Draft 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 (hereafter 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.

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 metric SI (International) System of Units standards. Quality assurance during manufacturing of the machine shall be according to ISO-9001.
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 Railways straight, transitions and curved track up to 10° 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 operation requirements of IR. However, condonation of an infringement in another track machine in the past does not by itself entitle the manufacturer to assume acceptance of the same in other track machines by IR.

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. A preliminary check in this regard will be conducted at the stage of technical acceptance of offers. 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 2.4 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:

2.8.

<table>
<thead>
<tr>
<th>Maximum Axle load (tone)</th>
<th>Minimum wheel diameter (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.82</td>
<td>908</td>
</tr>
<tr>
<td>22.00</td>
<td>878</td>
</tr>
<tr>
<td>21.50</td>
<td>860</td>
</tr>
<tr>
<td>21.00</td>
<td>841</td>
</tr>
<tr>
<td>20.32</td>
<td>816</td>
</tr>
<tr>
<td>20.0</td>
<td>805</td>
</tr>
<tr>
<td>19.5</td>
<td>787</td>
</tr>
<tr>
<td>19.0</td>
<td>768</td>
</tr>
<tr>
<td>18.5</td>
<td>750</td>
</tr>
<tr>
<td>18.0</td>
<td>732</td>
</tr>
<tr>
<td>17.5</td>
<td>713</td>
</tr>
<tr>
<td>17.42</td>
<td>710</td>
</tr>
<tr>
<td>17.0</td>
<td>700</td>
</tr>
</tbody>
</table>

Permitted worn out wheel diameter should be specified by the manufacturer. The diameter of wheel for assessment of permitted axle load will be the worn out wheel diameter. The new wheel profile shall be as per Indian Railway standard wheel profile provided in Annexure-V.

2.9. 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.

2.10. 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 to 1800 m
- Humidity: 20% to 100%
- Maximum rail temperature: 70°C

2.11. 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.

2.12. The machines shall be capable of working without requiring power block in electrified sections. 25 KV power 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).

2.13. 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.

2.14. 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.

2.15. 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 modules (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. Each individual module should have a fully adjustable angle range of +70 degrees to gauge to -20 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 shall contain 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 module. Grouping of two or more each modules is not allowed.

3.13. 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 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 18 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, from 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>18</td>
<td>0.213</td>
</tr>
<tr>
<td>15</td>
<td>0.2520</td>
</tr>
</tbody>
</table>

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.

3.27.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

3.27.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 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.

3.27. 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. The rail grinding machine shall be equipped with line recorder to enable the depth of irregularities to be recorded before and after grinding operations.
3.30. 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, no 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.

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

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

3.33. 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.

3.34. The rail grinding machine shall be equipped with Rail Grinding templates for Board Gauge (1676 mm), with 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.

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

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

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

3.38. 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.

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

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

3.41. 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.

3.42. The grinding motors shall be controlled through suitable starter control for starting/stopping of motor.
3.43. Grinding patterns must be balanced and not changed with curve elevation of the track on which the rail grinding machine is operating. 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.

3.44. 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.

3.45. 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.

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

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

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

3.49. 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.

3.50. 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 12.1 shall not be obstructed on this account.

3.51. The rail grinding machine shall be equipped with two water cannons (one in front and another in rear with) of capacity up to 600 1200 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.

3.52. 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.

3.53. 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 machine mechanism as well as rear of the rail grinding machine mechanism.

a. The profile measurement system should be able to capture rail profile both ahead of and behind the grinding machine at speed up to maximum grind speed (i.e. 18 kmph) 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) Speed at which to grind.

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 after commissioning of the rail grinding 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.

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. 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 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. 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 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 shut down circuit in case of operator’s failure to respond.

4.11. 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.

4.12. 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.

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

5. 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. REST VANS:

6.1. 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.

6.2. 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.

6.3. 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.

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

6.5. 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.
7. **BRAKES:**

7.1. The machines shall be fitted with the Compressed air brakes system applying brakes equally on all wheels.

7.2. 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.

7.3. 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.

7.4. 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.

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

7.6. 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. **SAFETY MECHANISM:**

8.1. The Machines 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 by means of push buttons provided in the cabs.

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

8.3. 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.

8.4. 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.
8.5. 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.

8.6. 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.

8.7. 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.

9. **HOOKS AND BUFFERS:**

9.1. The machines shall be fitted with transition CBC coupling and buffers of IR design on both the ends for coupling it with other vehicles for running it in train formation. Attachment with IR standard locomotives, wagons & coaches should be possible.

10. **ELECTRIC EQUIPMENT AND LIGHTING:**

10.1. 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. The flasher lights at both ends shall be provided on the machine to give indication to the train arriving on other line.

11. **CHASSIS AND UNDERFRAME:**

11.1. The chassis of machines 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 102t at buffers i.e. 51t at each buffering point without any permanent distortion. The under frame shall be sufficiently robust for safe travel of the machine in train formation and not necessarily as last vehicle.

12. **CABINS:**

12.1. 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.

12.2. 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.
12.3. The operator’s cabin shall be ergonomically designed to have easy access to all controls.

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

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

12.6. 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.

12.7. 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. **TOOLS AND INSTRUCTION MANUALS:**

13.1. Each machine shall be supplied with a complete kit of tools required by the operator in emergency and for normal working of the 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 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.

13.2. 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.

13.3. The manufacturer shall also supply circuit diagrams of electrical hydraulic, pneumatic and electronic circuits used on the machine. Trouble shooting diagram/table shall also be supplied. In addition, the supplier 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.

13.4. Documents 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.

13.5. 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.
13.6. 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.

13.7. 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

14. SPARE PARTS:

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

14.2. 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)

14.3. 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.

15. MAKER’S TEST CERTIFICATE:

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

16. 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.

17. 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.

18. INSPECTION:

18.1. 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.

18.2. 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.

18.3. 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 13, 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:

<table>
<thead>
<tr>
<th>Clause No.</th>
<th>Clause</th>
<th>Comments of Supplier/manufacturer</th>
<th>Comments of Inspecting Officer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>(To be filled by inspecting officer)</td>
</tr>
</tbody>
</table>

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 annexures mentioned at para 18.5.

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.

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

These above documents shall be part of final inspection report

19. **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.

20. **MARKING & COLOUR:**

20.1. 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.

20.2. Following should be written on the machine at appropriate location

(i) India Railways logo of height between 300 mm to 600 mm as suitable on all four faces of the machine.

(ii) On both side faces, 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.

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

21.1. **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 passes. 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 for both left and right rail separately shall be more than that specified in clause 3.16.

H. For the purpose of depth of metal removal capability of the machine (clause 3.17), 5 sites of minimum 500m each shall be selected for carrying out tests at the speeds mentioned in clause 3.17. 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. 22.1/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 3.17 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 3.21.

22. 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.
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.

   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. 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.

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. 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 will be at suppliers cost and nothing extra shall be paid for the same. The cost of boarding, loading and air fare of IR personnel shall be borne by the purchaser and should not be included in tenderer’s quote.
PROCEDURE OF DRAWING:

1. Draw a vertical line at a distance of 20mm from the profile end.
2. Draw line X-Y tangentially to profile.
3. Draw line X to Y parallel to X and Y.
4. Draw a horizontal line at 20.5mm from the top of the profile and extend it to X.
5. Draw a horizontal line at 20.5mm from the top of the profile and extend it to Y.
6. Draw a line at an angle of 90° from the line X to Y and extend it to P.
7. Draw a line at an angle of 90° from the line X to Y and extend it to Q.
8. Draw a line at an angle of 90° from the line X to Y and extend it to R.
9. Draw a line at an angle of 90° from the line X to Y and extend it to S.
10. Draw a line at an angle of 90° from the line X to Y and extend it to T.

NOTE:
- Coordinate of Points B & C
- CO-ORDINATES OF POINTS B & C
- SCALE 1:1
- ABE BASED ON NOMINAL DIMENSION
- CO-ORDINATES OF POINTS B & C
- SUPERFICIAL GT.
INSPECTION CERTIFICATE
CERTIFICATE OF INSPECTION OF TRACK MACHINE(                           )
BY INSPECTING OFFICIAL AND APPROVAL FOR DESPATCH OF MACHINES

(STRIKE OUT WHICHEVER NOT APPLICABLE)

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

The detailed inspection Note regarding its conformity/non-conformity to the laid
specifications is enclosed along with 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
  SI.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 despatch to ________________
(consignee) Indian Railway.

______________________________________________
SIGNATURE AND DATE

For M/s _____________   INSPECTION OFFICIAL
_________________________   (NAME AND DESIGNATION)
for and on behalf of President of India  P
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).
Following information as detailed below is also required along with the information required as per Annexure ‘A’ for processing the case for issue of provisional speed certificate for new vehicle.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. a)</td>
<td>Brake System details</td>
</tr>
<tr>
<td>1. b)</td>
<td>Gross Braking Ratio</td>
</tr>
<tr>
<td>2.</td>
<td>Brake rigging arrangement drawing and calculation of braking force</td>
</tr>
</tbody>
</table>
| 3. | Maximum Braking Effort. at start and at the speed of operation -  
   a) at working drive at start  
   b) at transfer drive at start  
   c) at operation speed  
   d) 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 |
| 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

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>Component’s Name</th>
<th>Parameters required</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>C.G. of component in x, y, z direction from rail level in mm (Referenced point 1st axle)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>1.</td>
<td>Super structure with vehicle frame (machine structure kept on secondary suspension of front and rear bogie)</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Front Bogie frame including brake rigging</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Rear Bogie frame including brake rigging</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Transmission system device (hydraulic, Mechanical or electrical traction motors)</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Wheel axle set including axle boxes which constitute the unsprung mass</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Mass of Items included in unsprung mass partially or fully along with their name per axle</td>
<td>1</td>
</tr>
<tr>
<td>7.</td>
<td>Total weight of</td>
<td>Front bogie</td>
</tr>
<tr>
<td>Components in tonnes</td>
<td>Full assembly</td>
<td>Full assembly</td>
</tr>
<tr>
<td>----------------------</td>
<td>---------------</td>
<td>---------------</td>
</tr>
<tr>
<td>8. 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>
</tr>
<tr>
<td></td>
<td>Vertical stiff</td>
<td>Lateral stiff</td>
</tr>
<tr>
<td>9. Damping force details</td>
<td>(If hydraulic damper used give there rating force per meter/second)</td>
<td></td>
</tr>
<tr>
<td>10. 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>
</tr>
<tr>
<td>11. Dimension of location of suspension elements</td>
<td>Detail of location of suspension springs and dampers and shock absorbers with support drawing</td>
<td></td>
</tr>
<tr>
<td>12. Details of centre pivot arrangement working and location</td>
<td>Provide detail arrangement drawing and description</td>
<td></td>
</tr>
<tr>
<td>13. 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>
</tr>
</tbody>
</table>
Annexure-IX

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.