TECHNICAL SPECIFICATION FOR “RAIL GRINDING MACHINE” AND “RAIL HEAD PROFILE INSPECTION AND ANALYSIS SYSTEM”

1.0 Scope of Work

1.1 These specifications provide the technical requirement for the manufacture and supply, testing and commissioning of a self-propelled rail-grinding machine of 72 stones module, Rail head inspection & analysis system and rail profile measuring equipment along with a digital camera for use on the tracks of Indian Railways and training of personnel to operate and maintain this machine. The machine to be supplied is meant for grinding the rails in corrective mode and preventive mode, to improve the rail wheel contact point location and to eliminate micro cracks on the rail table surface and short wave and long wave corrugations. The grinder shall be able to effectively grind open track, switches, and rail having checkrail. The supplier shall furnish, deliver and warrant the rail-grinding machine as per these specifications.

1.2 Two No’s crew rest van having resting capacity of about 24 persons (12 persons in each) as per the general layout given at Annexure I of the technical Specification (which may further be modified after approval of Indian Railway) and one tank wagon for storing water will be integral part of the machine and shall be supplied with the same. The supplier shall include all items and accessories required for proper operation of the machine along with the offer and not mentioned in these specifications and supply the same along with the machine.

1.3 The supplier shall be responsible for maintenance and operation of the machine and systems supplied for the warranty period. They shall also be responsible for its maintenance for two years post warranty.

1.4 The Technical Specifications have been drafted to cover the performance and quality requirement of the equipment in a neutral manner without bias to any specific manufacturer. Bidders are requested to carefully study the specifications and assure that their equipment fully comply with these specifications. Thereafter, if a bidder feels that his equipment can substantially meet the performance and quality 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.

1.5 The bidder shall specify the model offered and furnish a detailed Technical Description of the same. System/sub-systems of the working mechanisms of the machine as per para ‘3’ in particular (regarding Working Mechanism of machine) 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 machine (model) offered.

1.6 Photographs and video compact disc/s 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.

A RAIL GRINDING MACHINE

2.1 The diesel-powered self-propelled rail-grinding machine of 72 stones module 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.

2.2 The machine shall be a 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 Railways straight, transitions and curved track up to 10° curves on
broad gauge (1676 mm). Shared 2 axle bogies between two grinding cars or between carriages
are not acceptable.

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-2004 print. The minimum and maximum moving
dimensions are enclosed in Annexure-II. 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 less than 20.32 T with minimum axle spacing of
1.83m. Load per meter shall not exceed 7.67 tonne. 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. Stresses in the track and bridges shall be calculated by IR/RDSO
based on design data submitted by the firm as per Annexure–III and decision of IR/RDSO
shall be final in this regards.

2.6 It shall have a desirable 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 2.4 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:

<table>
<thead>
<tr>
<th>Maximum Axle load (tonne)</th>
<th>Minimum wheel diameter (mm)</th>
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<tbody>
<tr>
<td>22.82</td>
<td>908</td>
</tr>
<tr>
<td>22.00</td>
<td>878</td>
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<tr>
<td>21.50</td>
<td>860</td>
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<td>732</td>
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<tr>
<td>17.42</td>
<td>710</td>
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<tr>
<td>17.0</td>
<td>700</td>
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</table>

2.7 It 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 to be attached while travelling up to 3 % gradient.

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: -5° to 55°C
- Altitude: Sea level - 1750 m
- Humidity: 20% to 100%
- Maximum rail temperature: 70°C

2.9 The machine (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. 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.

2.12 The machine shall be capable of producing good longitudinal profile of the railhead continuously.

2.13 The machine shall 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 possible to grind track on sharp curves having check rails WITHOUT removing the check rails and with a minimum of 24 modules. Each of these 24 modules should have full, independent angle and lateral shift capability and it should be possible to grind without any special setup or mechanical adjustments. The change in operation to grind switches and checkrails shall be possible to implement from the operator control station seamlessly while grinding open rail. The same standard stone being used for open rail grinding should be used for this special operation.

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

2.15 The machine shall be capable of grinding profile of UIC 60 Kg rail section, 52 Kg and 90 R rail heads in 72/90/110 UTS strength and HH 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 through sleepers, CST-9 and wooden sleepers. It shall also function effectively on rails having 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.
2.16 Large window shall be provided in both cabs 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.

2.17 Diesel tank fuel capacity should not be less than 21,000lts.

2.18 The supplier shall ensure that the offered machine 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 of grading of track on level crossing without removal of check rails.

2.19 The machine shall be self propelled bogie type vehicle with minimum four axles (two bogies).

2.20 The wheel profile of machine shall be as per Indian Railway standard wheel profile provided in Annexure- IV.

3.0 Working Mechanism:

3.1 The working mechanism of the 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. Machine should be equipped with system to measure rail profile at a speed of not less than 10 kmph and storage of rail profile data of at least 100 km of track length.

3.1.4 Library of proposed rail profiles for various rail sections and locations, in the onboard computer. To develop library of target profiles for various rail sections on different routes, supplier of machine will design the target rail profiles for all the locations where it will be deployed to work after commissioning of the machine. 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.

3.1.5 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. Machine should be equipped with required hardware and software to capture, store and process rail profile data from other measuring devices of rail profile, design of target rail profile from the data of existing rail profile, quantitative assessment of metal removal per meter of rail to achieve target rail profile, recommended grinding pattern (angle setting of individual grinding module) to achieve a target rail profile from a given rail head profile, comparative picture target profile and profile achieved after grinding on real time basis, quantitative assessment deviation of ground profile from target profile.

3.2 Keeping in view the likely fire hazard due to heavy spark generation, the grinding mechanism should be electric driven, drawing power from an on-board diesel generating set.
3.3 All the components of the 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.

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

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

3.6 The grinding modules may be grouped together on carriages. The Grinding carriage up/down movement shall be controlled hydraulically/Pneumatically.

3.7 The 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.

3.8 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. Each individual module should have a fully adjustable angle range of +70 degrees to gauge to -45 degrees to field, independently controlled from the operator station in the cab. Each grinding module spindle angle shall be accurate within ±0.25° (plus/minus one quarter of a degree) of the designed spindle axis positioning angle. Each module contains only one grinding motor with individual, independent tilt cylinder and must have the capability of being positioned by the control system independent of any other grinding motor. The tilting cylinders should not be shared with adjacent modules and must be independent for each motor.

3.9 At the work location, the prevailing temperature may be higher than the specified maximum temperature of 55°C. The peak load on the grinding motors, under the most demanding conditions shall not be more than 85% 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.

3.10 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 machine (not less than 72). However, the total grinding power provided on the machine (number of motors x continuous load rating of each motor) shall not be less than 2160 HP (1612 KW).

3.11 The machine shall be capable of removing, a minimum of 15 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 10 kmph. While assessing the 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.
3.12 The capacity of grinder 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:

<table>
<thead>
<tr>
<th>Speed (kmph)</th>
<th>Depth (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>0.13</td>
</tr>
<tr>
<td>10</td>
<td>0.20</td>
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</tbody>
</table>

The details of the disposition of the grinding motors and their angular disposition range shall be furnished by the supplier.

3.13 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 there are any metallurgical changes or bluing of the rail top at the minimum operating speed.

3.14 The rail grinder 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.

3.15 To ensure Gauge Face correction without flattening the root curve, out of the total grinding modules, 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 45° on the field corner. At all angles the grinding effort must potentially be 100%.

3.16 While the machine is operating at full grinding load at the maximum working speed of 15 kmph, the minimum life of each stone shall not be less than 5 hrs grinding time.

3.17 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.

3.18 Machine driving controls must be at both extreme ends of the machine, each manned by an operator.

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

(i) Maximum grade 3%
(ii) Maximum curve 10°

3.20 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 onboard central control panel.

3.21 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

3.22(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.

3.22(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 horse power.
   (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

3.22(c) The computer controlled system shall have the facility of System diagnostics in operator’s cabin which should be able to do following:

   (a) Detection of short circuit and 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.

3.23 The on board computer will, monitor the following items and maintain a log:

   (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.

3.24 The rail grinder 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.
3.25 The machine shall be equipped with line recorder to enable the depth of irregularities to be recorded before and after grinding operations.

3.26 It shall also be possible to record the grinding length vis-à-vis time on a print out to obtain information on the machine output.

3.27 The grinding method must ensure the complete re-profiling of the railhead by excessive metal removal. The grinding must be done by rotating grinding stone and not by any cutting tools or abrasive blocks.

3.28 All the grinding stones shall be equipped with an automatic control and locking device preventing the stones from dropping into long pitch corrugation.

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

3.30 The machine shall be equipped with Rail Grinding Gauge for Broad Gauge (1676 mm), with four different Patterns (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.

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

3.32 The grinding trolley shall be designed for raising and lowering operation from the cabins.

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

3.34 The rail grinder 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.

3.35 The rail grinder must be capable of setting down or picking up grinding stones/carriages in curves.

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

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

3.38 Grinding patterns must be balanced and not changed with curve elevation of the track on which the machine is operating. The rail grinder must be equipped with a system to maintain
a positive pressure and constant reference to the gauge face of the rail for the 24 modules to be used for switches and curves with check rails.

3.39 The rail grinder 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.

3.40 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.

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

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

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

3.44 The 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.

3.45 The 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 litres water storage capacity should be available on the machine. There shall be separate arrangement of 55000 litres storage of water container in the rail grinder consist by way of a separate wagon (clause 1 & 6.1) for use during prevention of fire. It should be possible to connect the water storage on the attached wagon with the machine storage and use it for arresting fire as and when required. The visibility requirement of the machine as specified in clause 11.1 shall not be obstructed on this account.

3.46 The machine shall be equipped with water cannon of capacity upto 1200 litres per minute throughout with a reach of 40 meters. The machine shall also be equipped with separately controlled sleeper and ditch spray, for front and rear.

3.47 **OPTICAL RAIL PROFILE MEASURING SYSTEM:**

3.47.1 The grinding machine should be provided with a set of optical rail profile measuring system integrated with the onboard computer both in front of the machine as well as rear of the machine. The system should be able to capture rail profile both ahead of and behind the grinder for real time comparison of rail profile before grinding and after grinding.

3.47.2 The profile measurement system, in a real time basis, shows 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 alongwith input location data such as milepost, curve-data, grinding speed patterns used etc.

3.47.3 It 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 for software maintenance and upgradation during warranty and subsequent working life of the machine (minimum 15 years). 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) Speed at which to grind.

4.0 **Diesel Engine/Electric Generator:**

4.1 The machine shall be powered by diesel engine(s) preferably indigenous, with proven record of service in tropical countries with wide service network in India. Robust construction and low maintenance cost are of particular importance. Adequate allowance shall be made to provide adequate reserve power to take care of the working of machine 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. Furthermore, the grinding power should be on a common buss to ensure grinding with all 72 stones may continue in case of an engine / generator failure. The supplier shall furnish the details of power requirement for working under normal conditions as specified in clause 3.12 and total power provided on the machine.

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

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

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

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

4.6 There is a likelihood of dust deposition over the engine body and surrounding area over the lubricants spill over. These should be easy to access for daily cleaning and routine maintenance. In case, air cooled engines are proposed by the supplier, maintenance equipment for cleaning and maintenance of the air cooling fins shall be provided by the supplier alongwith the machine.

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

4.8 The diesel engines 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.

4.9 The grinding motors shall be controlled through suitable starter control for starting/ stopping of motor.
5.0 **Cooling System:**

5.1 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.

6.0 **Brakes:**

6.1 The machine shall be fitted with the airbrakes and provision shall be made to attach camping coach/crew rest van and separate water storage container available in the rail grinder consist. The brakes shall be protected from ingress of water, grease, oil or other substances, which may have an adverse effect on them. The brake lining shall be suitable for high ambient temperature of 55°C. The force required for operating the brake shall not exceed 10 kg at the handle while applying by hand and 15kg on the pedal, when applied by foot. In addition, mechanical brakes shall also be provided for use in an eventuality of failure as well as for parking.

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

7.0 **Safety Mechanism:**

7.1 The equipment shall be provided with electric horns/ hooters facing outwards at each end of the machine at suitable locations to warn the workmen of any impending danger at the work spot or from oncoming train. These electric horns/hooters shall be operated either by means of push buttons provided in the cabs and also should have remote control operation so that the Lookout man standing around 150 m away from the machine can operate the electric horn/hooters to warn the staff working on/around the machine about approaching train on adjoining track.

7.2 There shall be an arrangement that when the fire extinguisher is activated, the engine automatically shuts down.

7.3 There shall be arrangement to prevent dust from the grinding process from escaping into the air. For this a suitable and efficient “dust collection system” shall be provided on the machine.

7.4 There should be arrangement for water spray through nozzles at suitable locations to prevent track fires.

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

7.6 There shall be arrangement for flasher lights at both ends.

7.7 Safety equipments like jacks, pullers, tirfor and other such equipments specific to the machine for restoring failed units of the machine during working, shall be provided on the machine.
7.8 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.

8.0 **Hooks and Buffers:**

8.1 The machine shall be fitted with transition CBC coupling and buffers of IR design on both the ends per coupling it with other vehicle for running in train formation.

9.0 **Electric Equipment and Lighting:**

9.1 The electrical equipment to be provided shall conform to relevant standard specifications and shall be suitable for Indian climatic conditions. The machine shall be equipped with Twin beam headlight assembly conforming to RDSO’s specification No.ELRS/SPEC/PR/0024 Rev-1, Sept 2004 with latest amendments ensuring a light intensity of 3.2 lux at ground level at track centre at a distance of 305 mts. away on a clear dark night, at each end and with two front and rear parking lights, which can be switched to red or white according to the direction of the travel. Powerful swiveling floodlights shall also be provided to illuminate the working area sufficiently bright for efficient working during night. The flasher lights at both ends shall be provided on the machine to give indication for the train arriving on other line.

10.0 **Chassis & Under frame:**

10.1 The chasis shall be of 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 100t without any permanent distortion. The under frame shall be sufficiently robust for safe travel of the machine in train formation and not necessarily as last vehicle.

11. **Cabins:**

11.1 The machine shall be equipped with fully enclosed air conditioned and pressurised 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.

11.2 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.

11.3 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.

11.4 One screen wiper preferably operated by compressed air shall be provided on the windscreens.

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

11.6 The machine shall be provided with well defined space for keeping the tools and spares required for on site repair of the machine to attend the breakdowns and other working requirements.
12.0 **Tools and Instructions Manuals:**

12.1 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.

12.2 Detailed operating manual, maintenance and service manual shall be specifically prepared and three copies of these shall be supplied with each machine.

12.3 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 of items like hydraulic pump-motors, and the tenderer shall furnish the details of such other bought out components/assemblies.

12.4 The tenderer shall along with his offer, submit the list of tools, manuals, circuit diagrams and other technical literature/drawings to be supplied along with each machine as above, for operation, servicing, maintenance and trouble shooting. The list can be modified to suit the purchaser’s requirement, while examining the offer.

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

14.0 **Maker's Test Certificate:**

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

15.0 **Operators:**

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

16.0 **Optional Equipment:**

16.1 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.

17.0 **Inspection of the machine:**
17.1 The supplier while offering the machine for inspection shall submit the documents as laid down in Clause 12.5 above at least 3 months before the proposed date of inspection.

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

18.0 **Issue of Provisional Speed certificate**

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

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

b) **Current suppliers, whose models are not approved/ or new:**
   As soon as the supplier completes the design of the machine as per specifications, the technical details as per Annexure (VI/ A & B) 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 VI/ A & B) can also be asked for issue of provisional speed certificate for the machine.

c) **New suppliers, whose models are new:**
   The technical details shall be supplied as detailed in para (b) above.

19.0 **Acceptance test:**

The acceptance test shall consist of:

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

19.2 Testing for negotiability of 10-degree curve and 1 in 8.5 turnout.

19.3 Train running speed tests (light running) on the Indian Railway main line track in accordance with the procedure outlined at Annexure –VII.
19.4 Construction and engineering of the machine.

19.5 Output performance quality tests with the following conditions and methodology:

19.5.1 (a) High carbon 90 UTS/110 UTS H.H. rails with 60-kg/52 kg UIC section.
(b) Standard carbon rails 72/90 UTS and has 60/52 kg section.

19.5.2 Profile of the rail section shall not be deformed.

19.5.3 For the purpose of metal removal capability of the machine (clause 3.11), 5 sites shall be selected. At each site measurement of both left and right rail shall be taken.
(a) At each site, the machine shall grind a length of at least 500 meters to ensure that the stones are not heated up.
(b) The profile of the rail shall be close to the desired profile.
(c) The rail hardness shall be measured and recorded.
(d) To assess the material removal capability of the machine (clause 3.11), at each site, on the test rail, 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.
(e) The X-sectional area shall be recorded, at each X-section, before the grinding, and after 5 one grinding passes. The working speed, while grinding shall be maintained as specified. The material removal per pass at each X-section shall be worked out by dividing the loss of X-section over 5 passes by five.
(f) The average material removal per pass for the site shall be the average of material removal per pass at 5 X-sections.
(g) The average material removal per pass at the specified speed at each of the 5 sites for both left and right rail separately shall be more than that specified in clause 3.11.

19.5.4 For the purpose of depth of metal removal capability of the machine (clause 3.12), 5 sites shall be selected for carrying out tests at the speeds mentioned in clause 3.12. At each site measurement of both left and right rail shall be taken:
(a) At each site, the machine shall grind a length of at least 500 meters to ensure that the stones are not heated up.
(b) The profile of the rail shall be close to the desired profile.
(c) The rail hardness shall be measured and recorded.
(d) 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 rail-sections on both rails at each of the 5 sites.
(e) 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 each grinding pass. Measurement to be done with miniprof
(f) 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 divided by 25.
(g) 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 3.12 for the respective grinding speed.

19.5.5 Stoppages of work not attributable to machine shall be discounted.
19.5.6 The difference in the target profile and ground profile i.e. profile achieved after grinding, shall not more than ± 1% in terms of cross sectional area of rail head.

19.6 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 3.16.

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

B RAIL HEAD PROFILE INSPECTION AND ANALYSIS SYSTEM

20.1 GENERAL

20.1.1 The Rail Head Profile Inspection and Analysis System (hereafter referred to as “system”) is meant for collecting digitized image of the transverse profile of rail head for detailed analysis and for generating grinding plans to be used on Rail Grinding Machines – The main objectives are:

a) Recording digital image of the rail head profiles for selection of optimum grinding pattern, number of grind pass requirements and grinding speed per pass for any section of track.

b) Assessing the grinding requirements due to surface defects on rail top after recording visuals of the rail top.

c) GPS based route data recording of the track features.

20.1.2 The system is proposed to be installed in the existing Broad gauge (1676 mm) rail bound vehicle of Indian Railways. The vehicle shall be provided by the Indian Railways. System along with all hardware and software to be fitted, installed and commissioned by the contractor to the satisfaction of the purchaser.

20.1.3 The technical specifications have been drafted to reflect the performance and quality requirement of the system. Bidders are requested to carefully inspect the existing Rail Grinding Machines of Indian Railways and to ensure that their system is also compatible to these systems apart from being compatible to offered machines. If a bidder feels that his system substantially meets the performance and quality requirements but does not conform to a particular clause of the specifications. They/He should seek clarification from the purchase prior to submission of bids to ascertain whether such deviation is permissible or not.

20.2 FUNCTIONAL REQUIREMENTS

The working mechanism of the system shall be equipped with:

A- Optical Rail Inspection & Analysis System based on Laser System & CCD or advanced Video Camera System.

B- GPS based route data & event recorder system.

C- Image Acquisition System to collect and display top of rail (rail head) Images.

These systems should have due integration between them so that the complete system as a whole works as an ideal system on pre/post grind Rail Inspection Vehicle.

20.2.1 System should be reliable, rugged and capable of working satisfactorily in the harsh environment of heat, dust, vibration, shock, water, wind, humidity, fog, high voltage traction, electromagnetic effect etc. which are normally encountered on Indian Railways.

20.2.2 System should work satisfactorily under the following environment parameters:
- Temperature : -5°C to +55°C
- Relative humidity: upto 100%
- Wind speed up to 100km/h
- Overhead transmission wires: 25 KV AC & 1500 V DC
- Results should not be affected by direct sunlight, dust and rains.

20.2.3 The assembly should not infringe the Schedule of Dimensions prevalent on Indian Railways. The profile of the assembly longitudinally and in cross section during movement shall be within the minimum and maximum moving dimensions shown in the Indian Railways Standard BG schedule of Dimensions (metric)-Rev-2004. These dimensions are shown at Annexure-II.

20.2.4 On IR network the electrified traction consists of overhead electric system of either 25000 V AC or 1500 V DC with residual return current passing through one of the rails in the track. The voltage for track circuits for signaling purpose is up to 12 volts and the corresponding current up to 1 Amp, passes through the other rail. The track recording system and its accuracy of measurement shall not be affected in any manner due to the induction effect of the above stated electric traction and signaling systems.

20.3 Optical Rail Inspection & Analysis System based on Laser System & CCD or advanced Video Camera System.

20.3.1 Rail head profile measuring system should be capable of measuring the head profile of rail with an accuracy of 0.1 mm or better and output format acceptable on Rail grinders (preferably in CSV files with all independent X, Y coordinates). In the software of Rail profile measuring system there should be the capability to analyze the measured rail profiles with respect to number of predefined profiles and find out the linear differences between two superimposed profiles and area difference between those two profiles. There should be capability to store measured rail profiles of 10,000Kms and transfer the data on Compact Disc or external portable hard disks via USB ports, and it should also be possible to take an average of measured profiles of 1000 mtrs or so. Such studies and other such studies related with rail grinding needs is a requirement on our system.

20.3.2 Numbers & orientations of the cameras on the system should be such as to record the head profile of the rail in the region of rail top from 70 deg. on the gauge corner to 45 deg. on the field corner.

20.3.3 The system should be able to capture at least one snap of rail @ every 1 to 3 meters of track while moving at around 40-50 KMPH speed.

20.3.4 Such rail head profile recording should be possible in all weather conditions System shall be capable of recording accurately under all conditions of light. The recording should be possible even during the night time.

20.3.5 There should not be any need of manual calibration in case of change in the intensity of sunlight.

20.3.6 System should have in-built protection system to absorb voltage fluctuation and should work on 220V + 10%, 50 Hz AC supply. System should be contact less and it should be based on laser technology. System should be protected from all health hazards & comply with the relevant regulations in this regard.
20.3.7 CCD cameras, laser source, transducers and all other parts of the system must be at least 150 mm above the running rails.

20.3.8 Arrangement for fixing the system should be such as to permit recording on turnouts and level crossings also. A drawing showing mounting arrangement of the system should be submitted along with the offer.

20.3.9 The profile measurement system in a real time basis shows the actual rail profile and difference between the measured profile and the selected predefined profile.

20.3.10 The system should save the captured rail profile data along with input location data such as milepost, curve-data, grind speed, patterns used etc.

20.3.11 The captured images should be transferred to the system software through a specially designed interface that should allow real time management and analysis of the profile data. System should then overlay the actual (measured) rail profile of each (left and right) rail with the desired profile (template) to produce a dynamic difference profile and the amount of rail head to be removed by grinding.

20.3.12 System should have the ability to perform both pre- and post-grind analyses. The system should examine the measured pre- or post-grind profiles and determine if the rail is within tolerance or if additional passes are required to achieve the desired profile.

20.3.13 Systems main window should have multiple view ports to display the pre and post-grind profiles (right and left rail) and the calculated difference between profiles. In addition a pre- and post-grind list box should display data, such as the total number of passes needed to achieve a profile, the predefined pattern numbers associated with the passes, and the speed at which to grind.

20.3.14 System should have post-processing routines that allow the user to review captured data and adjust parameters in order to evaluate changes in grinding philosophy. In order to achieve this, the system should save the captured rail profile data along with track location data, curve data, grinding speed, patterns used, etc.

20.3.15 Overall the system should provide the railway the ability to effectively establish a rail grinding program, monitor the status of the grinding program and adjust that program accordingly, based on actual data collected.

20.4 GPS based route data & event recorder system:

20.4.1 This is a vehicle mounted system for accurately measuring and recording ground features, location and their details along the railway track to prepare route data file. The recording speed shall be approximately 40-50 km/h.

20.4.2 While moving at 40 to 50 Km/h it should record all track features i.e. Curves (in, out), turnouts, bridges, level crossings, station buildings etc (list as per Annexure-VIII) along with their chainages and the permanent Latitude & longitude of the track feature. For this the vehicle shall be GPS enabled and suitable distance encoders have to be fitted in the wheels as well.
20.4.3 For recording of the track features manual punching on a standard computer keyboard is to be done.

20.4.4 The system shall have facility to erase the wrongly entered data during recording and subsequently off line also.

20.4.5 The system and tachometer or optical encoder used shall have the facility to sense the direction of movement of the trolley i.e. if the trolley starts moving in reverse direction the system shall stop the recording and shall resume it at the point from where the trolley had started movement in reverse direction.

20.4.6 The system shall have the provision for checking and calibration of tachometer. The accuracy of distance measured shall be within ± 10 cm.

20.4.7 The system shall have diagnostic module to pin point the problem area of the system, along with suggested remedial measure.

20.4.8 The system shall be provided with an option to extract data from the recorded data files without longitude and latitude.

20.4.9 The system shall have facility to print the stored route feature files along with description of route feature both in desired formats detailed in the specifications.

20.4.10 A Global Positioning System (GPS) receiver shall be integrated with the hardware design to get the latitude and longitude at every ground feature and at distance defined by operator in set up.

20.4.11 The accuracy of GPS receiver shall be as follows:

   i) Horizontal (CEP) ≤ 3 m or better

   ii) RMS (2σ) ≤ 5 m or better

20.5 Image Acquisition System to collect and display top of rail (rail head) Images

20.5.1 This system captures blur free images in real-time of the rail surface with sufficient resolution to detail pitting and surface cracking on the top of rail surface.

20.5.2 System operation should be flexible to permit operators to control the update rate to monitor and to freeze and store images of the top of rail surface at any time, day or night.

20.5.3 The system should be designed for easy installation/removal on the Rail bound vehicle being provided by Indian Railways.

20.5.4 The system should utilize the stored light source unit to illuminate the rail head and a high resolution CCD digital camera to capture the rail head images.

20.5.5 Internal temperature and moisture controls should allow the system to be used in a wide range of climates. Onboard health monitoring should ensure that the operator always knows that the System is operating at its peak efficiency. Broad parameters of the system are as under:

   Camera Resolution: Min 2MP

   Sampling Rate: Up to 30 Hz

   Operating Speed: Up to (50 km/h)

   Environmental Range: -5°C to 55°C

20.5.6 The system should have facility to synchronize the chainage in the field with respect to route data tape containing the information regarding TP along with their chainage. This will
facilitate recording during night. System should be able to detect ground target (fixed at a known location) & synchronize the distance with respect to the chainage of ground target.

20.5.7 System should be self diagnostic. It should display error codes pinpointing the exact hardware & software problem. Operator should be able to repair the system normally during the run with plug-in type of modular arrangement.

20.5.8 During field trial, a curve of approximately 1 Km length will be selected & real wear will be measured with this system at varying speeds and also by a hand held device. The accuracy of measurement of the system at each corresponding location should be verified by miniprof reading.

**20.6 TOOLS, INSTRUCTION MANUALS OF COMPONENTS AND ASSEMBLY**

20.6.1 Along with each set of rail profile inspection and analysis system a complete kit of tools required by the operator, in emergency and for normal working of the system should be supplied. Detailed instructions regarding the use of these tools should also be provided by the supplier.

20.6.2 Detailed operating manual maintenance and service manual shall be supplied in three copies along with rail profile inspection and analysis system. Manufacturer shall also supply circuit diagrams of electrical and electronic circuit and all other details which are needed for trouble-shooting. Literature on probable troubles and remedial action to be taken should also be supplied along with the system. Supplier shall also provide at the time of commissioning of this system the names of the manufacturers and technical features of all the components and assemblies which are procured for this system from other suppliers.

20.6.3 Details of software including source code, used in the rail profile inspection and analysis system should be supplied. Necessary training should also be imparted for the software so that any subsequent change specifically applicable to Indian Railways can be incorporated in future if need arises.

**20.7 Acceptance Tests**

The system after installation will be run in a block section. The data collected and analysis made will be verified by Indian Railways existing system of taking measurement. The result should be as per specification and should be to the satisfaction of inspecting official.

**21 RAIL PROFILE MEASURING EQUIPMENT (Miniprof)**

21.1 **Scope:**

This is a broad functional specification which covers the essential functional requirements and technical features of Rail Profile Measuring Equipment. Rail Profile Measuring Equipment is to be used to measure the rail profile before and after grinding of rail profile, by rail grinding machine. The rail profile measuring equipment will be termed as ‘The equipment’ in this specification for convenience. Each equipment shall be supplied with one good quality DSLR camera with min 14 MP resolutions for taking photograph of rail surface at the location of measurement.
21.2 Functional Requirements:

21.2.1 The equipment (including its fixtures) shall be light weight (preferably less than 2 Kilograms), portable, hand held type & easy to fix on rail. Weight of PDA, Laptop and carrying/protection case shall be counted separately, however complete package shall not weigh more than 10 kilograms.

21.2.2 To measure the profile the equipment should be in direct contact (preferably with a magnetic contact so as to be in close touch) with the rail surface and should be capable of measuring with consistent accuracy all over the rail head profile.

21.2.3 The equipment should be capable of measuring the cross section of the rail profile w.r.t. the parameters of new rail profile, grinded rail profile, target rail profile or any other profile, fed into the system software. It should be possible to feed different computer generated profiles in the systems software for measurement and comparison purposes.

21.2.4 The equipment should be capable of measuring rail profile before & after grinding and quality control of new rails/grinded rails. The related software shall have the facility of measurement of profiles, calculation of standard wear parameters, graphical manipulation of profiles, comparison of profiles and references, estimation of trends of wear, extraction of results to text or excel format, exporting profiles to a variety of formats, printing profiles and results, database for organizing measurements, in addition it shall be possible to calculate the area difference between two different rail profiles. Complete details are required in English language only.

21.2.5 The measurement of rail profile shall be for the head portion of the rail. The equipment shall be micro-processor based having the interface with the personal computer/laptop/PDA through USB cables or similar arrangement. The equipment & PDA/laptop shall be delivered with a protection case that makes it water and shock resistant.

21.2.6 While measuring the rail profile in the field the recorded profiles shall be viewed, measured & stored in a palm top device PDA. These profiles can be further transferred in the office in a compatible laptop for better analysis and storage of data. Supply of one set of equipment shall mean supply of Rail profile measuring equipment along with (all standard fixtures including the devices necessary to keep the instrument truly perpendicular with the rail), palmtop (PDA) device, one laptop with compatible Windows software preloaded (minimum Windows vista or later versions of Windows), and related profile storage, viewer and analysis software. The license of the profile analysis software should be generic in nature so that it can be installed and run in any number of computers.

21.2.7 The equipment shall measure the rail profile and log the recorded data with time imprint (it shall be possible to know the date & time of all recordings).

21.2.8 The equipment shall be electrically powered by good quality re-chargeable battery easily available in market. The equipment shall be delivered in shock and rain water resistant protection case.

21.2.9 The measuring system shall have the output data in graphical mode with numerical display of the linear deviations of the recorded profile from a standard or any predefined rail profile.

21.2.10 The logged data of the equipment shall be transferable to any PC/Laptop by suitable means i.e., removable type data disc (VCD or DVD)/USB flash drives (commonly known as
pen drives) or any data transfer module etc. Any numerical display shall be through MS Excel or text files.

21.2.11 There shall be suitable arrangement (display of signals) to indicate the failure of the recording and/or data logging system during the course of recording.

21.2.12 The equipment shall have visual display unit to see the measured profile of the rail at any instant.

21.2.13 The output of the equipment shall be compatible with input of RGM. The output shall be generic in nature so as to plot the X-Y co-ordinates of the recorded rail profiles on established drawing software.

21.2.14 The equipment shall be capable of giving output which is compatible with the data requirement of reputed Rail Grinding Machines running in the world i.e., LORAM, HORSCO, SPENO etc.

21.2.15 Only such makes/brands of equipment are acceptable, which have been in use in the world successfully for rail grinding studies in last five years. The manufacturer should enclose necessary certificate in this regard.

21.3 Technical Features:

<table>
<thead>
<tr>
<th></th>
<th>Power source</th>
<th>Enclosed Re-chargeable battery along with charger</th>
</tr>
</thead>
<tbody>
<tr>
<td>II. Battery back-up for the instrument</td>
<td>Minimum 80 hours in recording mode and 100 hrs. in standby mode.</td>
<td></td>
</tr>
<tr>
<td>III. Battery back-up for PDA</td>
<td>Min 10 hrs</td>
<td></td>
</tr>
<tr>
<td>IV. Output data</td>
<td>In the field on a palm top device, this can be transferred to a laptop/computer in the office. The visual display should possible in LCD/TFT screen. In printable format on A4 size paper</td>
<td></td>
</tr>
<tr>
<td>a) Visual Display</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Printable Data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>V. Measuring Parameters</td>
<td>a) Profile of entire head in graphical mode on x-y axes with deviation in linear measurement in mm. b) %age loss of cross-sectional area of head c) Deviation from wear limit in vertical, lateral (at top/gauge/non-gauge face) and angular at gauge corner.</td>
<td></td>
</tr>
<tr>
<td>VI. Logical interpretation</td>
<td>To show whether within or outside the condemnation limit.</td>
<td></td>
</tr>
<tr>
<td>VII. Accuracy to be better than</td>
<td>± 0.010 mm</td>
<td></td>
</tr>
<tr>
<td>VIII. Repeatability to be better than</td>
<td>± 0.005 mm</td>
<td></td>
</tr>
<tr>
<td>IX. Atmospheric Condition</td>
<td>a) Atmospheric temperature of -5°C to 55°C and rail temperature from 0°C to 76°C. b) Relative humidity up to 90% c) Extremely dusty condition.</td>
<td></td>
</tr>
<tr>
<td>X. Scanning time</td>
<td>Less than 10 seconds</td>
<td></td>
</tr>
<tr>
<td>XI. Size of each profile on a computer</td>
<td>Less than 100 kb</td>
<td></td>
</tr>
</tbody>
</table>
21.4 The technical specifications have been drafted to reflect the performance and quality requirement of the equipment in a neutral manner without bias to any specific manufacturer. Bidders are requested to carefully study the specification and assure that their equipment fully complies with these specifications. Thereafter if a bidder feels that his equipment 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.

21.5 **DIGITAL CAMERA**

Minimum specification of Digital SLR Camera shall be:

i) Gross Pixel 14 mega pixels or more

ii) Optical Zoom More than 15 X

iii) Digital Zoom More than 30X

iv) Video Recording Minimum 10 minutes

v) Play back Zoom Yes

vi) LCD 7cm. or more

vii) Battery life 350 shots with single full charge or more than 3 hours

viii) Battery Lithium ION battery rechargeable

ix) Internal memory/ 10MB or more/

x) External memory capable to support Memory card of 8GB or more

xi) USB Hi speed

xii) HDMI output Should be available

xiii) Flash range 5M minimum

xiv) Red Eye Reduction Yes

xv) Double Anti Blur Yes

xvi) Weight Approx - 500gm.

22.0 **Spare Parts:**

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

22.2 The manufacturer shall be responsible for the subsequent availability of spare parts to ensure trouble free service for the life of the system (15 years).
22.3 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 system for inspection.

22.4 Recommended spare parts/assemblies for maintenance and operation of the machine for 4 years shall be supplied by the tendered. The same will be listed as:
   a. Spares covered under warranty
   b. Spares not covered under warranty which would be further divided in sub groups as essential spares, recommended spares and consumable spares.

23.0 TRAINING

23.1 Adequate training in operations, calibration, software overview, real time & post run operation should be imparted free of cost to four I.R officials for a period of 4 weeks. Training should be arranged in the manufacturing plant and on a Railway which is already using the system with Rail Head Profile Inspection and Analysis System. All travel, boarding & lodging expenses will be borne by the Indian Railways.

23.2 During commissioning of the system in India, four Indian Railways staff/operator would be trained in operation and maintenance of the system for a period of three weeks by the technical staff of the supplier.

23.3 12 personal will be given training for a period of one month each to be arranged by the supplier at their cost in their manufacturing plant and/or affiliated institute/training centre in the rail grinding technology with a view to establish efficient rail grinding management system on Indian Railways. All travel, boarding & lodging expenses will be borne by the Indian Railways.

24.0 WARRANTY MAINTENANCE CONTRACT:

The machine shall be warranted for 24 months from the date of commissioning and proving test of equipment at ultimate destination in India. Operation and maintenance of the supplied machine and system during this warranty period will be done by the supplier. In addition to the warranty and spare parts obligations covered under various clauses of the tender documents, the renderer shall comply the followings.

24.1 POST-WARRANTY MAINTENANCE CONTRACT:

24.1.1 The supplier shall quote for a maintenance contract to be operated by the Zonal Railways, for 2 (two) years period after the expiry of the warranty period.
   
   (a) Machine availability of minimum 25 (twenty five) days in a month.
   (b) Availability of spares excluding, fuel, lubricants and oils, based on a price-list to be a part of the maintenance contract, to ensure the machine availability mentioned at (a) above.

24.1.2 The supplier shall quote a monthly rate for the maintenance contract, to ensure the grinding stone and spares supply and keep the machine availability for minimum 25 (twenty five) days in the month. Any fall in machine availability below 25 (twenty five) days in a month shall result in no payment for the particular calendar month.
24.1.3 The maintenance contract after warranty period would include the maintenance of all systems/sub-assemblies provided on the machine including maintenance support system for hardware and software provided for the operation of machine (sub-assembly wise break-up of rates shall also be given including that for the engines(s)).
### Annexure III

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

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>Component’s Name</th>
<th>Parameters required</th>
<th>C.G. of component in x, y, z direction from rail level in mm (Referenced point 1st axle)</th>
<th>Mass in Kg and Mass moment of inertias in Kg·m^2 of component in three dimension space about their C.G</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Super structure with vehicle frame (machine structure kept on secondary suspension of front and rear bogie)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Front Bogie frame including brake rigging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Rear Bogie frame including brake rigging</td>
<td></td>
<td></td>
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<tr>
<td>4.</td>
<td>Transmission system device (hydraulic, Mechanical or electrical traction motors)</td>
<td></td>
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<tr>
<td>5.</td>
<td>Wheel axle set including axle boxes which constitute the unsprung mass</td>
<td></td>
<td></td>
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<tr>
<td>6.</td>
<td>Mass of Items included in unsprung mass partially or fully along with their name per axle</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>7.</td>
<td>Total weight of components in</td>
<td></td>
<td>Front bogie</td>
<td>Rear bogie</td>
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<tr>
<td></td>
<td>tonnes</td>
<td></td>
<td></td>
<td>full structure (front bogie + rear bogie + vehicle car body or super structure)</td>
</tr>
<tr>
<td>8.</td>
<td>Suspension stiffness details in Kg/mm</td>
<td>Primary suspension element stiffness per axle box between bogie and axle box</td>
<td>Secondary suspension element stiffness per side between bogie and machine frame</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vertical stiff</td>
<td>Lateral stiff</td>
<td>Longitudinal stiff</td>
</tr>
<tr>
<td>9.</td>
<td>Damping force details (If hydraulic damper used give there rating force per meter/second)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Clearance in mm or radian provided for motion between bogie frame and machine frame for relative motion (motion stopper)</td>
<td>Vertical direction</td>
<td>Lateral direction</td>
<td>Longitudinal direction</td>
</tr>
<tr>
<td>11.</td>
<td>Dimension of location of suspension elements</td>
<td>Detail of location of suspension springs and dampers and shock absorbers with support drawing</td>
<td>Detail of location of suspension springs and dampers and shock absorbers with support drawing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Details of centre pivot arrangement working and location</td>
<td>Provide detail arrangement drawing and description</td>
<td></td>
<td></td>
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<tr>
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<td>--------------------------------------------------------</td>
<td>--------------------------------------------------</td>
<td></td>
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</tr>
<tr>
<td>13.</td>
<td>Set of drawings and design description</td>
<td>Concerning with general arrangement of vehicle, bogie general arrangement, suspension arrangement details, suspension clearances drawing, detail written description of configuration and loading pattern accompanies design particular of vehicle bogie.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PROFIL
WORN WHEEL

NOTE:

PROCEDURE OF DRAWING:

1. Draw a vertical line at a distance of 20 mm from the flange end.
2. Draw a line perpendicular to 100.
3. Draw a circle of radius 14 mm tangent to.
4. Draw a horizontal line at 25 mm.
5. Draw a line parallel to the radius of the flange and tangent to.
6. Draw a line perpendicular to 100.
7. Draw a horizontal line at 25 mm.
8. Draw a circle of radius 14 mm tangent to.
9. Draw a line parallel to the radius of the flange and tangent to.
10. Draw a line perpendicular to 100.
11. Draw a vertical line at a distance of 20 mm from the flange end.

DIMENSION 22.7 DELTED 9/96
CO-ORIGINATE OF POINTS A & C
REFERENCE A & B
MEASURED DA, EXCEPT
OF 28.75 mm.

ANNEXURE IV
INSPECTION CERTIFICATE

CERTIFICATE OF INSPECTION OF TRACK MACHINE ( ) BY INSPECTING OFFICIAL AND APPROVAL FOR DESPATCH OF MACHINES (STRIKE OUT WHICHERVER NOT APPLICABLE)

This is to certify that I have inspected the machine (type)_____________________________ bearing Sl.No._________________ from (date) _____________to _____________at (Place) _____________ for its conformity/non-conformity with respect to the laid down Technical Specifications in contract Agreement No.__________________________ dated_______________________ between President of India through Director Track (Machines) and M/s. (Name of Supplier) __________________________________________________________________

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

- The Machine conforms to all the laid down specifications.
- The machine conforms to all the laid down specifications except those at Sl.No.________________________.
- The above deviations are minor/major affecting/not affecting the performance of the equipment in substantial way.

The following T and P/manuals/drawings are to be supplied alongwith the machine:

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 despatch to _____________ ____________________ (Consignee) Indian Railway.

SIGNATURE AND DATE

For M/s. __________________________
OFFICIAL __________________________
DESIGNATION __________________________

INSPECTING

(NAME AND

for and on Behalf of President of India)
Particulars Required in Respect of the Rolling Stock Under Consideration

A diagram showing elevation salient dimensions:

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

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

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

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

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

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

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

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

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

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

   at working axle : 
   at transfer axle : 

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

<table>
<thead>
<tr>
<th>S.no</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>a) Brake System details</td>
</tr>
<tr>
<td></td>
<td>b) Gross Braking Ratio</td>
</tr>
<tr>
<td>2.</td>
<td>Brake rigging arrangement drawing and calculation of braking force</td>
</tr>
<tr>
<td>3.</td>
<td>Maximum Braking Effort. at start and at the speed of operation -</td>
</tr>
<tr>
<td></td>
<td>a) at working drive at start :</td>
</tr>
<tr>
<td></td>
<td>at operation speed :</td>
</tr>
<tr>
<td></td>
<td>b) at transfer drive at start :</td>
</tr>
<tr>
<td></td>
<td>at maximum speed :</td>
</tr>
<tr>
<td>4.</td>
<td>Characteristics of springs used in suspension indicating free height, working height, dynamic range, stiffness and locations etc.</td>
</tr>
<tr>
<td>5.</td>
<td>Characteristics of the dampers if used, and over all damping factors and locations of dampers.</td>
</tr>
<tr>
<td></td>
<td>Calculation of the following frequency of the vehicle to be attached :-</td>
</tr>
<tr>
<td></td>
<td>Bouncing ii) Pitching iii) Rolling</td>
</tr>
<tr>
<td></td>
<td>Wave length of free axle and bogie</td>
</tr>
<tr>
<td>6.</td>
<td>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.</td>
</tr>
<tr>
<td>7.</td>
<td>What are lateral clearance of axle box / horn, wheel flange/rail and other locations for the negotiability of the vehicle on curve and turn out (enclose Vogels Diagram for negotiability on maximum degree of curve and turn out permitted on Indian Railways) of new and worn out wheel.</td>
</tr>
<tr>
<td>8.</td>
<td>Wheel and axle assembly drawings</td>
</tr>
<tr>
<td>9.</td>
<td>Calculation for flange force</td>
</tr>
<tr>
<td>11.</td>
<td>Calculation of natural frequency</td>
</tr>
<tr>
<td>12.</td>
<td>Calculation of spring characteristics and critical speed of the vehicle.</td>
</tr>
<tr>
<td>13.</td>
<td>Simulation result showing ride index, lateral force and acceleration results.</td>
</tr>
<tr>
<td>14.</td>
<td>A certificate regarding the speed of the vehicle for which it has been designed.</td>
</tr>
</tbody>
</table>
The speed potential of the machine offered by the firm should be established based upon oscillation trials conducted in India. The tests will be conducted at speed usually 10% higher than the maximum speed potential indicated by the firm for the machine under consideration and the following criteria satisfy for the same. For conducting the tests, a section of mainline track will be selected over which there is no temporary speed restrictions and which is considered by the Railway as being in a generally run down condition for mainline standards, but without speed restrictions. The vehicle will be tested generally for new and worn clearance conditions and where relevant for operation in the forward and backward directions. The vehicle selected for tests will be one in average condition for normal maintenance.

2. The criteria applicable for establishing speed potential will be as follows:

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

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

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

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