

Final Draft Specification of Rail Inspection Vehicle (RIV)
Based on Reasoned Documents

1. General

- 1.1. These specifications provide the technical requirements for the manufacture, supply, testing, commissioning of a self-propelled vehicle borne Rail Head Inspection and Analysis System(hereafter referred as RIV) for use on the tracks of Indian Railways. The self propelled Rail Inspection Vehicle (RIV) will be installed with Rail Head Profile Inspection & Analysis System to facilitate advance digital inspection of rails for selection of an optimum rail grinding program. The supplier shall furnish, deliver, warrant and maintain the RIV 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 model of the Vehicle offered should be specified and a detailed Clause by Clause; Technical Description of the same should be furnished. System/sub-systems of the working mechanisms of the RIV as per para'3' in particular (regarding Working Mechanism of RIV) 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 RIV (model) offered.
- 1.4. Photographs and video (in compact disc//Pen drive) of the type of vehicle 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 RIV 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 vehicle shall be according to ISO-9001 & ISO-3834.
- 2.2. The RIV 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 and continuous gradients (more than 1 Km) up to 3% on broad gauge (1676 mm).

- 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-I**. The tenderer shall provide sketches of the vehicle 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-V A, B & C** and decision of IR/RDSO shall be final in this regards.
- 2.7. The Vehicle shall have a desirable wheel diameter of 914mm or more (new wheel profile). However, lesser diameter up to 760 mm (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 provided the rail wheel contact stresses for 72 UTS rails are within permissible limits. The new wheel shall have a minimum wear margin of 50mm before reaching condemnation limit. Forged wheels to Indian Railways profile shall be provided on the machine. The worn out wheel diameter (condemning worn out diameter) based on the criteria of rail wheel contact stresses for various maximum axle loads are as under:

Maximum Axle load (tone)	Minimum worn out wheel diameter (mm)
22.82	908
22.00	878
21.50	860
21.00	841
20.32	816
20.0	805
19.5	787
19.0	768
18.5	750
18.0	732
17.5	713
17.42	710
17.0	700

Permitted worn out wheel diameter should be specified by the manufacturer. The diameter of wheel for assessment of permitted axle load will be the worn out wheel diameter. The new wheel profile shall be as per Indian Railway standard wheel profile provided in **Annexure-II** which is titled as **“WORN WHEEL PROFILE”**.

- 2.8. The vehicle 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 40kmph.
- 2.9. The vehicle 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
- 2.10. The Rail Inspection Vehicle 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 vehicle in both directions at the same speed. Since the vehicles 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 vehicle without much break down/failure.
- 2.11. The RIV shall be capable of working without requiring power block in electrified sections. 25 KVA power is used for traction through an overhead wire at 5.5 m above rail level. On bridges and tunnels, the height is restricted to 4.8 m. RIV's accuracy of measurement shall not be affected in any manner due to overhead electricity and also due to track circuit voltage (12 V & 1 AMP).

- 2.12. The vehicle 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 vehicle shall be equipped with pneumatically operated brake system. However, supplier has to furnish complete detail of the braking system provided.
- 2.13. While working on double line sections, the vehicle 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.
- 2.14. In the work mode, no part of the machine should rise beyond 4.265 m. above rail level for safe working in the electrified sections.
- 2.15. To enhance the safety of Machine operation in continuous Ghat section and to restrict the speed of the machine going down the gradient to pre-determined maximum speed, the supplier has to provide 'Automatic Penalty Brake Application System' in the machine as per Instruction Bulletin no. MP.IB.EC. 01.02.2008 issued by RDSO.

3. WORKING MECHANISM OF RAIL INSPECTION VEHICLE

- 3.0 The RIV 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 required 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.

RIV's components 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.

- 3.1. The working mechanism of the system shall be equipped with:

- A- Optical Rail head Inspection & Analysis System based on LASER System.
- B- Image Acquisition System to collect and display top of rail (rail head) Images.
- C- Corrugation Analysis System that provides an Corrugation Quality Index of the rail

3.2. Optical Rail head Inspection & Analysis System based on Laser System

- 3.2.1. Rail head profile measuring system should be capable of measuring the head profile of rail with an accuracy of 0.15 mm or better and output format acceptable on Rail grinding machines (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.

- 3.2.2. 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 15 deg. on the field corner.
- 3.2.3. 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.
- 3.2.4. There should not be any need of manual calibration in case of change in the intensity of sunlight.
- 3.2.5. System should have in-built protection system to absorb voltage fluctuation and should work on 220V + 10%, 50 Hz AC supply. System should be contactless and it should be based on laser technology. System should be protected from all health hazards & comply with the relevant regulations in this regard.
- 3.2.6. CCD/High resolution and high speed CMOS cameras, laser source, transducers and all other parts of the system must be at least 102 mm above the running rails.
- 3.2.7. Arrangement for fixing the system should be such as to permit recording on level crossings, curves with check rails, even if with limited visibility. A drawing showing mounting arrangement of the system should be submitted along with the offer, along with details of the inspection being performed.
- 3.2.8. The profile measurement system in a real time basis should show the actual rail profile and difference between the measured profile and the selected predefined profile.
- 3.2.9. The system should save the captured rail profile data along with input location data such as KM post, curve-data.
- 3.2.10. 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 metal to be removed by grinding.
- 3.2.11. 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. The system should be able to communicate the pre and post grind analysis wirelessly to the Rail Grinder, in order to communicate the grinding program developed, as well as the post-grind feedback to the rail grinding machine.
- 3.2.12. 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 the associated metal removal curves, and the speed at which to grind.

- 3.2.13. 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.
- 3.2.14. 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.

3.3. **Image Acquisition System to collect and display top of rail (rail head) Images:**

- 3.3.1. This system should capture blur free images of the rail surface in real time, concurrent with rail profile with sufficient resolution to detail pitting and various surface defects on the top of rail surface.
- 3.3.2. 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.
- 3.3.3. The system should utilize its own light source unit to illuminate the rail head and a high resolution/high speed CCD/CMOS digital camera to capture the rail head images.
- 3.3.4. The system should be able to capture at least one snap of rail @ every 1 meter of track while moving at a speed of 50 KMPH speed.
- 3.3.5. 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 5MP
 - Sampling Rate: Up to 30 Hz
 - Operating Speed: Up to (50 km/h)
 - Environmental Range: -5°C to 55°C)
- 3.3.6. The system should utilize the same format as by existing RGMs so as to synchronize the data transfer along with their chainage.
- 3.3.7. 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.
- 3.3.8. Camera should have optical image stabilization feature and vibrations reduction along with continuous auto focus to achieve proper crisp images.

3.3.9. During the run, the dust and other particles may deposit on camera because of which the image quality may suffer. The image acquisition system should have self-cleaning system in order to have continuous recording.

4. DIESEL ENGINE:

4.1. The vehicle 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 on steep gradients.

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 RIV should be sufficient to record minimum 2000km of track. Tenderer should mention the fuel storage capacity and average fuel consumption of vehicle.

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 vehicle.

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. A suitable and rugged mechanism should be provided to start the prime mover at no load and gradual loading after the start of the prime mover. The engine power take off shall be coupled to the main gearbox through a flexible coupling. In order to adhere to pollution Control norms, the diesel engine should be electronically controlled emissionized engine with minimum compliance of tier 2stage.

5. DRIVE MACHENISM:

- 5.1. The RIV should be provided with an efficient traction drive system for traction during the operation.
- 5.2. The RIV's driving system shall be through hydro-dynamically/electrically coupled power/transmission arrangement capable of achieving full speeds in travel mode in both directions. However, the system should be so designed that all the driving wheels work in synchronization and there is no slippage/skidding of wheels during work/travel mode.
- 5.3. Suitable differential system may be provided between coupled wheels on the same bogie.
- 5.4. Suitable flow divider/throttle arrangement may be provided to equalize the tractive effort amongst different bogies. Adequate gauges shall be provided to indicate the power sharing among different driving bogies to prevent over stressing of any traction bogie or its component.
- 5.5. The tenderer shall provide the necessary technical details including diagrams to confirm the above requirement.
- 5.6. Adequate gauges and solenoid valves shall be provided near linkage assembly for indication, flow control and carrying out necessary adjustment in the field.
- 5.7. To the extent possible hydraulic and pneumatic components/assembly should be fixed at suitable location preferably on the side frame of the machine so as to avoid the need to go up for day to day maintenance.
- 5.8. The pneumatic circuit (if any) should be provided with air dryer for the smooth working of pneumatic components.

6. COOLING SYSTEM:

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

7. BRAKES:

- 7.1. The vehicle shall be fitted with the Compressed air brakes system applying brakes equally on all wheels.
- 7.2. The RIV 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, vehicle can be braked by the traction vehicle.
- 7.5. There should be provision of emergency brake application in the machine either travelling alone or coupled with the coach/wagons, in addition to the normal braking system of the machine, using the compressed air. The emergency braking distance (EBD) of the machine on the Indian Railway Track, at the maximum design speed on level track shall not be more than 600 m. Design calculations for the braking effort and EBD at the maximum design speed of the machine on level track & at falling grade of 1 in 33 should be provided by the supplier. Brake design details are to be submitted as per Annexure VD.
- 7.6. Clearly visible brake lights shall be provided at both the ends of the machine, which will be automatically operated when brake is applied and switched off when brake is released. This will be to alert the operator of machine following this machine when the machines are working in groups.

8. SAFETY MECHANISM:

- 8.1. The RIV shall be provided with electric horns/ hooters facing outwards at each end of the vehicle 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 RIV shall have arrangement for flasher lights at both ends.
- 8.3. Safety equipments like jacks, pullers, tinfoil and other such equipments specific to the RIV for restoring failed units of the machines during working, shall be provided on each vehicle. The tenderer should submit the list of safety equipments provided for RIV.
- 8.4. The RIV shall have a UV and Temperature based fire detection system that will alert the operator.

9. HOOKS AND BUFFERS:

- 9.1. The vehicle 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. 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 vehicle 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 buffing point without any permanent distortion. The under frame shall be sufficiently robust for safe travel of the machine in train formation and not necessarily as last vehicle.

12. CABINS:

- 12.1. The vehicle shall be equipped with fully enclosed air conditioned and pressurized cabins with safety glass window at both the ends. The noise level in the cabins should be less than 70 dB for operator's comfort. 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 the vehicles.
- 12.6. The vehicle 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 RIV at low level to ensure good visibility for the operator controlling working and driving of vehicle. Facility of driving the machine for travelling purpose shall be from both the cabins. All travelling and inspection/measurement controls shall be housed in the air-conditioned cabins.

13. TOOLS AND INSTRUCTION MANUALS:

- 13.1. Detailed operating manual, maintenance and service manual shall be specifically prepared in English Language and four copies of these shall be supplied with each RIV.
- 13.2. 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 (soft and hard copies both) of these shall be supplied with each RIV.
- 13.3. Documents (in English) (soft and hard copies both) to be supplied with the vehicle should be sent 3 months in advance of inspection of the first vehicle 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 vehicle.
- 13.4. The firm shall provide detailed technical drawings and specifications of wheels and axles used on the vehicles. The above details shall be provided in four sets with each RIV.
- 13.5. 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 vehicle. 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.
- 13.6. Each RIV 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, like hydraulic jacks (20 T capacity two no. and 3 T capacity two no.), Mechanical Jacks (15T capacity four no.) 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.

- 13.7. Each RIV should be supplied with following Equipment -
- 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 if applicable, and general replacement intervals of consumable items and other stock items.
- 14.2. The manufacturer shall be responsible for the subsequent availability of spare parts to ensure trouble free service for the life of the machine. (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 as available by the OEM 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:

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

17. OPTIONAL EQUIPMENT:

- 17.1. 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 systems elsewhere indicating the user Railway system.

18. INSPECTION:

- 18.1. While inspecting the vehicle before dispatch from the supplier's premises, the inspecting officer to be nominated by the purchaser shall verify the conformity of the vehicle systems 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 vehicles" as per **Annexure-III** 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 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 9, in English language, including operation, service and field maintenance manuals/instructions and complete electrical, hydraulic and pneumatic circuit diagrams, trouble shooting charts, component drawings/ description and other relevant technical details as a reference documents for the inspecting officer.
- ii. Cross section of the machine super imposed on IR maximum moving dimensions envelope shall be provided to IO in advance.
- iii. Clause by clause comments of the manufacturer to be sent to Inspecting Officer (IO) in advance for his review. Comments should state manufacturer's conformity of compliance of each of the requirement stated in each clause, elaborating where necessary the details/manner in which the requirement has been complied. The proforma of draft inspection report for the clause-wise comments is given below:

Clause No.	Clause	Comments of Supplier/manufacturer	Comments of Inspecting Officer (to be filled by inspecting officer)

- iv. Manufacturer's Internal Quality Inspection Report of the machine.
- v. Manufacturer's quality certificate and/or test reports for bought out assemblies/ sub-assemblies to be provided to IO, containing serial number wherever applicable.
- vi. Draft Inspection Report to be prepared by the manufacturer, containing all annexure mentioned at para 18.4.
- vii. Details of arrangements made for checking Maximum Moving Dimensions for his approval.

Supplier will incorporate amendments/further clarification in the above documents to the satisfaction of the Inspecting Officer keeping in view the Inspecting Officer's comments, if any.

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 vehicle as per specifications, the technical details as per **Annexure (V/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 V/A, B & C)** can also be asked for issue of provisional speed certificate for the vehicle.

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 and RIV 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) Indian Railways logo of height between 300 mm to 600 mm as suitable on all four faces of the machine. **(Annexure-VI)**
- (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. Dimensional test of the loading gauge, maximum moving dimensions, buffer heights, clearances etc.
- 21.2. Testing for negotiability of 10-degree curve and 1 in 8.5 turnouts.
- 21.3. Train running speed tests (light running) on the Indian Railway main line track in accordance with the procedure outlined at **Annexure –IV**.
- 21.4. Testing of construction and engineering of the machine.
- 21.5. Testing of power supply system, electrical fittings and air conditioning.
- 21.6. Testing of all monitors and accessories.
- 21.7. Testing of mounting brackets of optical rail head inspection and analysis system and image acquisition system and ensuring that there is no slippage.
- 21.8. Testing of signals coming from various systems and ensuring that they are noise free. If possible test it in rain/wet condition.
- 21.9. Perform the Jig verification test and calibrate the system
- 21.10. The system after installation and calibration will be run in a block section at designed speed. The images collected will be checked for image quality. The imaged should be blur-free and clear. Image storage ability and its recall on demand will also be tested. The result should be to the satisfaction of inspecting official.
- 21.11. A curve of approximately 1 Km length will be selected & five test locations will be marked spread over the curve. Rail profile and wear at three locations on rail head will be measured with this system, for both left and right rail on all five test locations under static conditions and also by a hand held contact based Rail profile measuring equipment/miniprof. The accuracy of measurement of the system at each corresponding location will be verified.

21.12. A section of approximately 5 to 10 km with multiple track features will be selected that is representative of the typical rail. The system will be run in this section and following tests will be performed-

21.12.1. **Repeatability of data and grind plan-** The system will be run in above selected section twice at the same speed, and in same conditions. The average of the absolute difference in estimated GQI (left and right calculated separately) over that section for the two grind plan shall be less than 7 points.

21.12.2. **Reproducibility of data and grind plan-** The system will be run in above selected section twice at the same speed, and in same conditions. The average of the absolute difference in estimated GQI (left and right calculated separately) over that section for the two grind plan shall be less than 7 points.

21.13. The machine will also be operated at suitable locations in working mode for continuous 5 hours to ensure the machine's continuous working capability.

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-VII**.

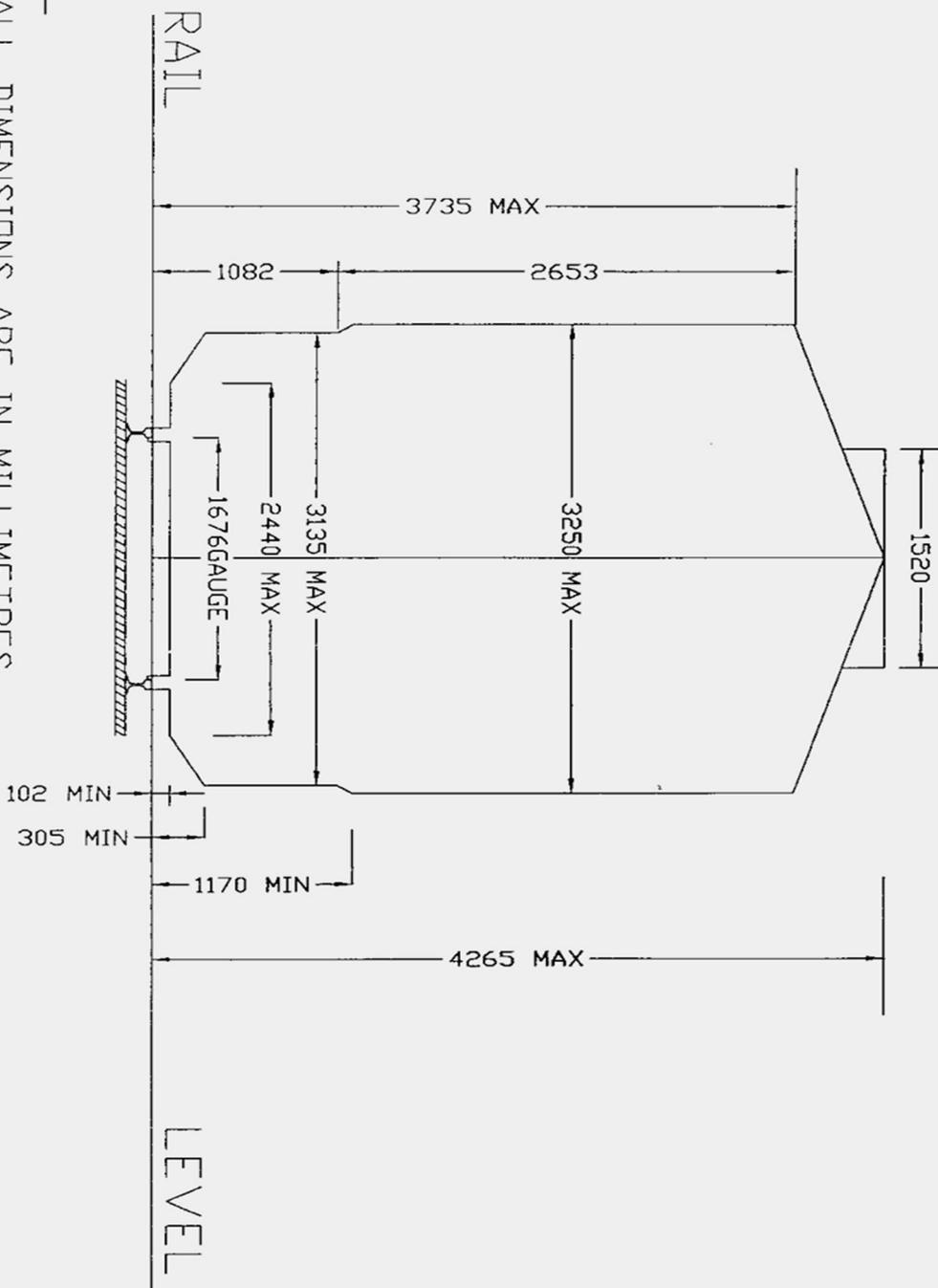
23.2. The tenderer will submit detailed program covering scope and coverage in detail, place and manner in which the training will be imparted so that a satisfactory level of knowledge and skill is developed by IR Personnel for satisfactory implementation of grinding program.

.....

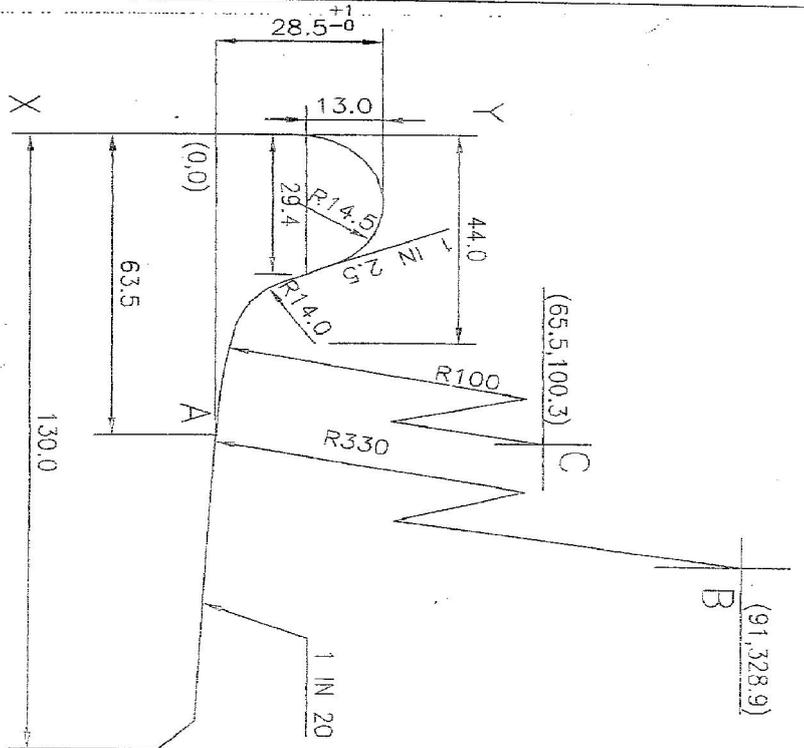
DIAGRAM No. 1D (EDD/T-2202)

1676mm GAUGE

MAXIMUM MOVING DIMENSIONS



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



(91,328.9)

PROCEDURE OF DRAWING

1. DRAW A VERTICAL LINE X-Y.
2. DRAW SEMI-CIRCLE OF 14.5R TANGENTIAL TO LINE X-Y.
3. DRAW LINE 1:2.5 TANGENTIALLY TO 14.5R SEMI-CIRCLE.
4. DRAW A HORIZONTAL LINE AT 28.5mm FROM THE TOP OF THE FLANGE, AND LOCATE Pt. 'A' AT 63.5mm FROM THE LINE X-Y.
5. FROM Pt. 'A' LOCATE CENTRE 'B' OF ARC OF 330R ON A VERTICAL LINE AT 91mm FROM X-Y.
6. DRAW ARC OF 330R FROM CENTRE 'B' LOCATE CENTRE 'C' ON VERTICAL LINE AT A HORIZONTAL DISTANCE OF 65.5mm FROM THE LINE X-Y SUCH THAT BC = (330-100) i.e. 230mm.
7. DRAW ARC OF 100R WITH CENTRE AS 'C'.
8. DRAW ARC OF RADIUS 14mm TANGENTIALLY TO 100R ARC AND LINE 1:2.5.
9. DRAW LINE 1:20 TANGENTIALLY TO 330R ARC.
10. DRAW A VERTICAL LINE AT A DISTANCE OF 30mm FROM THE FLANGE END.
11. DRAW A VERTICAL LINE AT A DISTANCE OF 30mm FROM THE FLANGE END.

NOTE:

CO-ORDINATES OF POINTS B & C ARE BASED ON NOMINAL DIMENSION OF 28.5mm.

SUPERSEDED BY:		SCALE		1:1	
SUPERSEDES:		P		C	
		D		G.V. RAJMAN	
		T			
		J.S.			
③	SS/24/04	DIMENSION 73.7 DELETED	9/04		
②	J.S. CD/3/94	REVISED & REDRAWN	3/94		
①	J.S. CD/7/92	CO-ORDINATES OF ARCS SHOWN	3/92		
ALT	AUTH.	DESCRIPTION	DATE	B. G.	R.D.S.O. (c)
WORN WHEEL PROFILE			GROUP	XXXX	SKETCH/1-91146

INSPECTION CERTIFICATE

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

(STRIKE OUT WHICHEVER NOT APPLICABLE)

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

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

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

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

1. _____
2. _____
3. _____

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

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

SIGNATURE AND DATE

For M/s _____

INSPECTION OFFICIAL
(NAME AND DESIGNATION)

For and on behalf of President of India

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 $1/20^{\text{th}}$ 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.

Particulars Required in Respect of the Rolling Stock Under Consideration

1. A diagram showing elevation salient dimensions :
Wheel spacing, Wheel diameter, bogie centers,
and axle load.
 - a)
 - i) Overall length of the vehicle :
 - ii) Length over head stock :
 - iii) Length over buffers :
 - iv) Distance apart for Centre of buffers :
 - v) Max./Min. height of centers of buffers above rail level :
 - b)
 - i) Wheel base :
 - ii) Axle load (max) :
 - iii) Bogie Centres :
2. Wheel dimension :
 - i) New :
 - ii) Worn out :
3.
 - i) Tread and flange profile of the wheel :
indicating clearly whether it is Indian
Railway standard profile or differs from
standard flange profile.
 - ii) Wheel gauge dimension – :
(back to back of tyre flange).
4. Whether the stock is designed to be used as :
a general purpose or in a closed circuit in
specified sections under defined conditions.
5. Maximum design speed
 - i) Own Power :
 - ii) In train formation :
6. Unsprung weight per axle in tonnes
 - i) Driving axle :
 - ii) Running axle :
7. Expected lateral force in tonnes per axle :
at maximum design speed.

8. Method of operation - :
 Whether single only or coupling together is possible. If coupling is possible, the number which can be coupled and what is trailing load.
9. Maximum tractive effort at start and at the speed of operation -
- i) at working drive at start :
 at operation speed :
- ii) at transfer drive at start :
 at maximum speed :
10. Maximum braking force coming on to the rails per wheel
- a) at working axle :
 b) at transfer axle :
11. Drawing indicating suspension arrangement details :
 of bogie and axle.
12. Height of centre of gravity from rail level :
13. Height of floor from rail level :
14. Type of coupler provided -Indian Railways Standard
- Coupling :
 Buffer :
15. Any infringement to the moving dimensions :
 Sketch provided in the Indian Railways Standard
 Schedule of Dimensions – Chapter IV (A).

Annexure: VB

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

S.No	Item
1. a)	Brake System details
b)	Gross Braking Ratio
2.	Brake rigging arrangement drawing and calculation of braking force
3.	Maximum Braking Effort. at start and at the speed of operation - a) at working drive at start : at operation speed : b) at transfer drive at start : at maximum speed :
4.	Characteristics of springs used in suspension indicating free height, working height, dynamic range, stiffness and locations etc.
5.	Characteristics of the dampers if used, and over all damping factors and locations of dampers. Calculation of the following frequency of the vehicle to be attached :- i) Bouncing ii) Pitching iii) Rolling Wave length of free axle and bogie
6.	Write up and salient design calculation on suspension system, type of suspension-whether it is of coil suspension with or without dampers and laminated bearing springs and double link suspension.
7.	What are lateral clearance of axle box / horn, wheel flange/rail and other locations for the negotiability of the vehicle on curve and turn out (enclose Vogels Diagram for negotiability on maximum degree of curve and turn out permitted on Indian Railways) of new and worn out wheel.
8.	Wheel and axle assembly drawings
9.	Calculation for flange force
10.	Technical specifications of Vehicle supplied.
11.	Calculation of natural frequency
12.	Calculation of spring characteristics and critical speed of the vehicle.
13.	Simulation result showing ride index, lateral force and acceleration results.
14.	A certificate regarding the speed of the vehicle for which it has been designed.

Annexure VC

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

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

7.	Total weight of components in tonnes	Front bogie full assembly	Rear bogie full assembly	Machine frame full structure	Full weight of vehicle (front bogie + rear bogie + vehicle car body or super structure)		
8.	Suspension stiffness details in Kg/mm	Primary suspension element stiffness per axle box between bogie and axle box			Secondary suspension element stiffness per side between bogie and machine frame		
		Vertical stiff	Lateral stiff	Longitudinal stiff	Vertical stiff	Lateral stiff	Longitudinal stiff
9.	Damping force details (If hydraulic damper used give there rating force per meter/second)						
10.	Clearance in mm or radian provided for motion between bogie frame and machine frame for relative motion (motion stopper)	Vertical direction	Lateral direction	Longitudinal direction	Rotation about vertical axis	Rotation about lateral axis	Rotation about longitudinal axis
11.	Dimension of location of suspension elements	Detail of location of suspension springs and dampers and shock absorbers with support drawing			Detail of location of suspension springs and dampers and shock absorbers with support drawing		
12.	Details of centre pivot arrangement working and location	Provide detail arrangement drawing and description					
13.	Set of drawings and design description	Concerning with general arrangement of vehicle, bogie general arrangement, suspension arrangement details, suspension clearances drawing, detail written description of configuration and loading pattern accompanies design particular of vehicle bogie.					

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

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



300 to 600 mm

INDIAN RAILWAYS

250 TO 600MM
in bold & black color

REGNO.---Maf. Yr -----.

200 mm in black color

Manufacturer's Name

200 mm

1.0 One 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, 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.

2.0 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 and RIV.
- 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 4 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 4 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.

3.0 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 4 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 4 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/refreshers.
- 3.3 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.
- 3.4 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.

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.