware shall be sturdy for operation under conditions of shock, vibration, dust, electromagnetic influences from outside and interruption of power supply. The unit shall have adequate memory to cover minimum 100 km track length to keep records of works performed, new track geometry obtained and enable transfer of the data via compact disc (computer enabled) or DVD or USB as required.

3.2 The machine shall be capable of carrying out automatic lifting, levelling, lining and tamping at the peak rate of 2600 sleepers per hour over a period of not less than 10 minutes and average 2000 sleepers in an hour of working .The time of working shall be counted from start to finish of tamping work at work place. The machine shall be capable of working on all type of track structures i.e. long welded, short welded or fish plated rails laid on wooden/CST-9/ST/Concrete sleepers on 90R/52kg/60 kg rails with uniform sleeper density, which may vary from 55 cms to 75cms. Dimensions of sleepers are given in annexure- IV.

3.3 The supplier shall furnish the complete details of the tamping cycle of the machine, its timings and other operational details to show the compliance to performance parameter as per clause no. 3.2 above.

3.4 On the joint sleepers, with clear spacing being only 50 mm, the machine shall be equipped with a mechanism to tamp these two sleepers also.

3.5 The ballast depth ranging from 300 mm to 350 mm shall be effectively compacted having zone of influence of tamping confined to app.roximately 150 mm layer below the bottom of sleepers. There shall be provision for step less adjustment of the depth of tamping tools to suit different type of sleepers and Rails. The depth of concrete sleeper at rail seat is 210mm.

3.6 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.

3.7 It shall be possible to vary the peak squeezing pressure exerted by the tamping tools, to suit the different types of track structures.

3.8 The tamping tools shall come to rest automatically after they encounter the resistance from 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 the varying ballast conditions.

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

3.10 The machine shall be provided with automatic levelling/lining equipment, which will permit correct levelling, alignment and, cross levels of the track including provision of super elevation along with tamping. Tolerances achievable shall be as follows:

Unevenness	:	± 1 mm on 3.6 m Chord
Cross level	:	± 1 mm
Alignment	:	± 2 mm on 7.2m Chord
Twist	:	1 mm/m

3.11 It shall be possible to control the target track geometry parameters, in infinitely variable steps, from the operator's/front cabin. To suit this, suitable Proportional/Servo Control Systems shall be provided.

3.12 Separate tamping unit shall be provided for each rail, with adequate number of tamping tools to impart adequate vibrations and squeezing of the ballast below the sleepers. The tamping unit shall be provided with necessary arrangements for lateral shifting to adjust and align them centrally over the rails in sharp curves.

3.13 The work units i.e tamping, lifting and lining units shall be positioned on an under frame (satellite 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. The movement of the satellite frame shall be synchronous with movement of main frame, so as to achieve a continuous tamping of track.

3.14 The lifting system shall be such that the track can be lifted without bearing on the ballast. The machine frame and lifting system shall be strong enough to withstand the track lifting forces for all types of track structures for 150 mm lifts in one go.

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

3.16 While working on track, 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 synchronised 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.

3.17 The machine shall be fitted with automatic lining equipment capable of carrying out lining simultaneously with levelling. The machine shall also

have the ability to slew 60 kg concrete sleeper and rail track upto 150 mm in one go for all type of track structures.

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

3.19 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 minimum specifications of the laptop are enclosed as annexure-V.

3.20 The machine shall be warranted for 1200 working hours or 4,50,000 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. Working hours for this purpose will be traffic block time during which machine is deployed for tamping work.

3.21 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.

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 this specification elsewhere.

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 High speed diesel oil to Indian Standard Specification shall be normally used. A minimum fuel capacity, sufficient for continuous operation for eight hours, 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 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.

4.8 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 coloured. There shall be audio visual warning (safety mechanism) to the operators in case of any of the 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. 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 synchronization.

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 supplier 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 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 train. The under frame shall be constructed from 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.

7.0 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 to minimize the weight transfer while starting, stopping and during runs.

8.0 Hooks and buffers:

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

9.0 Cabins:

9.1 The machine shall be equipped with fully enclosed cabins with safety glass windows for driving from both ends. The working cabin/cabins should be air-conditioned. However, the electronic equipment shall be so designed that it shall be able to work without air conditioning under the climatic conditions described in Para 2.7. The air conditioner shall be of industrial design capable of operating in highly dust laden environment. 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. 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 track. Additional driver's cabins shall be provided if the view while driving is not clear for safe travel in both directions.

9.2 The gauges, warning panel and controls shall be suitably located in the operator's cabins so that they can be observed without undue fatigue to the operator.

9.3 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.

9.4 Screen wipers preferably operated by compressed air or electrically operated shall be provided on the windscreens on both sides.

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

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

10.0 Cooling System

10.1 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 should be maintainable under these conditions.

10.2 Adequate heat dissipation arrangement for the hydraulic system shall be designed and provided so that under extreme heat conditions as mentioned in 2.7 above, the system oil temperature does not go beyond 85°C.

11.0 Brakes:

11.1 The machine shall be fitted with the compressed air brakes 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.

11.2 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.

11.3 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 design speed shall not be more than approximately 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 shall be provided by the supplier. Brake design details are to be submitted as per annexure VI.

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

11.5 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

12.0 Horn, Hooters and safety switches:

12.1 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.

12.2 Adequate numbers of switches, for stopping the machine and for operating electric horns shall be provided all around the machine so that in case of any danger to worker as well as to the safety of machine during working, the operator can be warned and working can be stopped immediately.

12.3 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.

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

12.5 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.

13.0 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 twin beam headlight assembly, conforming to RDSO specification no. ELRS/SPEC/PR/0024 revision–1, September, 2004 with the 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 swivelling floodlights 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 both ends of the machine

to give indication for the train arriving on other line about any impending danger.

14.0 Operators:

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

15.0 Tools and Instruction manuals:

15.1 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.

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

15.3 The supplier/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 dimensional 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.

15.4 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 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 for the inspecting officer.

15.5 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.

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

15.7 One set of all the manuals and diagrams should also be provided for Principal/IRTMTC, Allahabad, one set for ED/TMM, RDSO, Lucknow, one

set for DTK (MC)/Railway Board and one set for 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 for above mentioned authorities.

16.0 Spare Parts:

16.1 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.

16.2 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).

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

17.0 Maker's test certificate:

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

18.0 Optional Equipment:

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

19.0 Guarantee:

In addition to the clause 9 of 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.

20.0 Inspection of the machine:

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–VII enclosed.

21.0 Service Engineers:

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.

22.0 Acceptance test:

22.1 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.

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

22.3 Testing for negotiability of 10 degree curve and 1 in 8 ½ turnout.

22.4 Running speed tests on the Indian Railway mainline track on the first machine in accordance with the procedures outlined in Annexure-VIII with the machine running upto speed 10% higher than the maximum speed mentioned in Para 2.8 above.

22.5 Construction and engineering of the machine and its ability to perform all the functions as laid down in the specification.

22.6 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 condition of test and test parameters shall be as follows:-

a) The machine crew shall be either trained personnel of Indian Railways or the staff of the contractor/supplier.
b) Dry weather, ambient temperature between +0°C to + 55°C.
c) General lift during working upto 20mm.
d) Lifting of tack in non tamping mode of 150 mm in one go.
e) Maximum slew during working upto $\pm$10mm.
f) Slewing of track in non tamping mode of $\pm$150mm in one go.
g) Plain Track or curve of radius not less than 1000m
h) Clean ballast cushion upto 100 mm in sufficient quantity below the bottom of the sleeper and generally not cemented.
i) Straight track with gradient upto 1 in 200.
j) Long welded track on concrete/wooden/steel sleepers.
k) Rails and sleepers in good conditions and properly fastened.

l) Regular sleeper spacing of 60/65 cms with a tolerance of ±3 cms on straight track.

m) Good formation.

n) The machine shall able to tamp 2000 sleepers over a one hour period 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 rate of 2600 sleepers per hour over a 10 minutes period. Stoppage of work not attributable to machine shall be discounted. The setting up time and winding up time shall be measured and the total time taken for two operations of setting up and winding up of the machine together shall not exceed 20 minutes.

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

23.0 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, tractive effort 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 IX & X 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 IX & X 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 suppliers, whose models are new :

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

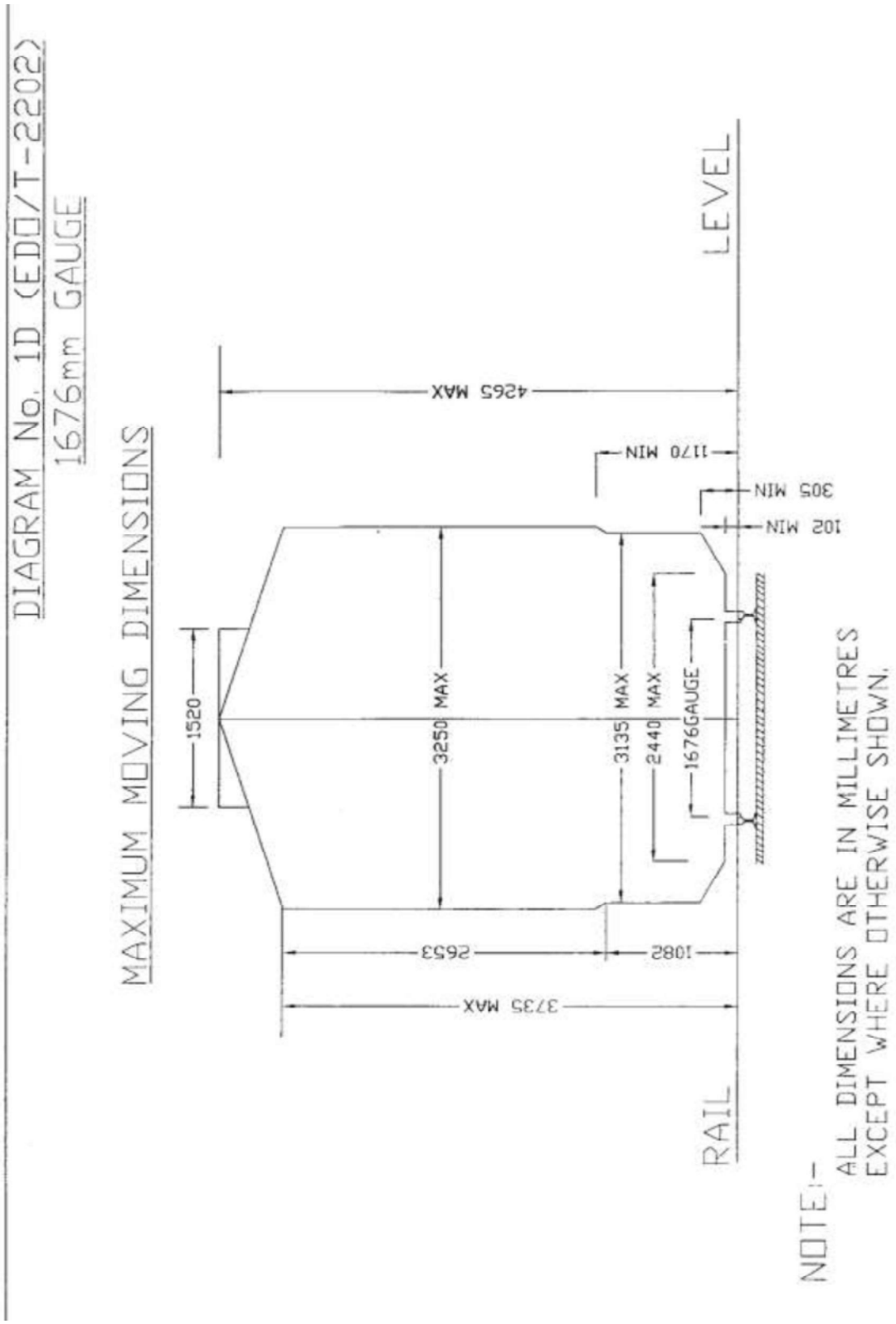


DIAGRAM No. 1D (EDO/T-2202)
1676mm GAUGE
MAXIMUM MOVING DIMENSIONS
LEVEL
4265 MAX
1170 MIN
305 MIN
102 MIN
1520
3250 MAX
3135 MAX
2440 MAX
1676GAUGE
2653
1082
3735 MAX
RAIL
NOTE:-
ALL DIMENSIONS ARE IN MILLIMETRES
EXCEPT WHERE OTHERWISE SHOWN.

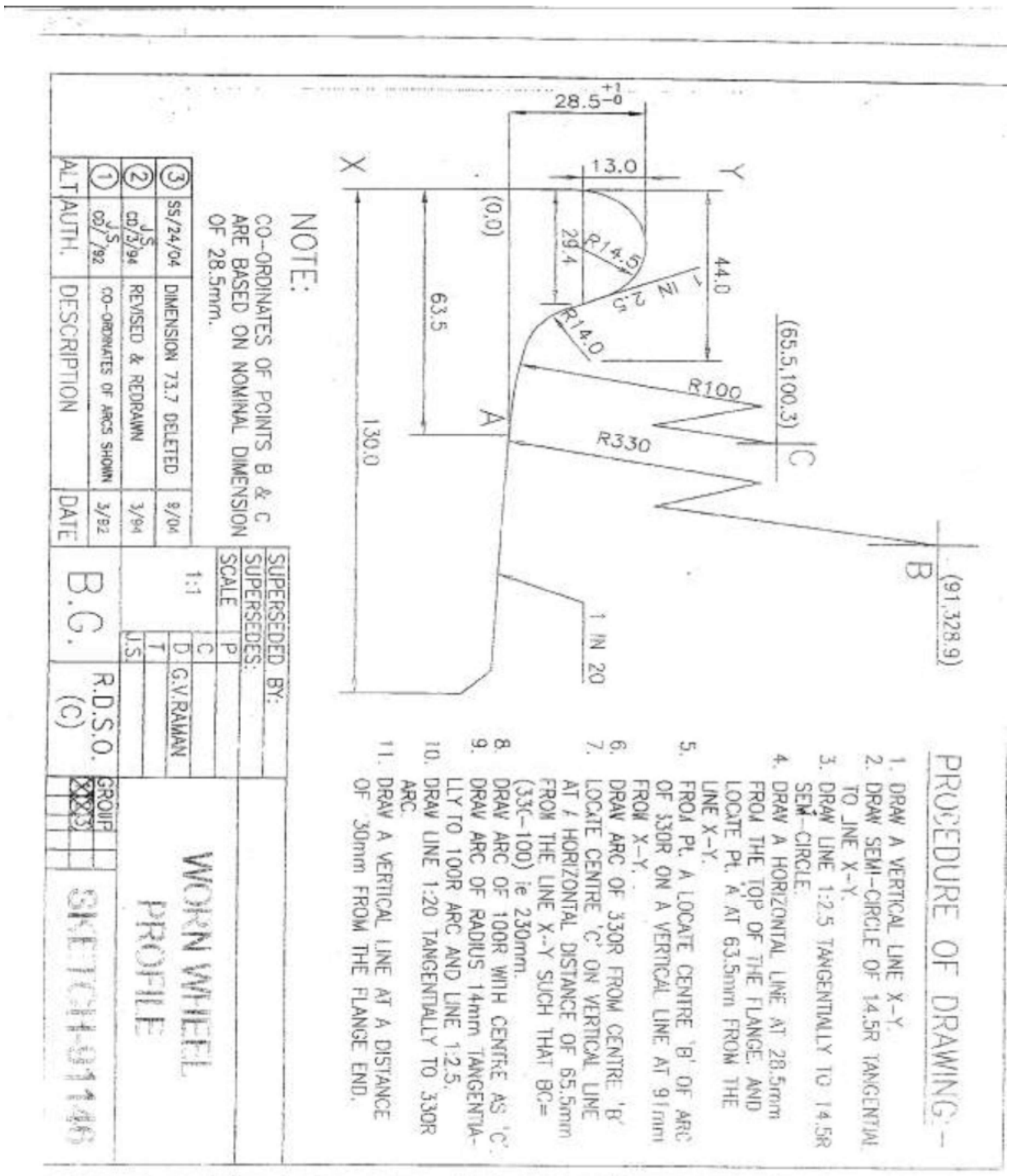
Annexure II

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

SL. 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 motion between bogie frame and machine frame for relative motion (motion stopper)	Vertical direction	Lateral direction	Longitudinal direction	Rotation about vertical axis	Rotation abou lateral axis	Rotation about longitudinal 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.					


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
A
C
R330
130.0
B
(91,328.9)
1 IN 20
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.
3 | SS/24/04 | DIMENSION 73.7 DELETED | 8/04
2 | CD/3/94 | REVISED & REDRAWN | 3/94
1 | CD/ /92 | CO-ORDINATES OF ARCS SHOWN | 3/92
ALT. | AUTH. | DESCRIPTION | DATE
SUPERSEDED BY:
SUPERSEDES:
SCALE 1:1
P
C
D G.V.RAMAN
T
J.S.
B.G.
R.D.S.O. (C)
GROUP
WORN WHEEL PROFILE
SKETCH-91146

ANNEXURE- IV

SIZES OF DIFFERENT B.G. SLEEPERS

Sl. No.	Type of sleeper	Description			
		Length (mm)	Width (mm)	Height (mm)	Weight (kg) (approx.)
1.	CONCRETE SLEEPER	2750	150	220	300
2.	WOODEN SLEEPER	2750	250	130	100
3.	STEEL TROUGH SLEEPER	2680	257	106	79

Annexure- V

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-VI

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 –VII

INSPECTION CERTIFECATE

CERTIFECATE OF INSPECTION OF ……. (Model No. ……..) BY INSPECTING OFFICIAL AND APPROVAL FOR DESPATCH OF MACHINE.

(Strike out whichever not applicable)

This is to certify that I have inspected the ……..…… …… bearing Sl. No. ……..from (date) ……...to ……..at (place) ……..for its conformity / non –conformity with respect to the laid down Technical Specification on contract Agreement No. ……..……..dated……..between the president of india through Director ……..……../RDSO/Lucknow and M/s. (Name of contractor) ……..……

The detailed inspection note regarding its conformity / non conformity to the laid down specification is enclosed along with Annexure 'A". It is observed that:

(Strike out whichever is not applicable)

• The …… …….. conforms to all the laid down specifications.

• The …… 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/machine/vehicle in substantial way.

The following T & P, manuals, drawings are to be supplied along with the machine.

1…….

2…….

3…….

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

The …… is approved/ not approved for dispatch to ……..(consignee) Indian Railway.

For M/s …….

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

ACCEPTANCE CRITERIA DURING OSCILLATION TRIALS

The speed potential of the machine offered by the firm should be established based upon oscillation trials conducted in India. The tests will be conducted at a speed usually10% higher than the maximum speed potential indicated by the firm for the machine under consideration and the following criteria satisfy for the same. For conducting the tests, a section of mainline track will be selected over which there is no temporary speed restrictions and which is considered by the Railway as being in a generally run down condition for mainline standards, but without speed restrictions. The vehicle will be tested generally for new and worn clearance conditions and where relevant for operation in the forward and backward directions. The vehicle selected for tests will be one in average condition for normal maintenance.

The criteria to assess the performance of the UTV in oscillation trials will be as applicable in Indian Railways at the time of actual oscillation trials.

However, the criteria applicable at present are given below:

1. A lateral force lasting more than 2 metres should not exceed the Prud Home's limit of 0.85 (1 + P/3) tonnes, where P is the axle load in tonnes.
2. Isolated peak values exceeding the above limit are permissible provided the record shows stabilizing characteristics of the vehicle subsequent to the disturbances.
3. A derailment coefficient should be worked out in the form of ratio between the lateral force (Hy) and the wheel load (Q) continuously over a period of $1/20^{th}$ second, the value of Hy / Q shall not exceed 1.
4. The values of acceleration recorded in the cab at location as near as possible to axle, shall be limited to 0.55 g both in vertical and lateral directions. The peak values up to 0.60 g may be permitted, if the records do not indicate a resonant tendency in the region of peak value.
5. In case of such vehicles where measurement of forces is not possible, evaluation shall be in terms of ride index, based on the accelerations measured as detailed in para 4 above, which shall not be greater than 4.50, but a limit of 4.25 is preferred.
6. A general indication of stable running characteristics of the whole vehicle as evidenced by the movements of the bogie in straight, station yard and curved track and lateral force and derailment coefficient or accelerations as the case may be.

Annexure –IX

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 – X

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 iv) 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.

Specification No. 7

Rail Grinding Machine

Annexure-I

Specification of Rail Grinding Machine

1. General

1.1. These specifications provide the technical requirements for the manufacture, supply, testing, commissioning, maintenance and operation of a self-propelled rail-grinding machine of minimum 72 stones module (here after referred as machines) for use on the tracks of Indian Railways. The Rail Grinding Machine to be supplied is meant for grinding the rails in corrective mode and preventive mode, to improve the worn profile of rail head, rail wheel contact band, its location, to remove fatigued material having micro cracks and other surface defects on the rail head and remove corrugations. The Rail Grinding Machine shall be able to effectively grind track on Indian Railways. The consist of RGM shall include two rest vans and one water wagon. The supplier shall furnish, deliver, warrant, maintain and operate the Rail-Grinding Machines as per these specifications and tender conditions.

1.2. The Technical Specifications have been drafted to cover the performance and quality requirement of the equipment. Tenderers are requested to carefully study the specifications and assure that their equipment fully comply with these specifications. Thereafter, if a tenderer feels that his equipment can substantially meet the performance and quality requirement of the specification in general but does not fully satisfy a particular specification, he should immediately seek clarification from the purchaser prior to submission of bids as to whether such deviation is substantive or not. Whenever there are any such deviation(s), tenderer should mention the same in the statement of deviation from the specification to be submitted along with bid and should clarify how his equipment will meet the functional requirement of such clause.

1.3. The tenderer shall specify the model offered and furnish a detailed Technical Description of the same. System/sub-systems of the working mechanisms of the Rail Grinding Machine as per para'3 of this specification &Annexure 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 requirement of the specifications are accomplished by the machines (models) offered.

1.4. Photographs and video (in compact disc//Pen drive) of the type of machine offered in working mode (showing the working of machine in real time under field conditions) be enclosed with the offer. This shall also show close-ups of various working assemblies/systems and the full machine. Tenderer shall also submit the names of countries & Railways where the offered machines are working and their working can be seen if felt necessary by the purchaser.

2. Dimensional and Operating requirements:

2.1. The diesel-powered self-propelled Rail-Grinding Machine shall be robust, reliable and suitable for working on Indian Railways. The design and dimensions of the machine components shall be to SI (International) System of Units standards and also comply with provision of Indian Railways BG schedule of Dimensions-2004 incorporating all 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 Rail Grinding Machine shall be Diesel powered (preferably indigenous) self-propelled bogie type vehicle(s) with minimum 4 axles (2 bogies) for each vehicle. It should be reliable and suitable for working on Indian Railway's straight, transitions and curved track up to 10º curves on broad gauge (1676 mm). Shared 2 axle bogies between two grinding cars and/or between two grinding buggies/carriages are not acceptable.

2.3. The profile of the on-track machines 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-2004 incorporating all correction slips up to date. The minimum and maximum moving dimensions are enclosed in **Annexure-III.** The tenderer shall provide sketches of the machines in plan and cross-section and shall give calculations to show the extent of lateral shift at the ends, centre and any other relevant cross section and to prove that the machines do not cause infringement while moving on a 10° curve at any cross section.

2.4. Where an infringement to Indian Railways Standard BG Schedule of Dimensions (metric)-2004 incorporating all correction slips up to date 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 same shall be done with the prior approval of the Purchaser and decision of the Purchaser in permitting any such infringement shall be final and binding on the manufacturer. Tenderers may note that acceptance of any such deviation during consideration of preliminary design details in the offer is only in principle acceptance and the final decision will be taken by the Purchaser at the stage of consideration of machine design for issuing speed certificate. In the past, IR have condoned certain infringements to such dimensions as Rigid wheel Base, Length of stocks, Distance apart of bogie centres and maximum height of floor above Rail level in certain track machines after due consideration of their design features vis-à-vis safety and operational requirements of 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.

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

2.6. Wherever applicable, axle load shall be less than 20.32 T with minimum axle spacing of 1.83m. Load per meter shall not exceed 7.67 tones. Axle loads up to 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. Further at the stage of consideration on machine design for issuing speed certificate, stresses in the track and bridges shall be calculated by IR/RDSO based on design data submitted by the firm as per Annexure–VIII A,B&C and decision of IR/RDSO shall be final in this regards.

2.7. The Machines shall have a desirable wheel diameter of 914mm or more (new wheel profile). However, lesser diameter up to 760 mm for Rail Grinding machine can be permitted provided it meets the condition laid down in clause 2.5 at its condemnation limit as per design and provided the rail wheel contact stresses for 72 UTS rails are within permissible

limits. The new wheel shall have a minimum wear margin of 50mm before reaching condemnation limit. Forged wheels to Indian Railways 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 (tone)	Minimum 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
17.42	710
17.0	700

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 shall be as per Indian Railway standard wheel profile provided in Annexure-V.

2.8. Wheels shall be conforming to Indian Railway Standard R-19/93 or European Standard EN13262 or any other equivalent standard (for product requirement) and design shall duly conform to European Standard EN 13979 or other equivalent standard. The supplier shall submit detailed design calculation along with material parameters at the time of supply of the machine.

2.9. The non-powered axles shall be conforming to Indian Railway Standard R-16/95 or European Standard EN 13261(EA1N) or any other equivalent standard. The supplier shall submit detailed design calculation along with material parameters at the time of supply of the machine.

2.10. The powered axles shall be conforming to Indian Railway Standard R-43/92 or European Standard EN 13261(EA4T) or any other equivalent standard (for product requirement). The design shall conform to EN: 13104 or any other equivalent standard. The supplier shall submit detailed design calculation along with material parameters at the time of supply of the machine.

2.11. The machines shall be capable of negotiating curves up to 10° curvature (175 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 conditions, which in any

case shall not be less than 25 kmph. Water wagon and camping coaches shall be considered as part of consist/formation while travelling up to 3 % gradient.

2.12. The machines 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 : -5° to 55°C
- Altitude : Sea level to1800 m
- Humidity : 20% to 100%
- Maximum rail temperature : 70°C

All the system components on the machine shall be covered by roof or other suitable sturdy covering so that the system & components vulnerable to moisture ingress are not adversely affected during rains and the machine is able to work continuously even during rains

2.13. The Rail Grinding Machine in consist/formation (in composition with all its integral part) shall be capable of travelling at a speed of 80 km/h in either direction when travelling on its own power. In train formation, it should be capable of being hauled at a speed of 100 km/h. It shall be possible to haul the machines in both directions at the same speed. Since the machines are 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 without much break down/failure.

2.14. The machines shall be capable of working without requiring power block in electrified sections. 25KV or 2x25 KV AC power supply 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. The accuracy of measurement by measuring equipments/systems of the machine shall not be affected in any manner due to overhead electricity and also due to track circuit voltage (12 V & 1 AMP).

2.15. The machines and any of its parts shall not infringe the adjoining track as per 'BG Schedule of dimensions of Indian Railways (metric)-2004 print with latest corrigendum and up to date correction slips issued while opening and closing of work. The machine shall be equipped with pneumatically operated brake blocks acting on all wheels.

2.16. In the work mode, no part of the machines should rise beyond 4.265 m. above rail level for safe working in the electrified sections.

2.17. While working on double line sections, the machines 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 4.265m.

3. WORKING MECHANISM OF RAIL GRINDING MACHINE

3.1. The working mechanism of the rail grinding machine shall be equipped with:

3.1.1. Rail grinding mechanism

3.1.2. Control system for rail grinding mechanism

3.1.3. Optical rail profile measurement system and its transfer to onboard computer

3.2. The rail grinding machine should be capable of producing good longitudinal profile of the railhead continuously.

3.3. The rail grinding machine should be capable of grinding operations on plain track and curves, track in tunnels, track on bridges having guard rails without removing the guard rails, and track on platform lines. It should also be capable of grinding operations on track on level crossings having check rails and curves with check rails with or without removing check rails. Maximum grind speed should not be less than 18 kmph on plain track.

3.4. The rail grinding machine shall also be capable of grinding, if required, only one of the rails of the track as in the case of curves.

3.5. The rail grinding machine shall be capable of grinding profile of UIC 60 Kg rail section, 52 Kg rail heads in 72/90/110 UTS strength and Head Hardened rails inclusive of fish plated joint, insulated joints and welded joints in long welded rails and short welded rails laid on pre stressed concrete sleepers, steel sleepers, composite sleepers and wooden sleepers. It shall also function effectively on rails having surface defects such as wheel burns, shelling etc. The number of grinding stones and grinding units of the machine shall be such as to carry out controlled grinding of all rail corrugation defects and also defects of long wave length to produce a smooth cross sectional profile without creating any sharp edge between the rail table and gauge face.

3.6. The supplier shall ensure that the offered rail grinding machines shall be capable of modular up gradation at a later stage and shall have such computer hardware and software which shall facilitate easy up gradation.

3.7. The rail grinding mechanism should be electric driven, drawing power from an on-board diesel generating set.

3.8. All the components of the rail grinding machine must be robust and capable of continuous operation upto 8 hrs in one spell under the field working conditions. They must be shielded against heavy heat accumulation in the work area and metallic dust generated at the work site.

3.9. To achieve the target profile with smooth curvatures, with minimum points of singularities, the Rail grinding machine shall have a minimum of 72 grinding stones (36 per rail), which can be configured in various configurations to achieve different target profiles.

3.10. Each grinding module shall be controlled by a hydraulic/pneumatic cylinder for its up/down movement.

3.11. The rail grinding machine shall be equipped with an inbuilt mechanism to stop the grinding and lift the grinding stones/carriages when the operating speed falls below a certain

minimum speed to avoid metallurgical damage due to heat accumulation. The minimum speed, at which the grinding shall stop automatically, shall be as per supplier's design but it shall be mentioned in the offer.

3.12. Each grinding module shall comprise of a ring shaped stone and a grinding motor with suitable positioning mechanism to control the stone position, to achieve the target profile by the various grinding module configurations. Firm shall submit their module arrangement, Configuration should have a fully adjustable angle range of +70 degrees to gauge and -20 degrees to field, independently controlled from the operator station in the cab Each grinding motor spindle angle shall be accurate within ±0.25° (plus/minus one quarter of a degree) of the designed spindle axis positioning angle. Each module shall contain one or more grinding motors with, independent tilt cylinder for each module and must have the capability of being positioned by the control system independent of any other grinding module. In each module grind motor/tilt cylinder should be separated by certain angle so that heating or other impact does not take place on rail. The tilting cylinders should not be shared with adjacent modules and must be independent for each module.

3.13. At the work location, the prevailing temperature may be higher than the specified maximum temperature of 55^{o}C. The peak load on the grinding motors, under the most demanding conditions shall not be more than 80% of the continuous load rating of the motor, at the prevailing temperature conditions. The supplier shall furnish the peak load for the motors at various locations and the continuous load ratings of the motors under the operating conditions, as per the manufacturer's catalogues.

3.14. The grinding motor power shall be as per the supplier's design to achieve the output parameters laid down below and may vary with the total number of grinding motors provided on the rail grinding machine (not less than 72). However, the total grinding power provided on the rail grinding machine (number of motors x continuous load rating of each motor) shall not be less than 2000HP.

3.15. The rail grinding machine shall be capable of removing, a minimum of 20 sq. mm material from each rail(40 sq. mm for both the rails) per pass, from the rail top of a 60 kg. UIC (90 UTS) rail section, with top surface work hardened to BHN 315 to 380, while operating at a speed of 15 kmph. While assessing the rail grinding machines performance, the test rail profile (after grinding) shall be close to the target profile and the metal removal shall be fairly uniform over the entire rail surface to be ground.

3.16. The capacity of rail grinding machine regarding depth of grinding per pass, for 60 kg 90 UTS work hardened rail top while grinding uniformly over full width and gauge faces at various working speeds, shall not be less than as mentioned below :

18 kmph : 0. 13mm

15 kmph : 0. 20 mm

3.17. While achieving the above progress rate, the overall combination of grinding stones pressure, RPM and travel speed should be such that no chattering or uneven removal of the material occurs at high speeds nor are there any metallurgical changes or bluing of the rail top at the minimum operating speed.

3.18. The rail grinding machine must be capable of bi-directional grinding i.e in both the directions on the same track without loss of metal removal capacity or productivity, while grinding both rails simultaneously or either rail independently.

3.19. To ensure Gauge Face correction without flattening the root curve, , all of the grinding modules shall have the ability of attaining spindle axis orientation with respect to the rail axis, up to 70° on the gauge corner and 20° on the field corner. At all angles the grinding effort must potentially be 100%.

3.20. While the rail grinding machine is operating at full grinding load at the maximum working speed, the minimum life of each stone shall not be less than 5 hrs grinding time.

3.21. Each module shall be provided with a stone stop mechanism to prevent accidental contact between the rail and grinding motor shaft chuck when the stone has completely worn out, to prevent damage to rail or the shaft.

3.22. Rail grinding machine driving controls must be at both extreme ends of the rail grinding machine, irrespective of driving direction. However grinding controls can be housed in one cabin.

3.23. The unit must be capable of travelling and grinding under the following track conditions:

(i) Maximum grade 3%

(ii) Maximum curve 10°

3.24. The unit must be capable of grinding a variety of profiling and re-contouring patterns depending on varying rail wear conditions. Such pattern changes and adjustments should be made instantly from an on board central control panel.

3.25. The unit must have the following controls/display the following operating data at the operator's console:

(a) Start/stop buttons for individual motor and master stop button (to stop all grinding motors).

(b) Current meters for various grinding modules and motor grinding power control.

(c) Grinding Module/Grinding carriage up/down control.

(d) Operating speed monitor and control.

(e) Stone condition monitor.

(f) Deviations in motor spindle angles.

(g) Any other data monitor/control required for proper operation and control of the working, depending on the supplier's design.

(h) Angle setting of different grinding module.

3.26. a. There shall be computer controlled monitoring of input and output of different electrical/electronic devices with the facility of display of input/output so as to monitor the functioning of electrical/electronic devices.

3.26.b. The computer controlled functions may be as per the supplier's design, but as a representative illustration, the following functions shall be computer controlled

(a) Auto horsepower adjustment of grinding stones with change in pattern

(b) Carriage Raising and lowering.

(c) Module raising and lowering.

(d) Pattern data input from Rail Profile measurement units.

(e) Storage of Profiles.

(f) Grinding pattern selection and down loading to grinding controls

3.26.c. The computer controlled system shall have the facility of System diagnostics in operator's cabin (at least in one cab) which should be able to do following:

(a) Detection of short circuit, open circuit conditions and measurement of amperage in connection to control devices.

(b) Diagnostics modules shall be provided for troubleshooting of various electronic printer circuit boards used up to card/board level fault finding.

(c) Communication between various sub systems used in the system shall be provided as a diagnostics feature.

3.27. The on board computer will monitor the main system of rail grinding machine and maintain a log of following items:

(a) Grinding Motor performance (amps).

(b) Stone usage.

(c) Grinding Motor idle amp.

(d) Stone spark time.

(e) Motor life.

(f) Performance monitoring

- Quantitative assessment of metal removal from each km of track to achieve target profile.
- Percentage deviation of ground profile from target profile
- Grinding speed and no of grinding passes
- Quantum of work done in pass km

- History of existing rail profile, target profile and grinding pattern followed for a given km of track.

3.28. The rail grinding machine must be capable of automatic adjustment of grinding patterns from the operator's cab. The supplier shall furnish details of all possible number and patterns subjected to minimum of 50 patterns. The on-board computer must be capable of storing all these grinding patterns and changing from any of these patterns to any other within the length of the grinding consist.

3.29. It shall also be possible to record the grinding length vis-à-vis time on a print out to obtain information on the rail grinding machine output. The system shall be able to produce performance parameters and progress of work such as grind length, speed of grinding, number of passes done, pattern used, pre/post Grind Quality Index (GQI) etc in a way that should facilitate its transfer to pen drive at the end of day's work.

3.30. The grinding method must ensure the complete re-profiling of the railhead by metal removal.

3.31. All the grinding stones shall be equipped with an automatic vertical control and locking device preserving the stone from dropping into pitch corrugation.

3.32. All the grinding units shall be so designed that it can be lowered or raised from grind cabin. Lowering and raising of grinding units should be automatic, electronically operated, which can be applied either on one rail or on both rails simultaneously.

3.33. The rail grinding machine shall be equipped with Rail Grinding templates for Board Gauge (1676 mm), with minimum four different profiles (a) Tangent track (b) The high rail in mild curves (c) The high rail in sharp curves (d) Low rail in both mild and sharp curves, because worn rail profiles are not always centrally located with respect to the vertical axis of the rails.

3.34. To ensure minimum vibration of the rotating grinding stones, a self-centering system for holding the stones shall be provided.

3.35. The grinding trolley shall be designed for raising and lowering operation from grinding control cabin.

3.36. The grinding power per grinding stone shall be minimum 25 Horse Power.

3.37. The rail grinding machine must be equipped with an obstacle sensing/detection system with manual lifting of the grinding carriages through controls from operators' cabin before approaching the obstacle and restarting of the grinding process after the clearance of the obstacles. The supplier shall specify the distance left unground after the clearance of the obstacles at various operating speeds. This distance shall not be more than 12 m for an operating speed of 15 kmph.

3.38. The rail grinding machine must be capable of setting down or picking up grinding stones in curves also.

3.39. Grinding carriages should be capable of being raised and lowered and locked into position on curved track up to 10 degrees.

3.40. The grinding stone must be centered over the grinding spot at all intended grinding angles. To ensure proper positioning and angle of the grinding stone, the support structure must be equipped with pivot to permit the angular adjustment of the motor/stone in relation to the rail for centering of the stone over the area with adequate force to produce desired grinding power.

3.41. The grinding motors shall be controlled through suitable starter control for starting/stopping of motor.

3.42. Grinding patterns must be balanced and not change with curve super elevation of the track on which the rail grinding machine is operating except for changes will made from system. The rail grinding machine must be equipped with a system to maintain a positive pressure and constant reference to the gauge face of the rail.

3.43. The rail grinding machine must be equipped with a vertical rate of correction feature to restrict the grinding in corrugation valleys, while smoothening the crests. For maximum grinding effort on rail running surface variations, the unit must be equipped with selective vertical stability control. The tenderer shall furnish the details of the mechanism to achieve this.

3.44. The unit must be capable of grinding any worn rail profile to shapes within plus or minus 0.30 mm of the selected target profile.

3.45. Metal removal rates must not vary more than 25% between grinding of rail with hardness ranging from 280-380 BHN.

3.46. The surface finishes after the grinding shall be that corresponding to RMS value of 12 microns roughness or less.

3.47. The rail grinding machine must be supplied with adequate lighting to perform grinding at night safely and efficiently.

3.48. The rail grinding machine shall be equipped with suitable spark arresters to prevent sparks from flying around and be a potential fire hazard. The spark arresters shall be suitably designed to withstand the heat generated at the work spot and the flying metal sparks.

3.49. The rail grinding machine should have adequate water capacity to prevent and fight fires, and to carry on grinding irrespective of terrain or dry weather conditions. A minimum 20000 liters water storage capacity should be available on the rail grinding machine. There shall be separate arrangement of 55000 liters storage of water container in the rail grinding machine consist by way of a separate wagon for use during prevention of fire. It should be possible to connect the water storage on the attached wagon with the rail grinding machine storage and use it for arresting fire as and when required. The visibility requirement of the rail grinding machine as specified in clause 13.1 shall not be obstructed on this account

3.50. The rail grinding machine shall be equipped with two water cannons (one in front and another in rear with) of capacity up to 600 liters each per minute throughout with a reach of

40 meters. The rail grinding machine shall also be equipped with separately controlled sleeper and ditch spray, for front and rear.

3.51. There should be an installed, integrated backup of the following critical sub-systems to ensure maximum availability and minimal chances of disruption of rail grinding machine operations:

a. Water system/pumps

b. Hydraulic pumps/motors

c. Air compressors

A suitable by-pass mechanism should be installed and integrated to main system to operate the rail grinding machine with backup assembly.

3.52. The rail grinding machine shall be provided with a set of optical rail profile measuring system integrated with the onboard computer both in front of the rail grinding mechanism as well as rear of the rail grinding mechanism.

a. The profile measurement system should be able to capture rail profile both ahead of and behind the grinding machine and should have capacity to store data of rail profile at least 200 km of track length for real time comparison of rail profile before grinding and after grinding. Optical rail profile measurement system should have facility to transfer data to onboard computer without human interface.

b. The on board profile measurement system, in a real time basis, should show the actual rail profile ahead of work and after the work and difference between the measured profile and selected target profile. The system should save the captured rail profile data along with input location data such as milepost, curve-data, grinding, speed patterns used etc.

c. Electronic/computerized rail profile data processing system and software plug-ins to grind the existing rail profile to a selected target rail profile shall be provided on board to Rail Grinding Machine. Rail Grinding Machine should be equipped with required following hardware and software-

i. To capture, store and process rail profile data from other measuring devices of rail profile,

ii. Optional merit given to supplier having quantitative assessment of metal removal per meter of rail to achieve target rail profile,

iii. Recommended grinding pattern to achieve a target rail profile

iv. Comparative picture of target profile and profile achieved after grinding on real time basis,

v. Quantitative assessment of deviation of ground profile from target profile.

d. The rail grinding machine should be provided with the necessary software and hardware system to store a library of desired railhead profiles (templates) and to calculate on real

time basis the amount of rail grinding to be done. The supplier shall be responsible to provide technical support and services for software maintenance and up gradation during warranty and subsequent working life of the rail grinding machine (minimum 15 years).

e. It should give:
   (i) Best/optimum pattern to use for grinding.
   (ii) Number of grinding passes needed in order to achieve a predefined acceptance envelope.
   (iii) Grinding speed for suggested pattern and profile

f. To develop library of target profiles for various rail sections on different route, supplier of rail grinding machine will design the target rail profiles for all the locations where it will be deployed to work. The system should be equipped to store data of rail profile before grinding, its target profile and rail profile after grinding in an integrated way so that it could be retrieved for any given location of track.

3.53. The machine should be equipped with GPS, GSM/GPRS based remote monitoring capabilities for various track parameters and vital parameters of track machine, It should also have facility to interface with Human Machine Interface (HMI) / Display and various other sensors. The data transfer unit should be compatible with the Track Management System (TMS) of IR.

4. DIESEL ENGINE/ELECTRIC GENERATOR:

4.1. The machines 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. The manufacturer of the engine shall have acquired quality assurance certification of ISO: 9001. Adequate allowance shall be made to provide adequate reserve power to take care of the working of machines under most adverse climatic conditions, heavy grinding requirements on steep gradients, and to provide back up power in case of failure of one of the engines.

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 Indian Railways. The engine should be of such design /brand which are being manufactured indigenously and/or such designs having after sale service facilities available in India. The supplier should furnish the information regarding agency which will provide after sales service support and availability of spares in India.

4.3. Diesel tank fuel capacity of the rail grinding machine should not be less than 21,000 lts. or 40 hrs of working. Tenderer should mention the fuel storage capacity and average fuel consumption of machines.

4.4. The engine shall be mounted on suitable Anti-Vibration Mountings.

4.5. High speed diesel oil to Indian Standard Specification shall be normally used.

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

4.7. For starting the engines, storage batteries of well-known make shall be provided. The engine shall be push button start type or key type.

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

4.9. 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 along with the machine.

4.10. 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 should shut down automatically.

4.11. 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 move**.**

4.12. The diesel engines of Rail Grinding Machine shall be coupled to the electric generator(s) of a continuous rating to suit machine-operating requirements. Suitable cooling arrangement for the generator shall be provided. The electric generation parameter monitoring gauges shall be provided like wattmeter, voltmeter, ammeter, frequency meter etc. Generator shall have over voltage protection.

4.13. The grinding power should be on a common bus to ensure grinding with all grinding modules may continue in case of failure of one of the engines / generators. The supplier shall furnish the details of power requirement for working under normal conditions as specified in clause 3.15 and total power provided on the machine.

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

4.15. The engine should have Electronic Control Module (ECM) or similar arrangement for taking out operating parameters on real time basis such as RPM, load, temperature, pressure and diagnostic data as well as trip and historical data. These data should be displayed and stored on a centralized computer and monitoring system. It should also be possible to transfer these data on USB device through the centralised computer based control.

4.16. The engine should be enclosed in a weather protective, sound and dust resistant enclosure to minimise engine noise and to prevent oozing out of oil spills etc. from engine area to the adjacent machine components, hoses, electrical cables fittings as a protection against fire. All doors on the enclosure shall be strategically located in areas as to allow ease of maintenance of the engine and allow good access to and visibility of instruments, controls, engine gauges, etc. Sufficient louvers shall be provided to allow the total engine cooling air requirements used in this application.

5. 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 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.

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.

5.5. 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.

5.6. Adequate gauges to monitor driving and working performance of machine 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. 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.

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

5.8. The machine shall be equipped with adequate safety circuit such that if any unit/part which may endanger the safety is unlocked and the air pressure in brake circuit is less than 5 bars, the machine shall not move during run drive. The indication of locking and unlocking of all units should be displayed in the cabin.

5.9. 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.

6. COOLING SYSTEM:

6.1. The cooling system shall be efficient and designed for a maximum ambient temperature of 55°C. Supplier must 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 shall be designed and provided so that the system oil temperature does not go beyond specified range.

7. REST VANS:

7.1. One No's crew rest van having total resting capacity of about 12 to 15 persons will be integral part of the Rail Grinding Machine and shall be supplied with the same and for second rest van with driving control as a last vehicle of the RGM.

7.2. Typical layouts of coaches, with/without operational controls are given at Annexure I & II of the Technical Specification. These layouts are for guidance of tenderers in respect of the facilities required and general arrangement thereof.

7.3. Tenderer can propose modifications in layout as a part of technical proposal while providing the required facilities as per typical layout. Overall dimensions of the rest van will be within (+/-) 10% of the typical layout subjected to conformity to the Indian Railways standard metric BG schedule of Dimensions-2004 incorporating all correction slips up to date. The modifications proposed by tenderer will be discussed with tenderer during technical evaluation and necessary modifications required by IR will be incorporated by the tenderer as per mutual consent. If any further modifications are required by the successful contractor at the stage of detailed design, the same will be subjects to approval of RDSO.

7.4. Rest vans should be air conditioned and fully furnished for comfortable stay of operation & maintenance crew and IR personnel.

7.5. Minimum amenities to be provided in rest vans, its color scheme and other details shall be as per Correction Slip no.12 of IRTMM-2000.A Washing machine, Microwave oven and communication gadgets are also to be provided.

8. BRAKES:

8.1. Machine shall be equipped with compressed air brake 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/wagons when the machine is hauling it. 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 pneumatic parking brake should also be spring loaded so that in case of drop in pneumatic pressure below certain value the brake will be automatically be applied. 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 parking.

8.2. The rail grinding machine shall have provision for suitable air brake system in the driving cabins to brake the entire consist including camping coach/crew rest van and water wagon attached as a part of its consist/formation. 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 pneumatic parking brake should also be spring loaded so that in case of drop in pneumatic pressure below certain value the brake will be automatically be applied.

8.3. The machines shall be equipped with suitable air brake valves so that while working in train formation, machines can be braked by the traction vehicle.

8.4. 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.

8.5. Provision of "Manual operated hand brake" system shall be provided.

8.6. 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.

9. HORN, HOOTER AND SAFETY MECHANISM:

9.1. The Machines shall be provided with dual tone (low tone & high tone) electric horns/ at suitable locations facing outwards at each end of the machine for use during travelling to warn the workmen of any impending danger. Controls/switches 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. These electric horns shall be operated by means of push buttons provided in the cabs.

9.2. The Machines shall have arrangement for flasher lights at both ends.

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

9.4. Safety equipments like jacks, pullers, tirfor and other such equipments specific to the machines for restoring failed units of the machines during working, shall be provided on the machines. The tenderer should submit the list of safety equipment to be provided.

9.5. 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.

9.6. 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

9.7. Machines shall be provided with emergency backup system to wind up the machines in the event of failure of prime mover or power transmission system of the machine. The emergency backup system should able to be operated manually and may also use a manual hydraulic power pack in addition to the emergency generator / battery based electric hydraulic system.

9.8. The grinding carriages of rail grinding machine should have non-flammable shields and guards so as to avoid damage due to sparks, grinding dust and flying debris.

9.9. The rail grinding machine shall have a UV and Temperature based fire detection system that will alert the operator. There shall be an arrangement that when the fire extinguisher is activated,if electronic control of engine detected malfunction, the engine automatically shuts down.

9.10. There shall be arrangement on rail grinding machine to prevent dust from the grinding process from escaping into the air. A suitable and efficient “dust collection system” shall be provided on the machine.

10. HOOKS AND BUFFERS:

The machines shall be fitted with transition CBC couplingas per RDSO specification no. 56-BD-07 with latest revision along with side buffers to RDSO drawing no. RDSO/SK-98145 with latest alteration on both the ends for coupling it with other vehicles for running it in train formation and for attachment with the coach, locomotives and wagon.

11. HEAD LIGHT, FLASHER LIGHT AND OTHER LIGHTING ARRANGEMENTS:

The electrical equipment to be provided on machines 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 pressurize floodlights shall also be provided to illuminate the working area sufficiently bright for efficient working during night. In addition minimum eight power point locations 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 lights 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 on the machine to give indication for the train arriving on the other line.

12. CHASSIS AND UNDERFRAME:

The chassis of machines shall be fabricated from standard welded steel section 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 102t at buffers i.e. 51t at each buffing point without any permanent distortion. The under frame shall be sufficiently robust for safe travel of the machine in train formation.

13. CABINS:

13.1. The machines 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 panel 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 controls.

13.4. Screen wipers preferably operated by compressed air or electricity shall be provided on the windscreens

13.5. Suitable number of fire extinguisher shall be provided in all the vehicles. The chemicals used for extinguishing fire by such fire extinguishers shall not chemically react with electronic equipments/components, PCBs, cables etc.

13.6. The machines shall be provided with well-defined space for keeping the tools and spares required for at least one week of operation and onsite repair of the machine to attend the breakdowns and other working requirements.

13.7. Large window shall be provided in both cabs of the rail grinding machine at low level to ensure good visibility for the operator controlling working and driving of machines to observe the track features and to operate the controls based on the features/obstructions being approached and cleared Facility of driving the machine for travelling purpose shall be from both the cabins. All travelling and grinding control shall be housed in the air-conditioned cabins.

13.8. Inter-communication system wired/wireless shall be provided inter-connecting all the cabins and coaches and outside of machine should be so oriented that the operator, seating on the seat of either cabins/working cabin, can distinctly hear the conversation and communicate with other staff.

13.9. The machine shall be equipped with speed indicator and recording equipment of range between 0 - 120km/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

14. 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 machines. The list of tools to be provided shall also include all tools necessary for maintenance and repair of the entire machine including specialized equipment, like hydraulic jacks, welding equipment, wheel truing shoes, refractometer, power tools, air hoses/wands, etc. 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. The supplier shall include all items, tools and accessories required for proper operation, servicing, maintenance, assembly overhauling, periodical overhauling of the machine along with the offer and not mentioned in these specifications and supply the same along with the machine.

14.2. Detailed operating manual, maintenance and service manual shall be specifically prepared in English Language 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 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 pump-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 supplied with each machine.

14.4. Complete technical literature in english to be supplied with the machines 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.

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

14.6. One set each of all the manuals and diagrams should be sent to the Principal/IRTMTC, Allahabad, ED/TM/RDSO, Lucknow, DTK(MC)/ Railway Board and 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.

14.7. Each machine should be supplied with following Equipments-

a. Two contact based rail profile measuring equipment shall be supplied by manufacturer along with machine as per RDSO Specification no. **TM/SM – 323**
b. Bar gauge with appropriate templates
c. Digital inclinometer
d. Rail Hardness measuring equipment
e. Rail Roughness measuring equipment

15. SPARE PARTS:

15.1. The expected life of the components shall be advised along with their condemning limits.

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

15.3. For indigenous parts and bought 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. MAKER'S TEST CERTIFICATE:

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

17. 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. OPTIONAL EQUIPMENT:

18.1 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 equipment is already in use on machines elsewhere indicating the user Railway system.

19. INSPECTION:

19.1. While inspecting the machine before dispatch from the supplier's premises, the inspecting officer to be nominated by the purchaser shall verify the conformity of the machine with respect to individual clause of technical requirements laid down in this specification. 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 dispatch of the machine" as per **Annexure-VI** enclosed.

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

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

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

i. One copy of complete technical literature mentioned in clause 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 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 of draft inspection report for the clause-wise comments is given below:

Clause No.	Clause	Comments of Supplier/manufacturer	Comments of Inspecting Officer (To be filled by 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 19.4.

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.

19.4. 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.

Above documents shall be part of final inspection report

20. 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 (VIII/A,B&C) 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 VIII/A, B & C) 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. MARKING & COLOUR:

21.1. The machine body shall be painted in golden yellow colour, conforming to RDSO specification No M & C/PCN/109/88 (with latest amendment) to minimum DFT of 80 mm. Colour code to be ISC: 356.

21.2. Following should be written on the machine at appropriate location (as per Annexure IX)
(i) Indian Railway's logo of height between 300 mm to 600 mm as suitable on all four faces of the machine.

(ii) On both side faces, 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 color 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 desired by the Manufacturers, his 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.

22. Acceptance test-The acceptance test as below shall be carried out at the time of commissioning of machines in India at the consignee Railway.

22.1. **Rail Grinding Machine** : The acceptance test of Rail Grinding Machine shall consist of:

A. Dimensional test of the loading gauge, maximum moving dimensions, buffer heights, clearances etc.

B. Testing for negotiability of 10-degree curve and 1 in 8.5 turnouts.

C. Train running speed tests (light running) on the Indian Railway main line track in accordance with the procedure outlined at **Annexure –VII**.

D. Construction and engineering of the machine.

E. Output performance quality tests with High carbon 90 UTS/110 UTS H.H. rails with 60-kg/52 kg UIC section.

F. Profile of the rail section shall not be deformed.

G. For the purpose of metal removal capability of the machine (clause 3.16), 5 sites of minimum 500m each shall be selected. At each site measurement of both left and right rail shall be taken.

i. At each site, the machine shall grind a length of at least 500 meters to ensure that the stones are not heated up.

ii. The profile of the rail shall be close to the desired profile.

iii. The rail hardness shall be measured and recorded.

iv. A each site, on the test rails, 5 X-sections shall be selected on both rails. These X-sections shall be at least 2 meters away from any weld/fish plated joint and not in heavily corrugated rail.

v. The X-sectional area shall be recorded, at each X-section, before the grinding, and after 1 grinding pass. The working speed, while grinding shall be maintained as specified.

vi. The average material removal per pass for the site shall be the average of material removal per pass at 5 X-sections.

vii. The average material removal per pass at the specified speed at each of the 5 sites both left and right rail separately shall be more than that specified in clause 3.15.

H. For the purpose of depth of metal removal capability of the machine (clause 3.16), 5 sites of minimum 500m each shall be selected for carrying out tests at the speeds mentioned in clause 3.16. At each site, measurement of both left and right rail shall be taken:

i. At each site, the machine shall grind a length of at least 500 meters to ensure that the stones are not heated up.

ii. The profile of the rail shall be close to the desired profile.

iii. The rail hardness shall be measured and recorded.

iv. 5 points shall be chosen at 5 locations across the X-section, one towards gauge face side, three in the middle of rail top and one towards non-gauge face side such as to cover full width of rail head, at 5 X-sections on both rails at each of the 5 sites.

v. The working speed, while grinding shall be maintained as specified. The depth of metal removed shall be measured by measuring the depth of cut before and after 1 grinding pass (as per para no. 21.1/G/v). Measurement to be done with Contact based Rail profile measurement Device with or better precision/accuracy.

vi. The average of the 25 observations at each site for each rail shall be worked out. The average depth of metal removal per pass for the site shall be the average depth of material removed for all 25 test points.

vii. None of the average depth of metal removal per pass for a site, out of 5 selected sites for both rails should be less than as specified at clause 3.16 for the respective grinding speed.

I. Stoppages of work not attributable to machine shall be discounted.

J. The difference in the target profile and ground profile ie profile achieved after grinding, shall not more than + 1% in terms of cross sectional area of rail head.

K. The machine will also be operated at suitable locations in working mode for continuous 5 hours to ensure the machine's continuous working capability for this type of work and test the life of the grinding stones as specified at clause 3.20.

22.2. Should any modifications be found necessary as a result of the tests, these shall be carried out by the supplier at his own expense.

23. TRAINING:

23.1. The supplier shall impart professional training to IR Personnel in various aspects of operation, maintenance and management of the machine, planning and designing rail grinding program, inspection, monitoring, quality control and review as per the brief scope defined in Annexure-IV.
The tenderer will submit detailed program covering scope and coverage in detail, place and manner in which the training will be imparted so that a satisfactory level of knowledge and skill is developed by IR Personnel for satisfactory implementation of grinding program

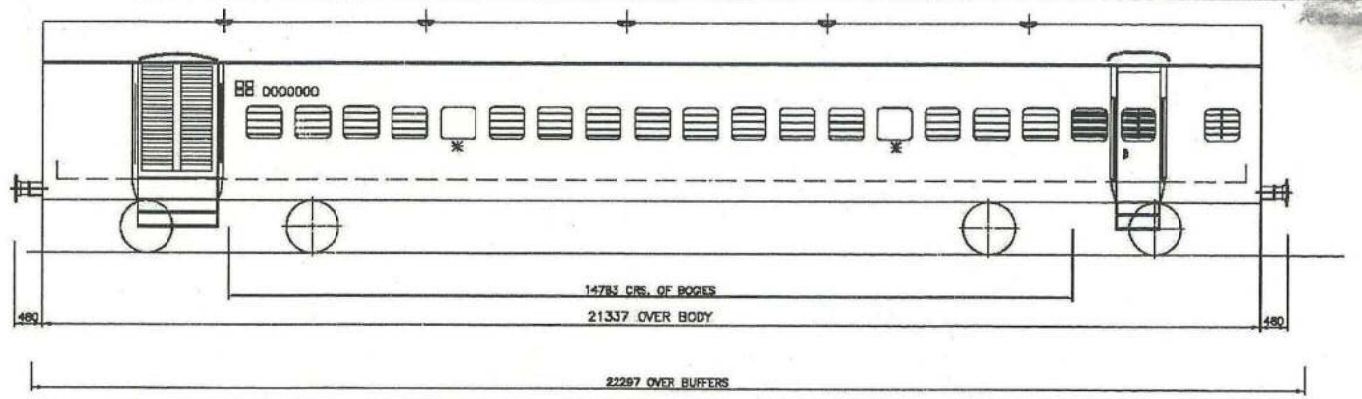
23.2. E-Learning courses module should be arranged for imparting training to railway operators. In addition, the service engineer shall provide hands on training to railway staff in calibration operation, repairing and maintenance of the machine in field to make them fully conversant with the machine. 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.

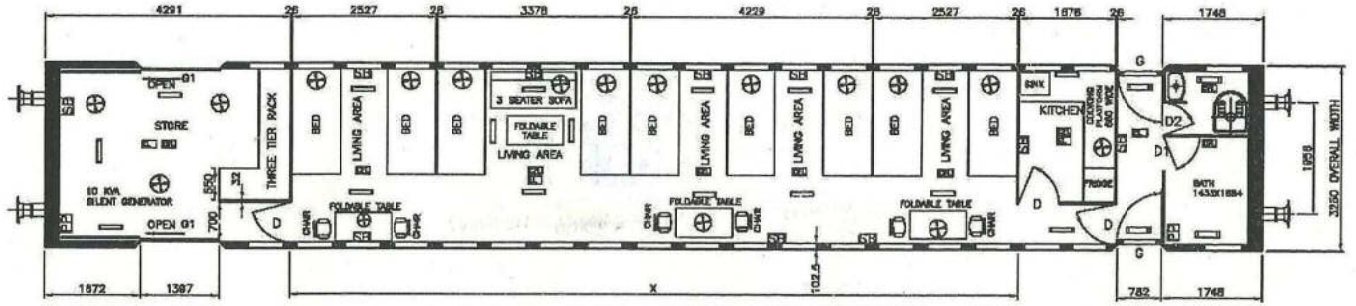
24. WARRANTEE AND POST WARRANTY MAINTENANCE CONTRACT

The machine shall be warranted for 24 months from date of commissioning at ultimate destination in India Design modification made in any part of the machine offered, the warranty period of 24 months would commence from the date of modification and proving

test of machine 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.

Other **warrantee and post warranty clause wise** term and conditions are attached as **Annexure –XI.**





SYMBOL :-

- SUNK IN TUBE LIGHT SHALL BE PROVIDED IN FALSE CEILING.
- BRACKET FAN SHALL BE MOUNTED ON WALL.
- SWITCH BOARD SHALL BE PROVIDED ON WALL.
- POWER POINT SHALL BE PROVIDED ON WALL.
- 10 W EMERGENCY LIGHT
- 15 W CFL ROOF SUNKEN

X – THE ADDITIONAL ROOF CEILING (FALSE CEILING) SHALL BE PROVIDED FOLLOWING THE SAME CURVATURE OF EXISTING ROOF CEILING WITH MINIMUM HEIGHT OF 2400mm AT THE CENTRE FROM FLOOR LEVEL.

G1 – SLIDING DOOR AS PER DESIGN IN PARCEL VANS.

G – NORMAL COACH DOOR.

G2 – CLOSED COACH DOOR.

D/D1/D2– SINGLE LEAF HINGED DOORS OF LIGHT MATERIAL SHALL BE PROVIDED WITH AUTO DOOR CLOSING SYSTEM. THE DOOR WIDTH SHALL BE 700/600/ 520mm RESPECTIVELY.

※ EMERGENCY WINDOW

2. TOTAL THREE EXAST FAN TO BE PROVIDED ONE IN EACH FOR STORE ,KITCHEN AND TOILET.
1. ALL DIMENSIONS ARE IN MM

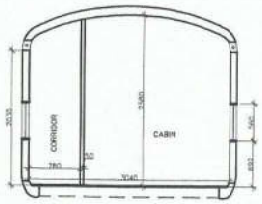
R. D. S. O.

CAMP COACH FOR TRACK MACHINES STAFF ON SLEEPER COACH BASED ON RDSO DRG. NO. CSC–1640 OR SIMILAR CODE–(RCC)

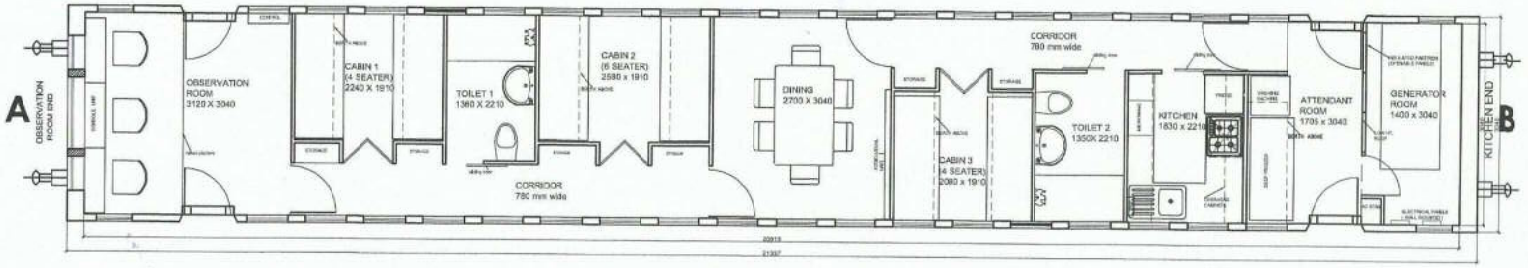
CANC./SUPED REVED.

DRG. No. RDSO/TM/02/11

NOTES	RDSO SPECIFICATION SPECIFICATION	SCALE	ALT	DESCRIPTION	AUTHY



TYPICAL CROSS SECTION



RGI CAMP COACH -LAYOUT PLAN

NOTES :

1.ALL PARTITIONS ARE 50 MM THICK

2.THE DRG.IS SUBJECT TO ON-SITE CHANGES MADE BY THE ARCHITECT

PROPOSED TYPICAL LAYOUT FOR RGI CAMP COACHES AT RAYANAPADU (A.P) & ALLAHABAD (U.P)

DEALT BY:	SCALE: N.T.S.	SHEET TITLE: LAYOUT PLAN	Space & Vision ARCHITECTS ,INTERIOR DESIGNERS # 3162,SECTOR 21-D, CHANDIGARH STUDIO # 1096,SECTOR-11,PANCHKULA TEL : 0172 - 2707325,5011149 email:spacenvision@yahoo.com
CHKD BY: SONALI	JOB NO.:RLW-IC-	THIS DRAWING AND DESIGN IS THE PROPERTY OF 'SPACE & VISION' AND CANNOT BE COPIED OR REPRODUCED WITHOUT PERMISSION.	
DATE:07.01.2011	DWG NO. : REV.2		

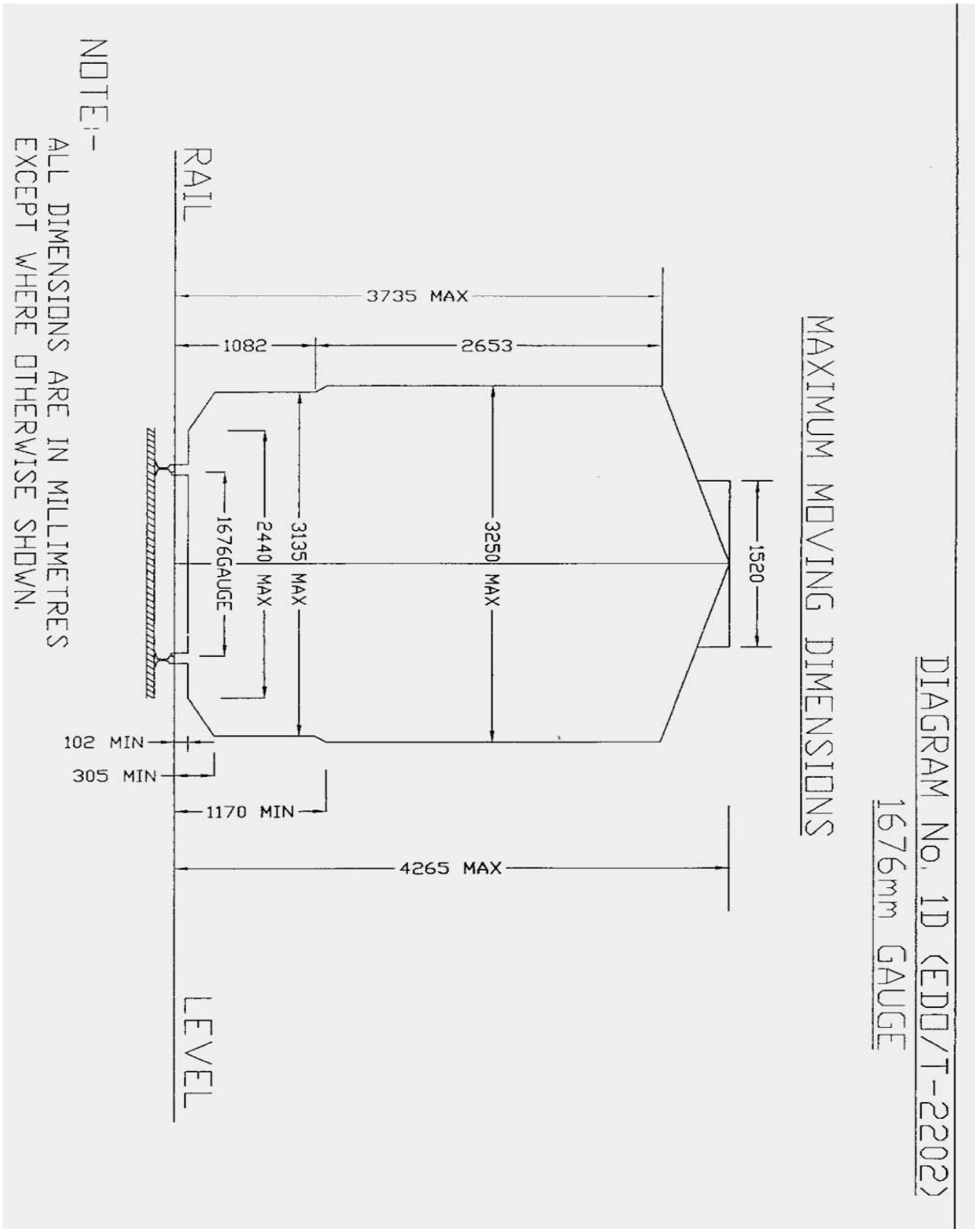


DIAGRAM No. 1D (EDO/T-2202)
1676mm GAUGE
MAXIMUM MOVING DIMENSIONS
NOTE:-
ALL DIMENSIONS ARE IN MILLIMETRES
EXCEPT WHERE OTHERWISE SHOWN.
RAIL
LEVEL
3735 MAX
1082
2653
1520
1676GAUGE
2440 MAX
3135 MAX
3250 MAX
102 MIN
305 MIN
1170 MIN
4265 MAX

Annexure- IV

Scope of Training to be imparted by Manufacturer/Supplier to IR Personnel

The training program shall consist of the following modules-

1. **For Senior Engineering officers of IR-**
   Four senior IR personnel shall be given training for a period of two weeks in manufacturing plant of manufacturer/supplier and/or affiliated institute/training centers and field operation where the machines are already in operation. Broad scope of this training shall be to provide quality training in the areas of management of grinding, machine familiarization, machine utilization, managerial aspects of operation and maintenance of the machine, grinding strategy, best practices for optimal performance, reporting, quality control, producing quality rail profiles, progressive review of grinding strategy program, important safety aspects, vendor support.
2. **For Track Machine organization Personnel –**
   This training will cover operation and maintenance of the machine. The broad scope of this training will be as under:
   - Machine's general arrangement including air systems, mechanical systems, hydraulic systems, electrical systems, rail measurement systems, controls etc.
   - Operation of the machine in working mode (grinding) and travel mode.
   - Maintenance and overhauling of rail grinding machine.
   - Recording of rail profiles, use of Rail Inspection data and preparing the grinding program.
   - Trouble shooting skills.
   - Responses of emergency situations
   - Basics of producing quality rail profiles.

   The training will be conducted as per following sub-modules-

2.1. 12 IR personnel shall be given training for a period of Three weeks at contractors manufacturing premises about machine assembly line in different shops, operation, repair and maintenance. Also they will be given on-site training in field operation abroad where same type of machine is already in operation for the contract.

2.2. In India, training of 12 IR personnel per machine for four weeks will be given in operation and maintenance of the machine. Out of four weeks, at least two weeks training will be imparted at the site of commissioning of the machines and has to be completed before commissioning of machines. The remaining period of training will be imparted in one or two modules spread over warranty period in the form of refresher/updating training at the time of delivery of each machine. Details of the proposed program should be given in the offer.

3. **For P-Way Personnels –**

This training will cover design, planning, quality control, monitoring and review of grinding program. The broad scope of this training will be as under:

- Technical aspects of Rail Grinding and the benefits
- Rail grinding functions and best practices for optimal performance.
- Basics of producing quality rail and wheel profiles.
- Rail and wheel interaction.
- Technical aspects of rail lubrication, and planning the lubrication strategies.
- Understanding and development of rail grinding program based on RCF, surface defects and profile deterioration.
- Monitoring of rail grinding result, its benefits and review of the grinding program.
- Rail Grinding Implementation and quality control.
- Track inspection and data collection for rail grinding
- Designing of optimal rail- wheel profiles
- Establishment of test sites and monitoring
- Designing rail grinding strategies and program

The training will be conducted as per following sub-modules-

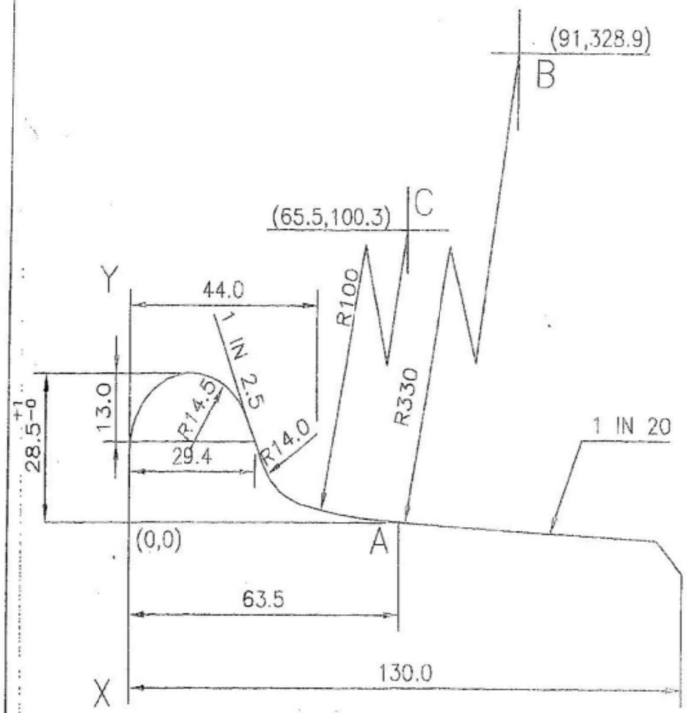
3.1. 12 IR personnel shall be given three weeks training at manufacturer's premises and/or affiliated institute/training centre, this training shall include taking rail profile, wheel profile, work on simulation software for different contact location of rail-wheel interface, designing theory for developing required rail profiles, different pattern for achieving the required rail profile and calculate rail life and such other aspects in the contract.

3.2. In India training for 12 IR personnel per machine for six weeks will be given at site of grinding / railway premises. This training includes taking rail profile pre-post grind and use of other handheld gadgets for inspection of grounded rail and contact bend before and after, how to maintain data base for grind quality, for establishing efficient Rail Grinding Management system on Indian Railways for each machine. This module of training may be staggered in suitable phases prior to supply of machines, post supply and mid warranty review/refresher.

4. Tenderers are required to submit detailed proposal of the training program along with their offer. The topics, detailed content of training, demonstrations, site visits and hands-on experience should be elaborated in detail in the offer. The names of manufacturing premises, affiliated institute/training centre where abroad training is proposed to be conducted should be detailed in the training proposal in the offer. Further details of places where field visits, demonstrations, hands on experience etc are proposed to be conducted may be submitted within 90 days of signing the contract agreement.

5. All the cost for arranging and facilitating the training are to be borne by the supplier. Tenderers are required to quote the prices for training as per tender conditions. However training as per 2.2 and 3.2 will be at suppliers cost and nothing extra shall be paid for the same. The cost of boarding, lodging and air fare of IR personnel shall be borne by the purchaser and should not be included in tenderer's quote.

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	9/04
2	J.S. CD/3/94	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 XXX3

WORN WHEEL PROFILE

SKETCH-91146

Annexure-VI

INSPECTION CERTIFICATE

CERTIFICATE OF INSPECTION OF TRACK MACHINE( )

BY INSPECTING OFFICAL 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 an Annexure'A'. It is observed that (strike out whichever is not applicable):-

- The machine conforms to all 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 along with the machine:

1._____

2._____

3._____

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

The machine is approved/not approved for dispatch to _____ (consignee) Indian Railway.

SIGNATURE AND DATE

For M/s _____ INSPECTION OFFICIAL

_____ (NAME AND DESIGNATION)

for and on behalf of President of India

ANNEXURE-VII

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.

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 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 movement of the bogie in straight and curved track and lateral force and derailment coefficient of accelerations as the case may be.

Annexure: VIIIA

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

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

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

3. i) Tread and flange profile of the wheel indicating clearly whether it is Indian Railway standard profile or differs from standard flange profile. :

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

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

5. Maximum design speed

i) Own Power :
ii) In train formation :

6. Unsprung weight per axle in tonnes

i) Driving axle :
ii) Running axle :

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

8. 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: VIIIB

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.

Annexure VIIIC

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	Front bogie		Rear bogie		Machine	Full weight of vehicle	

	components in tonnes	full assembly	full assembly	frame full structure	(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 motion between bogie frame and machine frame for relative motion (motion stopper)	Vertical direction	Lateral direction	Longitudinal direction	Rotation about vertical axis	Rotation about lateral axis	Rotation about longitudinal axis
11.	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.					

300 to 600 mm

INDIAN RAILWAYS	250 TO 600MM in bold & black color
Series NO.--- -------.	200 mm in black color
Manufacturing Year -------.	200 mm
Manufacturer's Name	200 mm

Annexure-X

List of Track features

1. Km post,
2. TP/OHE Mast,
3. Pt.& Crossing In
4. Pt.& Crossing out
5. Level Crossing,
6. Switch Expansion Joint,
7. Fish plated joint
8. Axle counter
9. Bridge () In,
10. Bridge () Out,
11. Curve In,
12. Curve Out,
13. Tunnel In,
14. Tunnel Out,
15. 10 spare keys as user options.
16. Platform () In.
17. Platform () Out.

Annexure-XI

1. OPERATION AND MAINTENANCE CONTRACT (DURING WARRANTY PERIOD)

The following clauses outline the key requirements of the O&M conditions for Indian Railways to be met by the supplier for a period of 24 months post commissioning:

1.1 The supplier or their designated Indian agent/Indian counterpart has to execute works of Operation & maintenance of 72 stones Rail Grinding Machine which will be deployed over many Zonal Railways as per the instructions of Consignee Zonal Railways office. During the execution of the contract fuel, oil, water and lubricants are to be provided by Zonal Railways free of cost to the supplier.

1.2 To operate & maintain complete the 72 stone Rail Grinding machine fully utilizing it's potential. The tenderer is responsible for ensuring the availability of machine for 08 hour every day for grinding operation (which might be increased by up to 2 to 3 hours depending on traffic condition over IR during operation). During maintenance shift, the stipulated maintenance of RGM, stipulated preventive checks and schedule maintenance of RGM machine including all assemblies (like engines, generators, electrical control system etc.) or sub-assemblies (various water & HSD oil pumps ,sensors etc) as specified by OEM/supplier updated time to time to ensure it's upkeep shall be carried out.

1.3 The supplier or their designated Indian agent/Indian counterpart, has to provide sufficient number of skilled/semi-skilled staff required (Minimum 12 staff including 6 Supervisors at a time) for operation and maintenance of RGM. Grinding operator shall be certified by the OEM and with valid competency certificate in train operation issued by ZRTI/IR and medically fit in A-1 Category. In case initial/refresher course to be done for G & SR from ZRTI/IR during the currency of this contract, the same shall be got done for the operators by the contractor and it shall payable as applicable. Zonal Railways shall facilitate in expediting the process. All the operators shall have valid PME certificate issued by IR and all the cost for medical examination connected with PME, shall be payable by the contractor.

1.4 One 4 wheeler vehicle in good condition with proper road permit and insurance(Safari/ Scorpio or similar) for transporting men and material required for day to day working will be provided by tenderer during O&M period for use by O & M crew and IR crew (on RGM) without any extra payment.

1.5 The RGM will work on IR track with the trains running on adjacent tracks. The contractor must ensure the care /safety/health hazards of the labours engaged by him/her during the course of the execution of work. Necessary safety equipment shall be provided by the contractor for the staff engaged by the tenderer and also for 2-4 IR official nominated on this machine. No extra amount is payable toward this.

1.6 Railway shall provide adequate and appropriate security at their disposal to protect and preserve the RGM Machine from anti-social elements especially in insurgency defined areas, where the machine maybe required to operate from time to time.

1.7 The contractor's staff & labour shall not have any claims of appointment in Railways in future.

1.8 Authorized Railway's representative having route learning of the particular section where the RGM is working will be present for supervising the grinding work and to

monitor the movement of the RGM from one section to another. RGM shall not be moved without authorized Railway's representative. The same would be provided free of charge.

1.9 All tools and plants, drawings, manuals which are supplied by the manufacturer to the Railways will be handed over to the contractor free of cost for use along with the machine. All these to be handed over back in good condition after expiry of the contract period to authorized Railways.

1.10 RGM shall be made available for grinding operation for minimum period of 25 days in a month and 75 days in consecutive 3 months. The balance 15 days are meant for maintenance functions during which time all maintenance activities are to be completed by the tenderer. While the RGM is on transit from one station to another or waiting for loco for hauling, it will be considered as availability unless the RGM is under breakdown preceding to this.

1.11 The supplier will be responsible for ensuring the availability of machine for eight hours every day for at least 25 days a month and the availability certificate will be rendered (as per enclosed Annexure - A). During these 8 hours (which may be in two shifts with one break of maximum up to 3 hours) of daily availability of machine, the working hours (actual grinding) will be in general for about 4 hours per day.

The machine availability for penalties purposes will be worked out by taking average availability of machine after 6 months (150 days over 6 months). Availability of machine for work less than 150 days in half year on account of supplier during the warranty period will invite a penalty of Rs 30,000/- per day and the penalty certificate will be rendered (as per enclosed Annexure - B)

1.12 When the RGM is on transit with its own power from one station to another, and RGM shall be made available for movement in two shifts of 10 hours each (2x10 hours) in 24 hours time frame till it reaches destination, since there will be no routine maintenance. The staff of operation and maintenance shall be so redistributed that at least one operator and three other staff are available in each shift during transit.

1.13 All the fixtures in Camping coach shall be maintained in good condition. Special cleaning of camping coach (once a month or earlier) to be carried out so as to maintain in excellent condition. All electrical, plumbing, furniture, electronics, computers/laptop, TV&DVD, Genset, Washing machine, freezer, geysers, microwave/oven, communication and all other fixtures available in camping coach to be maintained in good fettle at all times and at the end of the contract period. The fixtures would be handed over the Zonal Railways in good condition, as received at the beginning of the contract.

1.14 Special cleaning of RGM to be carried out once a month (as far as possible) with detergents and other cleaning agents to remove all soot, dust etc. and to keep the entire machine in good appearance. RGM will be stabled at a place so that adequate water (to be provided by Zonal Railways) & non-OHE siding are available so as to ensure proper cleaning. Patch panting at rusted locations should be done after cleaning with matching colour. No amount is separately payable towards this.

1.15 Complete and up to date records for daily, weekly and monthly maintenance will be maintained by the contractor and countersigned by IR officials. The daily/weekly/monthly and all progress report, grind history in the prescribed format

shall be mailed to nominated officials of division/zone/RDSO/Rly board. For which required arrangement shall be made on the machine by the contractor.

1.16 The contractor shall maintain history book, Log book and all othe documents prescribed for track machines on IR.

1.17 Contractor shall furnish adequate VHF sets for crew communication for safe operation of RGM. This should include at least 6 hands free devices.

1.18 As prescribed in Clause 1.26 (Annexure-XI), contractor shall submit total cost of the spares likely to be consumed during the warranty period. Total quantity of spares supplied by the contractor for operations and maintenance under warranty period shall be kept in Railway stores of Zonal Railways and shall be issued to RGM as per the machine requirement.

1.19 Each party agrees to indemnify, defend, and hold harmless the other party from all liability, cost or expense (including any court costs) caused by the joint and/or concurring negligence of the parties, arising on account of injury to or death of any employee, agent or representative of the indemnifying party during the performance of the Services or who shall, if not performing Services, be present as a bystander or otherwise on the property of either party, provided always, however, that if the injury or death to an employee of an indemnifying party is caused solely by the negligence of the other party then this indemnity and hold harmless provision shall be null and void, and the party who solely caused the injury or death shall bear the cost or expense. Notwithstanding any provision herein to the contrary, Tenderer's total cumulative liability for any or all claims arising out of this agreement shall not exceed the three month value of this O&M portion of the contract.

1.20 If there is deficiency of staff on RGM w.r.t. minimum stipulated staff in operation and maintenance (minimum staff. in O & M shift put together), penalty of Rs 3000.00 per head per shift or part thereof shall be imposed. For maintaining attendance of the staff for this purpose, the contractor has to provide biometric attendance system in the camping coach & shall ensure it is working condition always. No extra payment shall be admissible on this account.

1.21 The maintenance role encompasses undertaking all schedule/periodic/ routine of RGM machine including all assemblies (like engines, generators, electrical control system etc.) or sub-assemblies (various water & HSD oil pumps, sensors etc) as specified by Supplier / OEM as well as RDSO updated from time to time, either by day or night. OEM recommended spares will be transported from Railway stores to the machine and the released spares/material from machine to Railway stores, by Zonal Railways.

1.22 Scheduled Maintenance:

i. Daily maintenance will be strictly followed after grinding operations. Other schedule maintenance (weekly, monthly, two monthly, quarterly, half yearly, yearly and two yearly checks) are to be performed at appropriate time intervals in the balance time available after offering the RGM for operational activities.

ii. Routine maintenance of undercarriage systems shall be undertaken by the tenderer.

iii. Tenderer shall be responsible towards mounting and dismounting of unserviceable/ Serviceable/New components/ parts / materials on the RGM. Zonal railways shall be responsible for providing serviceable components / parts/ materials on the machine for fitment and suitability tests.

iv. Wheel and Bogie turnings (if needed) will be coordinated and executed by Zonal Railway. Wheel turning charges as applicable by w/shop per wheel would be paid by the tenderer.

v. Workshop facility if needed shall be provided by Zonal Railways.

1.23 Maintenance of Records

i. Maintenance records during Schedule and breakdown maintenance shall be maintained in hard copy as well as soft copy as per format provided and updated from time to time.

ii. These records shall be provided to Zonal Railway by the crew on the machine in a timely manner.

iii. Tenderer shall maintain a standard daily report accurately depicting operational times, delays, and machine availability. Zonal Railway crew/ representative has to sign daily report based on satisfactory completion of daily operational services. The signed daily report shall be the basis for invoicing and shall constitute Zonal Railway's acceptance of day to day work apart from the completion of scheduled maintenance in timely manner.

1.24 Test Site Management:

(i) As part of the O&M Services provided by the tenderer or their designated Indian agent, 12 test sites would be actively managed by them. This would include atleast 4 mild curves, 4 sharp curves and 4 tangents. Breakup would be as follows:

- 2 mild curves at same location on UP Line and DOWN Line = 4 Total
- 2 sharp curves at same location on UP Line and DOWN Line = 4 Total
- 2 tangents at same location on UP Line and DOWN Line = 4 Total

Final = 12 test sites and would be jointly selected by IR/Zonal Railways and the tenderer / contractor.

These locations should be maintained as permanent test sites and should be re-marked periodically by proper paint by Zonal Railways. Format for Test site location marking by paint as ben shown as Annexure C.

(ii) As part of requirement of the Test site management, tenderer or their designated Indian agent shall record the following for each test site:

- Pre Grinding Rail profile with the help of MiniProf, surface photograph and dye penetration test, within 10 days before grinding
- Post Grinding Rail profile with the help of MiniProf, surface photograph and dye penetration test, within 10 days after grinding
- Maintaining proper record of the same.
- Sharing run over run analysis for all 12 test site locations duly countersigned by designated IR official.
- Review of grinding pattern changes needed, if any post analysis
- Review for further changes in profile and grinding cycle.

(iii)As part of this exercise, any existing templates would also be reviewed and modified as needed.

1.25 During the currency of the O&M period, the supplier or its Indian agent may seek documents for importing spare parts/material/testers/manuals/equipment's on requirement basis for Customs clearance. These will be provided by Consignee Zonal Railways in required format for speedy clearance on arrival at port.

1.26 Spare Parts:

Complete and exhaustive list of OEM spare parts along with their unit cost, list broken down to the last level for Rail Grinding Machine, classified into following categories shall be furnished by the tenderer:-

i. Recommended – Spare parts covered under warranty period and will be either replaced/repaired. During repaired/replacement period, Recommended parts held on Railway Inventory can be fitted on the machine on returnable basis and is provided by IR only to ensure machine uptime.
ii. Consumables – As per actual consumption, during the warranty period is to be provided by the contractor.

It may be noted that the Spare Parts List along with unit cost of each part indicated for O&M Period must indicate the anticipated quantity of use. This would be used to establish a budget and the total budget per machine, as furnished by the tenderer, would remain fixed, while actual used quantities may vary based on usage. During the 24 month O&M period, in case spares beyond the budget, need to be used, the additional spares would be supplied free of cost by the supplier. Cost of Spares needed for the 24 month O&M period would be considered as part of price calculation for the determination of successful bidder.

It is important to note that spares not included in the list would be provided by the supplier free of charge during the O&M period. The supplier must ensure that spares are properly budgeted keeping in mind the IR working and environmental conditions.
Initial batch of spares , costing up to 30% of the total budget for spares would be supplied with the machine. Remaining 70% of the spares can be supplied in instalments, as per the experience gained in the field/ actual requirement. All such spares shall be kept in the custody of consignee railway. The railway shall issue such spares to the machine as per O&M requirement.

Tenderer should insure availability of spares for machine stipulated service life of 15 years by providing ware house or store in India for uninterrupted working of machine.

Furthermore, spares per year per machine should generally not exceed 5% of machine price.

2. POST-WARRANTY OPERATION & MAINTENANCE CONTRACT:

2.1 The supplier shall quote for a two year extension of O&M services after the expiry of the warranty period. The additional extension for 2 years is on the sole discretion of Railway Board / Zonal Railways.

2.2 All terms and condition for post warranty O&M of RGM shall be same as in case O & M of RGM under warranty, except clause for spare parts.(1.18, 1.26)

2.3 Spare Parts:

2.3.1 Spares for repair/maintenance and consumables would be supplied by Railways. Rate contract, for supply of spares will be fixed by respective Zonal Railways separately.

ANNEXURE A

QUARTERLY AVAILABILITY CERTIFICATE FORMAT

"THE OPERATION AND MAINTENANCE OF RAIL GRIDING MACHINE HAS SATISFACTORILY PERFORMED FOR _____ DAYS DURING THE THREE CONSECUTIVE MONTHS / 90 DAYS PERIOD FROM _____ TO _____ FOR WHICH PAYMENT INSTALMENT IS CLAIMED".

The details of Rail Grinding Machine availability days for _____ Quarter is furnished below.

Quarter	Month	M/C Availability Days	M/C Non-Availability Days
Total days			

Average no of days available/month = Days

Dy CE/TM/Lines

C/- CE/TM For kind information.
C/- Supplier,

ANNEXURE B

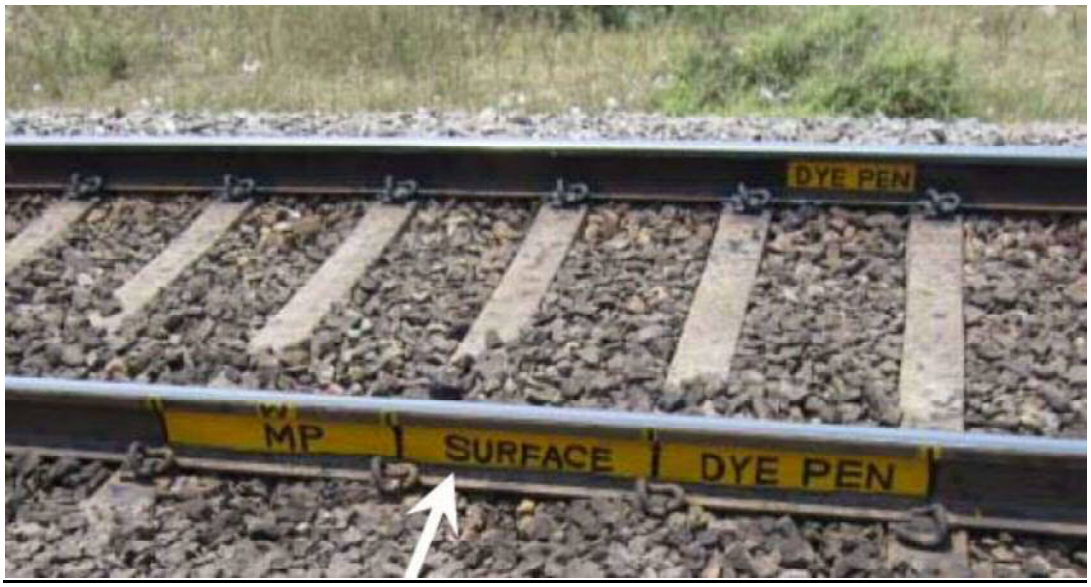
HALF YEARLY PENALTY DEDUCTION CERTIFICATE FORMAT

"AMOUNT OF PENALTY DEDUCTION TO BE MADE AS PER CLAUSE NO 1.11 OF THE TECHNICAL SPECIFICATION TO RAILWAY BOARD CONTRACT AGREEMENT NO ___ _____ IS _____".

Dy CE/TM/Lines

C/- CE/TM For kind information.
C/- Supplier,

ANNEXURE C



Specification No. 8

Integrated Track Monitoring System

GOVERNMENT OF INDIA
MINISTRY OF RAILWAY
RESEARCH DESIGNS AND STANDARDS ORGANISATION
Manak Nagar, Lucknow-226011

Technical Specification for integrated Track Monitoring System
SPECIFICATION NO. TM/IM/382

TRACK MACHINE & MONITORING DIRECTORATE

SUPPLY, INSTALLATION AND COMMISSIONING OF INTEGRATED TRACK MONITORING SYSTEM

1.0 DEFINITIONS & ABBREVIATIONS :

IR - Indian Railway

RDSO -Research, Designs and Standards Organisation, Lucknow, India.

Purchaser - RDSO, Ministry of Railways, India

System - Integrated Track Monitoring System

TRC - Track Recording Car

UPS - Uninterrupted Power Supply System

VDU - Video Display Unit

ALD - Automatic Location Device

LVDT - Linear Variable Differential Transformer

SD - Standard Deviation

ITMS - Integrated Track Monitoring System

RWVRS - Rear Window Video Recording System

TMS - Track Management System (A web enabled IT application)

2.0 SCOPE:

2.1 The specifications given below are meant to broadly bring out the functional and technical requirements of integrated track monitoring system (ITMS). The tenderer shall furnish compliance or deviations, if any, for each clause and sub-clause of the specification along with technical explanations/details. In case of any ambiguity in any clause or sub clause, bidder is free to seek clarification before submitting the bid. The clarifications may be sought from Director Track Machine - IV, TMM Directorate, RDSO, Manak Nagar, Lucknow – 226011, Fax – 91-522-2465682 or through email at dtm4rdso@gmail.com

2.2 The design, manufacture, lab validation and supply of the system shall be completed within the time period specified in the contract. Subsequently, the installation, field validation and commissioning of the system shall be completed within 04 months from the date of receipt of material in RDSO.

3.0 GENERAL:

3.1 The ITMS with all related instrumentation / electronic system shall be installed in an IR Broad Gauge (1676 mm) Coach which will be supplied by the Purchaser. The coach will consist of a LHB shell mounted on FIAT bogies provided with hooks and buffer for attachment to other rolling stocks of IR. The layout drawing of coach and bogie will be supplied along with tender document.

3.2 The ITMS, shall Consist of following sub – systems and shall be capable of recording the parameters mentioned under each sub systems in para 5.0.

i) Track parameters recording system

ii) Full rail profile and wear measurement system

iii) System for measurement of acceleration on one pivot of TRC & test vehicle/Locomotive and on both side axle box of one axle of TRC.

iv) System for identification of any obstacle in Maximum Moving Dimension (MMD) envelope of IR

v) System for Rear Window Video Recording of IR track

vi) System for video recording of track components and analysis by image processing for status of track components

3.3 All Transducers/Sensors, Sensor beam and their mounting arrangements shall be installed within the Maximum Moving Dimension (MMD) envelope of IR as per Schedule of Dimension (SOD)-2004 and latest correction slips. The same is available at http://www.indianrailways.gov.in.

3.4 SERVICE CONDITIONS

System should be able to work under following service conditions:

i.	Ambient temperature	-	0^0 C to 55^0 C
ii.	Rail temperature	-	(-) 10^0 C to (+) 65^0 C
iii.	Humidity	-	100%
iv.	Rain fall	-	Fairly heavy
v.	Atmospheric condition	-	Very dusty, Heavy fog

3.5 On IR network the electrified traction consists of overhead electric system of 25000 V AC or 2*25000 V AC with residual return current passing through one of the rails in the track. System and accessories having part of electronic train running safety system such as Train protection warning system (TPWS), Audio frequency track circuit (AFTC), Digital axle counter, DC track

circuiting shall not affect the accuracy of track recording results in any manner due to the induction effect of the above stated electric traction and signaling systems.

3.6 The recording of parameters by ITMS should not be affected by direct sun light, dust and rains.

3.7 ITMS should have in-built protection to absorb voltage fluctuation and should work on 220 V ± 10%, 50Hz±5% AC supply to be given from diesel generating set /AC main line.

3.8 The ITMS shall be capable of recording the parameters of various sub systems given in para5.0in the speed band of 20 km/h to 200 km/h.

3.9 ITMS shall have the facility for wheel wear compensation to enable accurate measurement and recording of speed & distance and also ensure constant sampling distance with new as well as worn wheel.

3.10 The ITMS shall be capable of monitoring all parametersof various sub systems in both forward and reverse directions accurately to avoid need for turning of coach.**However** rear window video recording and clearance measurement facility shall beavailable during recording in forward direction i.e with inspection window trailing.

3.11 The ITMSshall be capable of doing track monitoring of all parameters on all types of track structures prevalent on IR viz continuous welded / long welded panels /short welded panels / fish plated track comprising of concrete / steel trough / CST-9,wooden sleepers and 65 kg / 60 kg / 52 kg rails. The System shall be capable of identifying the type of rail automatically.

3.12 The ITMS should be capable of monitoring on various track features e.g Turn outs, SEJ, Curves, Bridges and Level crossings etc.

3.13 All the transducers/sensors and measuring frame/sensor beam/mounting arrangement for sensors and system including sub systems shall be supplied and installed in the coach by the supplier. However, prior approval for the design & drawing of system including sub systems, measuring frame/sensor beam and its mounting arrangement shall be taken from the purchaser. All holes drilled for connection of sensors to system shall be properly closed sealed to prevent entry of rats and insects.

3.14 Suitable metallic / wooden racks, panels etc. for installation of hardware, computers, monitors, power supplies and printers etc. in the inspection room of TRC shall be provided and installed by the supplier.

3.15 The furnishing of the instrumentation room will be done by providing and fixing required furniture for operators and inspecting officials along with 01

working bench and chair for carrying out minor repair. The furniture shall be got approved from purchaser before supply.

3.16 The layout of ITMS shall be such that adequate space is available for maintenance of system and movement of IR officials. Prior approval from the purchaser shall be taken for the layout. The finish and workmanship shall be to the best international standards and shall give a decent appearance with durability and serviceability. All surfaces liable to frequent handling shall be finished with materials suitable for periodical washing or cleaning and shall be of colour matching with the interior of the coach. The material used shall be suitable for use under all climatic conditions and shall be fire retardant, non-hygroscopic and vermin & rot proof.

3.17 The facility shall be provided for processed data transfer from TRC to R.D.S.O and headquarters of Zonal Railways. This facility shall be provided through GPRS network.

4.0 SALIENT TECHNICAL FEATURES:

4.1 Track Parameter Recording System

i) Inertial principle of measurement with laser contact-less sensors shall be used for measurement of vertical and lateral profiles of both left & right rails with appropriate correction for roll and yaw. Gauge shall be measured with laser based contact-less sensors.

ii) System shall have the ability to record track irregularities having wavelengths in the range of 3.0 m to 100 m. Speed independentband pass filters shall be used for the same.

iii) Sampling distance for recording shall be user selectable from0.25 to 0.50 meter. The least count of the tachometer shall not be more than 1.0 mm.

iv) The system shall be capable of storing raw data (Transducer/Sensor signals), profile/chord in ASCII/Binary format and processed data in ASCII/Database format in separate files for 10,000 km of track recording. An additional mirror image disk of the same capacity shall also be provided to guard against possible loss of data in case of hard disk crash. Option to record or not to record various types of data shall be selectable by the operator through user interface. The system shall also be capable of uninterrupted recording and storage of above-mentioned data for 1,000 km.

v) System shall have the capability for on line reporting of track parameter peaks above predefined threshold value with location to nominated P. Way official of the concerned section through **GPRS based**cellular

communication network. Facility to change the limits shall also be available.

vi) System shall be capable of recording track features and their location along with track geometry parameters, accurately using previously prepared route feature location file (wherever available) and TRC's navigation system, in data files and marking of same in graphical and digital exception reports.

vii) System shall have facility to automatically pause the recording in case of TRC's movement in reverse direction. The system shall also be able to correctly measure the reverse movement and compensate for the same on forward movement of TRC, so as to restart the recording from the point where recording was paused.

viii) The System shall be capable of real time (during recording) processing, analysis, storage, reporting and printing of the recorded data/reports. During recording the digital reports and analogue chart shall be displayed on separate VDUs and printed on separate printers. Three copies of exception report and one copy of analogue report shall be printed during recording. Option to take or not to take the print of exception report and analogue report shall be available to user.

ix) Adequate number of minimum, 21 inch flat, thin LCD based VDU shall be provided in the inspection room of TRC. In addition, required number of minimum 17 inch LCD based VDUs for operator interface, display of digital exception reports and analogue chart shall also be provided near operator console.

4.2 Full rail profile and wear measurement system

i) The same LASER contact less sensors being used for recording of track geometry parameters shall be used in this sub system for measurement of rail profile and wear.

ii) The LASER sensors used shall be protected from all health hazards & comply with the relevant regulations in this regards.

iii) Sampling distance for recording shall be user selectable from 0.25 to 0.50 meter. The least count of the tachometer shall not be more than 1.0 mm.

iv) The system should have the facility for measurement **of** both rail profiles with an accuracy of 0.15 mm or better and storage of same in a format compatible with rail grinding machine working on Indian Railway at user selectable interval in the range of 0.25m to 5.0m

v) The rail wear and other parameters should be measured/calculated on selected sampling interval and stored in a separate file in ASCII/Binary file.

vi) The system shall be capable of Storing both rail profile, vertical & lateral wear, other parameters data and exception report on the basis of predefined limits in separate files for 10,000 kilometers of track monitoring. An additional mirror image disk of the same capacity shall also be provided to guard against possible loss of data in case of hard disk crash. Option to record or not to record various types of data shall be selectable by the operator through user interface. The system shall also be capable of uninterrupted recording and storage of above-mentioned data for 1,000 kms.

vii) System shall be capable of recording track features and their location along with rail wear and other parameters accurately using previously prepared route feature location file (wherever available) and TRC's navigation system in data files and marking of same in graphical and digital exception reports.

viii) The System shall be capable of on line (during recording) processing, analysis, storage, reporting and printing of the recorded data/reports. During recording the digital reports and analogue chart shall be displayed on separate VDUs and printed on separate printers. Exception report and analogue report shall be printed during recording. Option to take or not to take the print of exception report and analogue report shall be available to user.

ix) Adequate number of minimum, 21 inch flat, thin LCD based VDU shall be provided in the inspection room of TRC. In addition, required number of minimum 17 inch LCD based VDUs for operator interface, display of digital exception reports and analogue chart shall also be provided near operator console.

4.3 System for measurement of acceleration on one pivot of TRC and test vehicle/Locomotive and axle box of TRC.

~~i)~~ System shall have the ability to record vertical and lateral accelerations on both side axle box of one axle and pivot of TRC &Locomotive/test vehicle in the user selectable band pass filter in the frequency range of 0.3 hz to 48hz.

ii) Systemshall have the facility to select sampling frequency for measurement of all accelerations in time domain in the range of 100 hz to 1000 hzs in steps of 50 hzs

iii) System shall have the facility to record and store all accelerations in space domain on user selectable distance in the range of 0.25m to 0.50m. The least count of the tachometer shall not be more than 1.0 mm

iv) The System shall be capable of on line (during recording) processing, analysis, storage, reporting and printing of the recorded data/reports. During recording the digital reports and analogue chart shall be displayed on separate VDUs and printed on separate printers. Exception report and analogue report shall be printed during recording. Option to take or not to take the print of exception report and analogue report shall be available to user.

v) System shall be capable of recording track features and their location along with acceleration values using previously prepared route feature location file (wherever available) and TRC's navigation system in data files and marking of same in graphical and digital exception reports.

vi) The system shall be capable of storing all acceleration data in time and space domain on user selectable sampling interval in separate files for 10,000 of track recording. An additional mirror image disk of the same capacity shall also be provided to guard against possible loss of data in case of hard disk crash. Option to record or not to record various types of data shall be selectable by the operator through user interface. The system shall also be capable of uninterrupted recording and storage of above-mentioned data for 1,000 km.

vii) System shall have facility to automatically pause the recording in case of TRC's movement in reverse direction. The system shall also be able to correctly measure the reverse movement and compensate for the same on forward movement of TRC, so as to restart the recording from the point where recording was paused.

viii) System shall have the capability for on line reporting of acceleration peaks above predefined threshold value with location to nominated P. Way official of the concerned section through GPRS based cellular communication network. Facility to change the limits shall also be available.

4.4 System for identification of any obstacle in Maximum Moving Dimension (MMD) envelope of IR

~~i)~~ The system shall have the facility to measure in forward direction only i.e with inspection window trailing.~~-~~

ii) The system shall be able to scan the MMD envelop at least at every **100**millimeter at maximum recording speed of 200 Kmph.

iii) The system shall have the facility to upload the standard Indian Railway Maximum Moving Dimension envelop in the system.

iv) The system shall be able to evaluate the deviations of the measured envelop with respect to the standard IR MMD envelop.

v) The presence of any obstacle with in standard IR MMD envelope shall be stored and printed with details and location (chainage of obstacle in terms of last Kilometer and Meter).

vi) The system shall be capable of displaying and storing the video of clearance envelop on separate VDU and store the overlapping image of measured and standard MMD envelop along with obstacle.

4.5 System for Rear Window Video Recording of IR track

i) The system shall have the facility for measurement in forward direction only i.e with inspection window trailing.

ii) The system shall be capable to capture good image of rear view of the track with inspection window trailing. Resolution of the captured view shall not be less than 1280x720 pixels.

iii) The video of rear window monitoring shall be displayed on the VDU and stored on magnetic media. The system shall be capable of storing video, image at track features with location for at least 10,000 kilometer of track. An additional mirror image disk of the same capacity shall also be provided to guard against possible loss of data in case of hard disk crash. Option to record or not to record various types of data shall be selectable by the operator through user interface. The system shall also be capable of uninterrupted recording and storage of above-mentioned data for 1,000 km.

iv) The system shall be capable to acquire, store, display and print the image of track features with Section, Line, Date, Time and location of track feature with GPS coordinates, Level Crossing, Curve Start, Curve End, Bridge Start, Bridge End, Station etc.using preloaded track feature location file. A line on the location of track feature shall be printed on image along with track parameter peak value on short chord and acceleration values. Option to print the image at track features shall be user selectable.

v) System shall have the capabilityfor storage of images with location at least at every 4.0 meter at maximum recording speed of 200 Kmph.

4.6 System for video recording of track components for reporting their status

i) System shall be capable to identify, store and print image and description of the defects in both left and right Rail, Fastenings, sleepers and Ballast.

ii) System shall be capable to store image and description of defect with location in separate files for each component of track i.e Rails, Fastenings, Sleepers and Ballast

iii) Defect information shall be printed and stored in ASCII or database format. The images shall be stored in JPEG format.

iv) The format and limiting values for exception reports will be finalized and provided after award of contract.

v) The video of track component monitoring shall be displayed on the VDU and stored on magnetic media. The system shall be capable of storing video, defect images and defect information for at least 10,000 kilometer of track. An additional mirror image disk of the same capacity shall also be provided to guard against possible loss of data in case of hard disk crash. Option to record or not to record various types of data shall be selectable by the operator through user interface. The system shall also be capable of uninterrupted recording and storage of above-mentioned data for 1,000 km.

5.0 PARAMETERS TO BE RECORDED:

5.1 Track Parameter Recording System :

A. The System shall be capable of measuring / recording the following parameters.

i) Absolute vertical profile of left and right rail on two user selectable **band pass** filters in the range of 3 m to 100 m in steps of 1m.

ii) Unevenness of left and right rail on two user selectable chords in a range of 2 m to 20 m simultaneously with actual chord length being an even multiple of sampling distance. While recording on chord, only one band pass filter is to be selected for acquiring the vertical profile in the range of 3 m to 100 m in steps of 1m.

iii) Absolute lateral profile of left and right rail on two user selectable **band pass** filters in the range of 3 m to 100 m in steps of 1m.

iv) Alignment of left and right rail on two user selectable chords in a range of 2 m to 20 m, simultaneously with actual chord length being an even multiple of sampling distance. While recording on chord, only

one band pass filter is to be selected for acquiring the lateral profile in the range of 3 m to 100 m in steps of 1m.

v) Gauge (measured 14mm below rail table) at every sampling point.

vi) Super elevation or Cant at every sampling point.

vii) Twist on two user selectable bases in a range from 2 m to 20 m from cross level and from dynamic cross level (difference of left and right rail absolute profiles). Option to select either of the methods shall be available. Individual defect will be represented as the amplitude from the zero line to the peak value.

viii) Curvature at every sampling point. (To be measured in degrees. Degree is defined as 1750/R, where R is the radius of the curve).

ix) Marking of 36 route features through route feature information file **and** 24 route features using dedicated key pad by punching single key assigned for each feature during recording along with distance.

x) Speed of recording

xi) Distances for relevant features

b. The accuracy of measured track parameters in terms of repeatability and reproducibility shall be in accordance with the limits laid down in European code EN 13848-2. The reproducibility shall be tested and confirmed in the speed band of 40 to 200Kmph as per the limits laid down in European code EN 13848-2.

5.2 Full rail profile and wear measurement system

i) Complete Rail Profile of both rails (left & right) for different type of rails being used on Indian Railways.

ii) Vertical and lateral rail wear of both rails (Left & right) for different type of rails being used on Indian Railways.

iii) Horizontal rail wear of both rails (Left & right) for different type of rails being used on Indian Railways

iv) Angular rail wear of both rails (Left & right) for different type of rails being used on Indian Railways.

v) Rail roll over i.e. inclination of rail.

vi) Lip flow i.e. burring on rail head.

vii) Marking of route features through route feature information file and dedicated key pad by punching single key assigned for each feature during recording along with distance.

viii) Speed of recording

ix) Distances for relevant features

x) The accuracy of wear in terms of repeatability and reproducibility shall be measured in terms of SD of sample to sample variation for a block of 200 m and the 95 percentile values shall be within the limits given below

a.	Lateral wear (Horizontal gauge side wear)	0.2 mm
b.	Vertical wear	0.2 mm
c.	45^0 internal rail profile wear	0.2 mm
d.	Rail roll over	$\pm$ 0.25^0
e.	Lip flow	0.3mm

5.3 System for measurement of acceleration on one pivot of TRC and test vehicle/Locomotive and axle box of TRC

i) Vertical and Lateral acceleration on bogie pivot of TRC and in Loco/Test Vehicle in a user selectable band pass filter.

ii) Vertical &lateral acceleration at axle box level on both sides of axle on a user selectable band pass filter in the frequency range of 0.3 to 48 Hzs.

iii) The accuracy of acceleration measurement in repeatability at same speed and in identical conditions shall 1% of full scale offset (FSO) or better.

iv) Marking of route features through route feature information file and dedicated key pad by punching single key assigned for each feature during recording alongwith distance.

v) Speed of recording

vi) Distances for relevant features

5.4 System for identification of any obstacle in Maximum Moving Dimension (MMD) envelope of IR

i) Location of obstacle infringing MMD envelop of IR

ii) Description and Dimension of infringing obstacle with reference to some coordinate system

iii) Image of MMD envelop showing obstacle with location

5.5 System for Rear Window Video Recording of IR track

i) Image of track feature with Date, Time, Section, Line, description, location and speed at track feature

ii) Track parameter value in peak form on short chord at track feature location

5.6 System for video recording of track components for reporting their status

System shall be capable of identifying and reporting defects in rails, sleepers, fastenings and ballast. Following defects shall be identified in each track component.

i) Rails

a. Linear Defect

b. Area Defect

c. Joint Gap Measurement

d. Weld detection

ii) Sleepers

a. Crack Detection

b. Sleeper misalignment

c. Sleeper level check

d. Concrete sleeper spalling

iii) Fastenings

a. Missing Clip

b. Shifted rail pads

c. Missing Bolts and Rail anchors

iv) Ballast

a. Excess or lack of ballast

b. Detection of axle counters, Dancing sleepers, Foreign objects, SEJ, Switches & Crossings and Level Crossings,

c. Base plate crack check and vegetation check

d. Excess of Mud/Dry mud

Note: The accuracy values for above parameters are given in Annexure-IV.

5.7 Route Feature Information and Synchronization:

A. Route Feature location file is a data file for each route of IR. This file is in ASCII format containing the location of various route features viz. turnout, level crossing, bridges, station etc. in terms of distance from the previous km postand length of previous kilometer along with latitude and longitude of the route feature. The data file of some routes may also be without latitude and longitude. Thus system should have the capability to read both type of files. This data file will be supplied by the purchaser.

B. The ITMS should also have the capability of identifying the RFID tags of open protocol which are proposed to be placed on IR track and make relevant location corrections. RFID tag reader compatible to read RFID tag of open protocol is to be installed on the TRC car along with ITMS by the firm.RFID based Automatic Location Detector (ALD) system for location synchronization shall be supplied as per technical details given below:

RFID based Automatic Location Detector (ALD) comprises of two parts, one passive ground transponder installed in track and one active unit installed in TRC to detect the ground transponder. The active unit (Reader) of ALD sensors shall be suitable to be fitted underneath the coach body & shall be rugged enough to withstand field conditions. Reader is to be supplied by the supplier. The passive unit (Tags) of ALD shall be installed on track by IR. The supplier will install the RFID reader compatible with RFID tag of open protocol as per specification details given below

(a) The ground/track installed tags are used with all types of Sleepers of the Indian Railways. These are typically placed at least 150 mm away from center (± 150 mm) of the sleeper, in-between the two rails.

(b) The tags on sleepers are mounted at sleeper top level. The base metal is steel, stainless steel or aluminum as per relevant Indian Railways standards.

(c) The tag specifications are, in general, as per GS1 standards and broadly aligned with the 'European Guideline for the Identification

of Railway Assets using GS1 Standards'. The basic encoding standard applicable is SGLN195 of GS1.

(d) For understanding the data formats for use on the tags please read the associated document 'Guidelines for Data onboard RFID Tags of the Indian Railways Track' attached as annexure -III.

(e) The tag reader should work in conditions of EMI/ RFI as 25kV AC or 2x25 kV AC is used in overhead lines on tracks..

(f) Base standard of Tag being used will be: EPC Gen2 V1.2 or higher.

(g) Generic information on Tag:

- Concrete / metal mount type of tags.
- All standards as applicable for use of UHF RFID tags in India are applicable.

(h) The RFID Tags have a user memory of 3 kb or higher.

(i) Dynamic Performance of Tag used by IR: Minimum read rate based on circularly polarized reader antennas with 110º or more azimuth angle at a minimum distance of 1.0m and maximum distance of 2.0m up to a speed of 200 kmph.

(j) Sensitivity of tags is as under:

- The best case sensitivity is equal or better than 17 dBm
- The worst case values are more than 25.5 dBm, i.e., the variation between the worst case and the best case should 50% or less, keeping in mind that the scale is negative.

(k) Tags used by IR are as per IP68 housing standards. TRC will run under the most severe climatic conditions. This includes sandstorms, pelting rain, snow, heat, vibrations etc. Therefore, there should be no concern in reading the data from the tag under such conditions.

5.7.1 System shall be capable to capture route features with its distance from previous kilometer post accurately using previously prepared route feature location file & manually entered route features by event marker key pad using TRC's navigation system and incorporate the same in the exception and analogue reports of various sub systems mentioned in para 3.2 along with storing the same in data files of various sub systems. The TRC's navigation system comprises of tachometer, ALD, event marker keypad and associated

processing hardware and software. The method of incorporation and combining of these shall be got approved in advance from the purchaser.

5.7.2 In addition to Route feature location file, system shall also provide for manual entry of various route features by the operator using a dedicated event marker keypad having one key for each of the features given in Annexure-II. It should be possible to mark& print track features from keypad while recording with route tape in analog and exception reports andstorethe same in data files. The list of route features available in route feature location file and to be made available on dedicated key pad is attached as annexure- I and II

5.7.3 The location of RFID tags installed in the track will be made available in the route feature location file. While recording, when the reader detects a RFID tag on the track, its current location should be updated/corrected as per the location stored in the route feature location file. The design and mounting of the automatic location detector should be such that it can sense the ground target without infringing the IR Maximum Moving Dimension envelope. The method of incorporation and combining of these shall be got approved in advance from purchaser.

5.7.4 The system shall have the facility to detect RFID tag location installed on track and synchronize the distance with respect to the actual location of the RFID tag stored in the route feature location file. In case a RFID tag is not detected or missing, then system should give a message “RFID tag not found” and synchronization should take place on next RFID tag. In addition, facility for manual synchronization by punching the kilometer switch of keypad shall also be provided.

5.7.5 The successful tenderer will be required to provide the user manuals of RFID Tag Reader.

5.7.6 The speed shall be accurately recorded using a digitaloptical encoder connected to one of the axles of the TRC. The speed shall be displayed in digital form inside the TRC at two suitable locations. A spare tachometer shall be provided duly connected with another axle as standby.

6.0 HARDWARE :

The digital and analogue hardware shall meet all requirements of the specification, keeping the following in view.

6.1 The system shall be so designed that the same is capable of up-gradation in future.

6.2 All data acquisition and amplifier cards used in the system shall be properly secured from all sides in such a way that these do not get loose in their sockets due to vibration of the coach during recording and idle movement of coach.

6.3 The latest and new industrial quality digital and analogue hardware, capable of withstanding the service conditions stipulated in clause no. 3.4 and vertical & lateral accelerations of upto $\pm$ 1.0 g at coach floor level and upto $\pm$ 5.0 g at axle box shall be provided. Axle box mounted accelerometers shall be capable of withstanding acceleration occurring on IR track. Transducers/Sensors used shall be of rugged quality and well protected against flying objects, debris, shocks, vibrations etc. and shall be properly secured.

6.4 Flexible good quality shielded cables and connectors capable of working reliably in dynamic condition prevailing on IR System shall be used.

6.5 System shall be such that results are not affected by electronic noise, spikes, surges of the generator, power line and EMI generated by over-head electric traction lines, return current & track circuiting currents in the rails etc. Adequate shielding, line filters with surge suppressors etc. shall be provided.

6.6 The system shall be compact with minimum loose links, so that during recording runs the problem of loose connection & loose link shall not be encountered

6.7 The system shall be modular in design so that in the event any unit / card / transducer going defective, it can be replaced with ease during run.

6.8 Facility and equipment for monitoring of individual transducer output, conditioned output of the signal and the frequency/voltage/wave pattern of the power supply by the operator, shall be provided.

6.9 A system of indicating the functioning of transducers/sensors during recording shall be provided.

6.10 The system shall be provided with good quality UPS of proper rating and reputed make. The entire system will be powered via this UPS, with back up time of at least 60 minutes.

6.11 Adequate number of Laser/Dot Matrix Printers shall be supplied to print various on-line reports being generated by various sub systems for recorded parameters as mentioned in para 5.0.The copy of exception report of track parameter shall be printed on 132 column high speed dot matrix printer.

6.12 The system shall be provided with DVD/Blue ray device for down loading of all data being stored in various sub systems.

6.13 The supplier shall take prior approval of the hardware / software design from the purchaser before actual adoption.

7.0 SOFTWARE:

7.1 DATA PROCESSING AND REPORTING BY VARIOUS SUB SYSTEMS DURING RECORDING:

7.1.1 The software shall be user friendly and menu driven and it shall be so designed that it should be compatible for upgradation with newer versions of operating systems and PCs.

7.1.2 Track Parameter Recording system

i) Software shall be able to print on line exception reports and analogue charts after every kilometer.

ii) Software shall have the facility to select parameters for analog / graphical output for display on VDU and print the same on laser printer. Analog output of each kilometer shall be printed on one page. The system shall also have the capability to store the analog output in suitable format for it's future viewing, processing and printing. The graphical / analog output shall include following for each kilometer.

a) Two level lines for each parameter as per predefined limits.

b) Vertical lines at every 100 or 200 meter distance.

c) Average speed for every 100 or 200 m section.

d) Route Features

e) Header details e.g. Railway, Section, Section speed, Kilometer, Date of recording, file name in which analog data has been stored etc.

iii) The software shall have option to select either profile or chord mode. In case of profile mode, the software shall be capable of recording the profiles on two user selectable bands of wavelengths in the range of 3m to 100m. In case of chord mode there shall be a single band of wave length in the range of 3m to 100m with processing of data on two user selectable chords in the range of 2 m to 20 m.

iv) Facility for entering threshold values initially for various parameters for generation of exception report and same shall editable subsequently.

v) Software shall be able to calculate the following from the profile and chord data and print the same as exception report on line after each kilometer. The format of exception report will be finalized and provided by the purchaser.

a) Evaluation of Standard Deviation (SD) for all track parameters for each block of 200m length in a kilometer, except for the last block, length of which may be less or more depending upon the length of the kilometer. However, if the distance in the last block is more than 250m, the SD of excess length above 200m shall be calculated and reported in next block. A kilometer can have variable number of blocks depending on the length of the kilometer.

b) Evaluation of average gauge (for blocks of 200 meter), calculated from absolute gauge and measured above specified gauge entered at the start of run.

c) Evaluation of 01 SD based indices separately for all track parameters for each block, as per the formula supplied by RDSO.

d) Evaluation of 02 SD based composite indices for each block as well as for the whole km, as per the formula supplied by RDSO.

e) Recording & printing of route features along with distance from km post in exception reports and analogue charts being printed during recording and offline.

f) Evaluation and reporting of peak distribution for both profile and chord modes according to various user selectable predefined limits / bands.

g) Categorization of track for each parameter for both profile and chord modes in minimum four categories based on the predefined criteria to be supplied by the purchaser.

h) Evaluation and reporting of maintenance instructions as per user selectable predefined limits of SD values for various parameters.

i) Determination and storage of one highest value peak for all parameters for every 50 meter length of track and reporting of 10 worst peaks out of the determined total no of peaks in decreasing order of magnitude along with distance from the last km post. The logic of zero crossing shall be used for determination of peaks.

j) Determination and storage of all peaks in a kilometer with location. The logic of zero crossing shall be used for determination of peaks.

k) For evaluation of SD and peak information/distribution, variation of gauge over moving average (with specified length of moving window) shall be taken.

l) Evaluation of block wise and km wise average speed.

m) Generation and printing of curvature report in the format given by RDSO.

7.1.3 Full Rail Profile and Wear Measurement System

i) Software shall be able to print on line exception reports and analogue charts after every kilometer

ii) Software shall have the facility to select parameters for analog / graphical output for display on VDU and print the same on laser printer. Analog output of each kilometer shall be printed on one page. The system shall also have the capability to store the analog output in suitable format for it's future viewing, processing and printing. The graphical / analog output shall include following for each kilometer.

a) Two level lines for each parameter as per predefined limits.

b) Vertical lines at every 100 or 200 meter distance.

c) Average speed for every 100 or 200 m section.

d) Route Features

e) Header details e.g. Railway, Section, Section speed, Kilometer, Date of recording, file name in which analog data has been stored etc.

iii) Software shall be able to calculate the following from the recorded data and print the same as exception report on line after each kilometer. The format of exception report will be finalized and provided by the purchaser.

a) Vertical and lateral wear of both left and Right rail

b) Angular wear of both left and Right rail.

c) Rail roll over of both left and Right rail

d) Lip flow of both left and Right rail

iv) Facility for entering threshold values initially for various parameters for generation of exception report and same shall editable subsequently.

7.1.4 System for measurement of acceleration on one pivot of TRC and test vehicle/Locomotive and axle box of TRC

i) Software shall be able to print on line exception reports and analogue charts after every kilometer. The format of exception report will be given by purchaser after award of contract.

ii) Facility for entering threshold values initially for various parameters for generation of exception report and same shall be editable subsequently.

iii) Software shall have the facility to select parameters for analog/graphical output for display on VDU and print the same on laser printer. Analog output of each kilometer shall be printed on one page. The system shall also have the capability to store the analog output in suitable format for it's future viewing, processing and printing. The graphical / analog output shall include following for each kilometer.

a) Two level lines for each parameter as per predefined limits.

b) Vertical lines at every 100 or 200 meter distance.

c) Average speed for every 100 or 200 m section.

d) Route Features

e) Header details e.g. Railway, Section, Section speed, Kilometer, Date of recording, file name in which analog data has been stored etc.

iv) Evaluation of vertical and lateral Sperling Ride Index for vertical and lateral acceleration at bogie pivots and at axle boxes of TRC for every 200m block except for the last block, length of which may be less or more depending upon the length of the kilometer. However, if the distance in the last block is more than 250m, the SD of excess length above 200m shall be calculated and reported in next block. A kilometer can have variable number of blocks depending on the length of the kilometer. Formula for ride index shall be given by RDSO.

v) SD value of vertical and lateral acceleration for every 200m of block on left and right side of axle box.

vi) Determination of number of peaks above two and three predefined threshold for vertical and lateral acceleration at bogie pivot of coach, left side axle box, right side axle box and at bogie pivot of locomotive.

vii) Determination and storage of all peaks in a kilometre with location. The logic of zero crossing shall be used for determination of peaks**.**

viii) Determination and storage of one highest value peak of vertical and lateral acceleration at bogie pivot of coach, left side axle box, right side axle box and at bogie pivot of locomotive for every 50 meter length of track and reporting of 10 worst peaks out of the determined total no of peaks in decreasing order of magnitude along with distance from the last km post. The logic of zero crossing shall be used for determination of peaks.

7.1.5 System for identification of any obstacle in Maximum Moving Dimension (MMD) envelope of IR

i) The format of reports to be printed by software will be finalized and provided by the purchaser

ii) Software shall have the facility to upload the MMD envelop of IR

iii) The presence of any obstacle within standard IR MMD envelope shall be stored and printed on line with details and location (chainage of obstacle in terms of last Kilometer and meter).

iv) The software shall display the video of clearance envelop on separate VDU and store & print the overlapping image of measured and standard MMD envelop along with obstacle.

iv) Software shall be capable of on line printing of Description and Dimension of infringing obstacle with reference to some coordinate system.

7.1.6 System for Rear Window Video Recording of IR track

i) The software shall be capable to acquire, display, store and print the image at track features with Date, Time, location of track feature with Kilometer, Meter, and GPS Coordinates(Latitude and longitude) e.g Level Crossing, Curve Start, Curve End, Bridge Start, Bridge End, station etc. using preloaded track feature location file.

ii) Software shall have the facility to print the image at track features. The facility to print or not to print shall be user selectable.

iii) The software shall have capability to store and print track parameter value in peak form on short chord at track feature location

iv) The software shall be capable for storage of images with localization index at least at every 4.0 meter at maximum recording speed of 200 Kmph

7.1.7 System for video recording of track components for reporting their status

i) The software shall be capable to identify and print the defect for each component of track with location i.e Rails, Fastenings, Sleepers and Ballast, and store the same in separate files in ASCII or database format. The images shall be stored in JPEG format.

ii) Following defects in various track components shall be identified and printed in report format. Format of report will be provided by purchaser after award of contract.

a) Rails

- Linear Defect

- Area Defect
- Joint Gap Measurement
- Weld detection

b) Sleepers

- Crack Detection
- Sleeper misalignment
- Sleeper level check
- Concrete sleeper spalling

c) Fastenings

- Missing Clip
- Shifted rail pads
- Marking Detection
- Missing Bolts and Rail anchors

d) Ballast

- Excess or deficiency of ballast
- Detection of axle counters, Dancing sleepers, Foreign objects, SEJ, Switches & Crossings and Level Crossings,
- Base plate crack check and vegetation check
- Excess of Mud/Dry mud

7.2 POST PROCESSING OF DATA:

7.2.1 The post processing of the various data recorded by the various sub systems are to be carried out in office environment. PCs, printers and any additional hardware required for post processing of data shall be supplied with the system.

7.2.2 The post processing software modules for various systems shall be capable for regeneration of various online graphical chart and exception reports being generated during recording from the stored data along with display on PC's VDU.

7.2.3 The post processing software modules for various systems shall be capable for generation of various offline reports for track parameters in chord and profile mode, rail wear parameters and vehicle ride parameters. The detail of these reports are furnished below:

7.2.4 Track Parameter Reports

i. Recording run summary, Section wise summary and various other reports using different peak based, SD based and indices based exception limits.

ii. Reports for comparison of two recording results as per formats provided by the purchaser after award of the contract. The comparison software shall also indicate the improvement or deterioration among various recordings.

The purchaser (RDSO) will provide the formats of reports after award of contract. The data of all reports shall also be stored in comma separated ASCII files.

iii. Data of section wise summary of various repeat runs shall be stored in same ASCII data file or in some standard database in the format provided by purchaser (RDSO). The purchaser will provide the data file/data base format after award of contract.

iv. Generation of analogue/graphical output of raw data (transducer signal)

7.2.5 Rail wear reports

i. Software module shall be capable for regeneration of on line analog/Graphical and exception reports for parameters given in para 5.2 by selecting the correct rail type where wrong rail type has been identified.

ii. The software shall be capable to analyse the measured rail profile with respect to number of predefined rail profiles and find out the linear difference and area difference between two superimposed profiles. The format for report and storage of data will be provided by purchaser after award of contract.

iii. Facility to input predefined profile in the system shall be available.

iv. Various exception reports for vertical, lateral and angular rail wear by changing the threshold values through user interface.

v. The purchaser (RDSO) will provide the formats of reports after award of contract. The data of all reports shall also be stored in comma separated ASCII files.

7.2.6 Vehicle Parameter Reports

i. Software module shall be capable for regeneration of on line analog/Graphical and exception reports for parameters given in para 5.3

ii. Various exception reports for vertical and lateral accelerations, SD values and Ride Index at axle box and bogie pivot by changing the threshold values through user interface.

iii. The purchaser (RDSO) will provide the formats of reports after award of contract. The data of all reports shall also be stored in comma separated ASCII files.

7.2.7 All data required by TMS from TRC shall be stored in database or ASCII file in a format compatible with Indian Railway TMS data format for generation of various reports. Format of TMS data will be provided after award of Contract.

8.0 CALIBRATION, DIAGNOSTICS AND SIMULATION RUN:

8.1 Detailed procedures and periodicities of different types of calibrations required to be done viz. lab, field, quick, detailed etc. shall be given for various components, cards, transducers, sub-systems etc. The daily calibration before start of recording should be possible in minimum possible time, preferably within 15 minutes.

8.2 The calibration procedure shall be easy and should require minimum adjustments.

8.3 System shall be designed with diagnostic features. It shall have facility to check various transducers, modules etc. and communication between various sub-systems and peripherals etc.

8.4 The system shall be provided with features to facilitate trouble shooting at module/card level. Status of various parameters of modules/ transducers shall be displayed on system VDU with reference and limiting values for identification of faulty modules/Transducers/sensors.

8.5 System shall have facility / modules for generation of simulated signals and speed required for testing of system in stationary condition.

9.0 ACCEPTANCE TESTS:

9.1 The system shall be subjected to both laboratory and field validation tests, before acceptance. **Supplier shall submit detailed lab and field validation schemes within 03 months after award of contract for approval.** The decision of the purchaser regarding validation and testing of the system shall be final and binding on the supplier. Inspection, validation and acceptance of the system (laboratory & field) will be done by the nominated officials of RDSO.

9.2 LABORATORY VALIDATION TESTS:

9.2.1 The laboratory validation tests shall include detailed testing of various components, transducers, sub-systems, assemblies etc. of the system as per the approved lab validation scheme.

9.2.2 During laboratory validation various system will be tested using simulated signal at 5 simulated speeds in the range of 20 to 200 kmph

9.2.3 The laboratory validation tests shall be carried out, prior to shipment at firm's premises. Firm shall make available all facilities required for laboratory validation tests. The firm will inform the purchaser at least 10 weeks prior to the date when system will be ready for laboratory validation tests.

9.2.4 If laboratory validation/tests show any deficiency in the system from the specifications, the supplier shall rectify the deficiencies within a reasonable period. The travel, Boarding and other expenses to be incurred for subsequent inspection should be borne by the supplier.

9.3 FIELD VALIDATION TESTS:

9.3.1 Field validation shall be done on short stretches of up to 10 km as well as on long stretches of 500 to 1000 km consisting of any type of track (CWR, SWR, fish plated or mixed) in well maintained and/or run down track including straight, curves, bridges and station yards.

9.3.2 In case of short stretches, the system will be tested for repeatability and reproducibility as per the provisions mentioned in para 5. 2 and 5. 3 in the speed band of20 to 160Kmph at 05 speeds.

9.3.3 The magnitude of the defect peaks/exceedences recorded at various speeds will be compared with that measured by IR's existing contact less sensor based TRC and actual field measurements/measurements taken by portable system. The variation in results shall be within a reasonable accuracy to the satisfaction of the inspecting engineers of the purchaser.

9.4 If field validation/tests show any deficiency in the system from the specifications, the supplier shall rectify the deficiencies within a reasonable time to complete the commissioning in the specified period.

9.5 The supplier shall be required to supply and install free of cost all the equipment, components, PCB cards, ICs, cables, transducers, connectors, spares and consumables which may fail, malfunction, become defective or required for uninterrupted working of testing car during field trial and commissioning of system.

10.0 DOCUMENTATION:

10.1 Installation, Calibration, operation, maintenance, service, and troubleshooting manuals shall be prepared in sufficient detail to the satisfaction of purchaser and supplied in three copies each.

10.2 Formats of all data files generated in various sub systems with explanatory note including detail table structure with explanatory note of database for the data to be stored in database.

10.3 Detail documentation (Manuals) for the third party sub systems/sensors/transducers/equipment used in the system design to the extant supplied by the manufacturer.

10.4 Documentation of system hardware including transducers/sensors shall be supplied in sufficient detail to enable diagnosis, repair and maintenance of system up to card/module level comprising of details of circuit diagrams.

10.5 Source code of processing and exception report generation part of online software and post processing software **shall be supplied** along with flow charts and algorithms. Source code and executable files of the software shall also be supplied on CD/DVD as well as in hard copy.

10.6 Installable version of system software along with procedure to install the same from scratch in case of failure of hard disk shall be provided on CD/DVD & portable hard disk.

10.7 Transfer function plots of digital filters used for recording of various parameters in different sub systems and procedure for testing of these filters.

10.8 Licensed copy of operating systems, compilers or assemblers for the language used in writing the software shall be supplied.

11.0 TOOLS:

All tools including measuring equipment required for calibration/ diagnostics/fault finding and normal maintenance/repair shall be supplied as a complete kit. The list of such tools and equipment proposed to be supplied with system shall be furnished as part of technical details of offer.

12.0 TRAINING

12.1 Supplier shall provide the training to four RDSO officials for four weeks in calibration, operation, fault diagnosis, card/module **level** repair and maintenance of the system at his premises. In case of indigenous supplier, if certain parts/sub-assemblies is imported the required training shall also be

provided at the premises of such foreign manufacturer/supplier. The following shall be included in the training schedule.

a) Hardware: This training shall include calibration, operation, fault diagnosis, repair and maintenance of hardware supplied upto card/module level. The interconnectivity of the modules/subsystems shall be explained in detail.

b) Software: The training should be so imparted that any subsequent minor changes in post processing software and online processing software for indices calculation and reporting as desired by IR in future can be incorporated. This training shall include the explanation of, flow charts, algorithms and source code of the online processing software and post processing software.

12.2 The theoretical part of the training regarding fault diagnosis, repair and maintenance including explanation of, algorithms, flow charts and source codes of the processing and reporting online software and post processing software shall be completed before commencement of lab validation. The training shall be given on the system to be supplied.

12.3 During commissioning of the system, four RDSO officials shall be trained in operation, maintenance and repair of the system and installation of system software from scratch for a period of six weeks by the supplier.

12.4 Training notes and suitable reading material shall be provided to each trainee official before commencement of each spell of training.

12.5 The charges for providing the training per official shall be separately quoted by the tenderer and payment for training shall be based on the number of officials actually trained. However, the cost of traveling, boarding and lodging for IR officials will be borne by the purchaser.