Functional Requirement Specification for High Output Tamping Machines Electric cum Diesel engine driven for B.G. (1676 mm).

1.0 GENERAL:

1.1. Due to increasing traffic on Indian Railways, more productive utilization of time period (Traffic Block) for working of track maintenance machines has become necessary. Therefore there is need for high output tamping machines so that shortest interval between the trains can be used for maintenance of track. Such high output tamping machines hereinafter called the machine are required to give substantially increased output economically and quantitatively. Indian Railways likely to become world's first net zero carbon emitter by 2030. To achieve this target, railway traffic and transport is becoming increasingly decarbonised. The entire Indian Railways network is being electrified for the same. A machine capable of fully electric transfer and work drive via overhead traction is need of the time.

1.2. The technical specification has been drafted to reflect the performance and quality requirements of the machine in a neutral manner without bias to any specific manufacturer. Bidders are requested to carefully study the specification and ensure that their machine fully comply with this specification. Thereafter, if a bidder feels that his machine can substantially meet the performance and quality requirements of the specification but does not fully satisfy a particular system specification, he should mention the same in the statement of deviations from the specification, giving the details as to how the functional requirement are going to be met with.

1.3. The bidder shall specify the make/model of the machine offered and furnish a detailed technical description of the same. Systems/sub-systems of the working mechanism of the machine as per clause 3.0 in particular and all the items of the specification in general shall be described in details in the "Technical Description" along with sketches to show the manner in which the requirements of the specifications are accomplished by the machine (model) offered.

1.4. Photographs of the type of machine/other similar type of on-track machines manufactured offered in working mode and technical literature shall be enclosed with the offer. The photographs shall also show close-ups of various working assemblies/systems and the full machine/other similar type of on-track machines. The tenderer shall also furnish a video in USB showing the working of machine/other similar type of on-track machines under field conditions. Tenderer shall also submit the names of countries & railways where the offered machine/other similar type of on-track machines are working and where their working at site can be visited by Indian Railway officials.

1.5. The bidder shall be entirely responsible for the execution of the contract strictly in accordance with the terms and conditions of the specification not withstanding any approval, which RDSO or the Inspecting Officer may have given:

- Of the detailed drawings prepared by the bidder.
- Of his sub- bidders for materials, components & sub-assemblies.
- Of other parts of the work involved in the contract.
- Of the tests carried out by the bidder/sub- bidder or RDSO or the inspecting officer.

2.0 DIMENSIONAL AND OPERATING REQUIREMENTS:

2.1. A machine shall be capable of fully electric transfer and work drive via overhead traction which shall be robust, of latest design, reliable with four or more axles and suitable for working on plain track, transitions and curved tracks (up to 10º) on the Broad Gauge (1676 mm) of Indian Railways. The machine shall also be diesel powered to use in situations like neutral zone, non-electrified section and in emergency. The diesel power shall be robust, of latest design and reliable with four or more axles and suitable for working on plain track, transitions and curved tracks (up to 10º) on the Broad Gauge (1676 mm) of Indian Railways. The design and dimensions of the machine and components shall be to metric standards and shall comply with provision of Indian Railways Schedule of Dimensions–1676 mm gauge (BG), revised, 2022 with latest and up to date corrigendum issued. Quality assurance during manufacturing shall be as per ISO-9001. The welding standard followed for manufacturing of machine should confirm to ISO:3834, EN:15085 or any other equivalent standard for welding railway vehicle and components. The manufacturer shall specify the standard followed and certify that it meets the welding standard mentioned above.

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

2.3. The profile of the machine (including its units) longitudinally and in cross section during transfer as self-propelled machine or towed in train formation as last vehicle shall be the with pantograph in lowered condition within Indian Railways Schedule of Dimensions–1676 mm gauge (BG), revised, 2022 incorporating all correction slips/amendments. The maximum moving dimensions (MMD) is enclosed in Annexure-I. The tenderer shall provide sketches of the machine in plan and elevation and shall give calculation along with Vogel's diagram to ensure that the machine does not cause infringement while moving on a 10° curve at any cross section.

2.4. In the past, Indian Railways have condoned certain infringements to the Indian Railways Schedule of Dimensions–1676 mm gauge (BG), revised, 2022 with latest and up to date corrigendum issued of such dimensions as rigid wheel base, length of stocks, distance apart of bogie centers 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 Indian Railways. 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 Indian Railways. Where an infringement to Indian Railways Schedule of Dimensions–1676 mm gauge (BG), revised, 2022 with latest and up to date corrigendum issued 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 Indian Railways, the condonation of the same may be permitted by Indian Railways. However, only those infringements which are acceptable shall be permitted.

2.5. Adequate clearance shall be allowed so that no component shall infringes the minimum clearance of 91 mm from rail level while travelling on track up to condemnation limit of wheel.

2.6. Axle load of the machine shall be less than 22.82 t with minimum axle spacing of 1800 mm. Load per metre shall not exceed 7.67 t. Stresses in the track and bridges shall be calculated by Indian Railways/RDSO based on design data submitted by the firm as per Annexure–VII and decision of Indian Railways/RDSO shall be final in this

regards.

2.7. The maximum and minimum permitted diameter of new wheel is 1092 mm and 740 mm respectively. However it shall have a desirable wheel diameter of 914 mm. Minimum permitted diameter of worn wheel is 710 mm. It is desirable that 50 mm margin between new and permitted worn wheel diameter shall be available, but this shall not be less than 30 mm.

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.

2.8. The new wheel profile in the machine shall be as per Indian Railway standard drawing attached as Annexure-III which is titled as “WORN WHEEL PROFILE”.

Note: Annexure-III “WORN WHEEL PROFILE” is currently standard new wheel profile of Indian Railways.

2.9. Wheels shall be conforming to Indian Railways Standard R-19/93 with latest revision or European Standard EN13262 with latest revision and design shall duly conform to European Standard EN 13979 with latest revision. The supplier shall mention the standard followed & shall submit certificate for detailed design calculation along with material parameters at the time of supply of the machine. However, in case of wheels sourced from already supplying Indian suppliers, 3rd party/RITES Inspection certificate of the wheels to be provided in lieu of design and material parameters certificate.

2.10. The non-powered axles shall be conforming to Indian Railways Standard R-16/95 with latest revision or European Standard EN 13261(EA1N) with latest revision. The supplier shall submit certificate for detailed design calculation along with material parameters at the time of supply of the machine. However, in case of non-powered axles sourced from already supplying Indian suppliers, 3rd party/RITES Inspection certificate of the non-powered axles to be provided in lieu of design and material parameters certificate.

2.11. The powered axles shall be conforming to Indian Railways Standard R-43/92 with latest revision or European Standard EN 13261 (EA4T) with latest revision. The design shall conform to 13103:1:2017 or latest. The supplier shall mention the standard followed& submit certificate for detailed design calculation along with material parameters at the time of supply of the machine. However, in case of powered axles sourced from already supplying Indian suppliers, 3rd party/RITES Inspection certificate of the non-powered axles to be provided in lieu of design and material parameters certificate.

2.12. The machine shall be capable of negotiating curves up to 10° curvature (175m radius), super elevation up to 185 mm, maximum cant deficiency 75 mm and gradients up to 3% (1 in 33) in travel mode. The supplier shall specify the minimum attainable speed under the above limiting conditions.

2.13. The machine 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	**:**	Up to 2250 m above mean sea level

Humidity	:	Up to 100%
Maximum rail temperature	:	76° C

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

2.14. During transfer from one station to another, it shall be capable of travelling on its own at a speed of 70 kmph and speed of 70 kmph when hauled in a train formation as last vehicle. Since the machines are likely to cover long distances on its own power, the travel drive system shall be robust to sustain these requirements during the life of the machine without significant break down/failure. The machine shall be capable of hauling a 8-wheeler coach/wagon (90 t approximately) at the specified speeds above and as per conditions specified in clause 2.12.

2.15. The machine shall be capable of working and travelling with electric power in electrified sections. On Indian Railways, 25 KV or 2X25 KV AC power is used for traction through an overhead wire at 5500 mm above rail level. On bridges and tunnels the height is restricted to 4800 mm.

2.16. The machine or its any part shall not infringe the adjoining track as per Indian Railways Schedule of Dimensions–1676 mm gauge (BG), revised, 2022 with latest and up to date corrigendum issued while opening and closing of work. During working on double/multiple line section, it shall not infringe the adjoining track and it shall be possible to permit trains at full speed on that track. Minimum spacing of track is 4265 mm centre to centre.

2.17. The machine shall be possible to drive the machine in both directions at the same speed.

2.18. All operations for work and travel shall be controlled from a spacious fully enclosed cabin permitting unobstructed view in both directions.

2.19. The design of the machine and the sub-systems and systems thereof shall comply with the following standards:

i)	Electric traction — rolling stock — test methods for electric and thermal/electric rolling stock on completion of construction and before entry into service	IEC 61133
ii)	Electronic equipment used on rail vehicles	IEC-61287
iii)	Specific rules concerning the electronic control part of converters	IEC-60571
iv)	Electronic converter fed alternating current motors	IEC 60349 -2
v)	Railway application—rolling stock — Part 1: combined testing of inverter fed alternative current motors and their control system	IEC 61377-1
vi)	Guide for the evaluation and identification of insulation systems of electrical equipment	IEC 60505
vii)	Electric railway equipment-train communication network	IEC 61375-1
viii)	Rotating electrical machines: Functional evaluation of insulation systems	IEC 60034-18
ix)	Railway applications — electromagnetic compatibility	EN 50121-3-2/

	— Part 3-2: rolling stock — Apparatus	IEC 62236-3-2
x)	Railway applications — electromagnetic compatibility — Part 2: emission of the whole railway system to the outside world	EN 50121-2/ IEC 62236-2
xi)	Railway applications — compatibility between rolling stock and train detection system	EN 50238
xii)	Transformer and chokes	EC 60310
xiii)	Transformer oil	IEC: 60296
xiv)	High voltage AC circuit breaker	IEC 60077-4
xv)	Rules for pantograph of electric rolling stock	IEC: 60494 Pt.1
xvi)	Low-voltage switchgear and control gear, Electrical relays for power system protection	1S 3231, IEC 60337, 60947
xvii)	Cables	IEC 60228, IS 10810
xviii)	Lightning arrestor	TEC 60099-4, IS 3070 ptlll
xix)	Railway applications — rolling stock equipment — shock and vibration test	IEC 61373
xx)	Programming languages for PLC	IEC 61131-3
xxi)	Railway applications — electric equipment for rolling stock	IEC 60077
xxii)	Electronic equipment used on rail vehicles	IEC 60571
xxiii)	Power converter installed on board rolling stock — Part 1: Characteristics and test methods	IEC 61287-1
xxiv)	Power converter installed on board rolling stock— Part 2: Additional technical information	TEC 61287-2
xxv)	Railway application — rolling stock protective provisions against electrical	IEC 61991
xxvi)	Auxiliary machines	IEC 60034
xxvii)	Power factor correction	IEC 60871
xxviii)	Control cubicle	TEC 60068
xxix)	Batteries	IEC 60623
xxx)	Degree of protection provided by enclosures	IEC 60529
xxxi)	Rules for installation of cabling	EN 50343
xxxii)	AAR approved couplers and coupler yokes	M-211
xxxiii)	Railway applications, welding of railway vehicles and components. Inspection, testing and documentation	EN15085
xxxiv)	Reliability of electronic component	IEC 61709
xxxv)	Metallised carbon strip for pantograph	RDSO's technical circular no. ELRS/TC/0071 (rev.'0')

2.19.1. **Alternative Standards:**

The requirements listed in these Specifications and Standards are the minimum. The supplier may adopt alternative internationally recognized codes, standards and specifications if it can demonstrate to the competent authority that such alternative is superior or more pertinent to the machine than the standards specified in these Specifications and Standards. The Contractor shall seek the prior approval of the competent authority for any alternate standards proposed to be used.

2.20. **Power Supply System:**

Power supply system for 25 kV AC traction:

i)	General	The power supply system adopted is 25 kV, 50Hz, single phase AC, 25 KV being the nominal voltage of the system. The design calculations and guaranteed performance shall be based on voltage of 22.5 KV.
ii)	Variation in voltage of supply 19 KV to 27.5 KV	19 KV to 27.5 KV Occasional max. —31 KV Occasional min. — 16.5 KV
iii)	Variation in frequency	± 3% (48.5 Hz to 51.5 Hz)
iv)	Stagger of the contact wire	± 200 mm on straight track. Up-to 300 mm on curves.

v) **OHE parameters:**

	Normal OHE	High rise OHE
Normal contact wire height in mid span	5. 5 m from rail level	7.42 m from rail level
Max. contact wire height	5.8 m from rail level	7.52 m from rail level
Min. contact wire height	4.58 m from rail level	7.37 m from rail level
Neutral Sections	After every 25 to 50 Kms	

vi)	Types of Neutral sections	i) 41 m in length having insulated over lap on both end and neutral wire in between which is not earthed; and
		ii) Short neutral sections of approx. 4.61 m and 9.6 m length having an insulated portion (of PTFE) on both sides and middle portion of neutral section which is solidly earthed. There shall be power interruptions at neutral sections varying from 12 seconds to 30 seconds
	Pantograph bounce	Up to 45 ms (millisecond) (limit of zero pressure contact).

2.21. **Signal and Telecommunication Installations:**

2.21.1. The tracks over which the machines will run may be equipped with 83-1/3 Hz track

circuits as well as track circuits at higher frequencies. Similarly, other devices like axle counters, block instruments, point machines, etc., may also be employed. On the communication network, control circuits, teleprinter circuits, as well as VHF/UHF and micro-wave circuits are employed.

2.21.2. The harmonic currents injected in the overhead supply system (as also the track return current) can introduce voltage/current harmonics on power supply and can interfere with signal and telecom circuits. The design of the power electronics and control electronics provided on the propulsion system shall be such as not to cause levels of interference exceeding the levels specified below at any point for stages of operation of 100% down to 50 %, working in a machine:

	Interference Current	Limit
1	Psophometric current	10.0 A
2	DC component	47 A
3	Second Harmonic component (100 Hz) and 83.33 Hz component	8.5 A
4	1400 Hz up-to 5000 Hz	400 mA
5	>5000 Hz up-to 32000 Hz	270 mA
6	39500 Hzup-to 43500 Hz	270 mA

(Note: The measurement of the interference current shall be done in track return current circuit of the machine.)

2.21.3. The Contractor shall undertake FFT (Fast Fourier Transformation) analysis of the total current from 1000 Hz to 5000 Hz and 5 kHz to 50 kHz separately to find out the frequencies which produce the highest currents within each bandwidth. In the frequency bands > 32000 Hz to < 39500 Hz and > 43500Hz to 50000 Hz the frequencies at which the current values exceed 270 mA shall be identified. This test shall be included within the tests listed within Schedule H and the results shall be provided in a Type Test report.

2.21.4. If the interference limits for track circuits and axle counters as per EN 50238 are more onerous than those stated in Clause 2.21.2 of these Specifications and Standards these limits as per EN 50238 shall be applied subject to provisions made in Clause 2.19.1 of these Specifications and Standards.

3.0 WORKING MECHANISM:

3.1. The machine shall be capable of carrying out automatic lifting, leveling, lining and tamping at the peak rate of 3500 sleepers per hour over a period of not less than 10 minutes and an average of not less than 2700 sleepers in an effective hour of working on all type of track structures in Indian Railways with uniform sleeper density as per clause 3.11 and the specified parameters of clause 3.6.The time shall be counted from start to finish of tamping work at work place. Stoppage of work not attributable to machine shall be discounted. The setting uptime and winding uptime shall be measured and the total time taken by the two operations of setting up and winding up of the machine together shall not exceed 10 minutes. The tenderer shall furnish the complete details of the tamping cycle of the machine, its timings and other operational details.

3.2. All rotary drives (vibration motors, cooling motor, radiator fan, compressor etc.) shall be electrically driven.

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

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

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

3.6. The tamping tools should be capable of tamping ballast up to 300mm depth below the bottom of sleepers. There should be provision for step-less adjustment of the depth of tamping tools to suit different type of sleepers.

3.7. Amplitude of vibration, vibration pressure, vibration frequency, squeezing pressure, squeezing time and tamping depth of the tamping tool should be such that durable compaction under the sleeper is achieved. Details of all the above parameters will be submitted in the offer.

The machine shall be capable of giving the output stipulated in clause 3.1 with following tamping parameters:

a. Squeezing time of 0.8 sec to 1.2 sec.
b. Squeezing pressure of 110 kg/cm² to 120 kg/cm² or average force of 10 kN at tamping tool.
c. Tamping depth upper edge of tool blade shall be 15-20 mm below the bottom of the sleeper.

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

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

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

Unevenness	:	± 1 mm on 3.6 m Chord
Cross level	:	± 1 mm
Alignment	:	± 2 mm on 7.2m Chord
Twist	:	1 mm/m on 3.0 m base.

3.11. The machine shall be fitted with automatic lining equipment capable of carrying out lining simultaneously with levelling on straight & curve track. The machine shall also have the ability to slew all type of track structures including rails and concrete sleepers as per Annexure-X up to 150 mm in one go. The lining & levelling unit shall have two sets of track lifting and lining rollers clamps for each rail.

3.12. The machine shall be capable of tamping, lifting and lining of track laid on pre-stressed concrete sleepers with long welded rails or short welded rails or fish-plated rails as per Annexure-X. As the minimum clear distance between the joint sleepers is 50 mm, the machine should be able to tamp these two sleepers together. The normal sleeper spacing in different track structures on Indian Railways is 550 mm to 650 mm and the clear spacing between sleepers will be minimum 260 mm and maximum 405 mm.

3.13. It shall be possible to control the target track geometry parameters, in infinitely variable steps from operators/front cabin. To achieve track tolerance mentioned in clause 3.9, suitable hydraulic valves (servo control) shall be provided.

3.14. On Indian Railways, rail top to sleeper bottom depth may vary from 365 mm to 425mm. There shall be provision for step less adjustment of the penetration depth of tamping tools to suit different types of rails and sleepers. The machine shall be provided with a mechanical penetration assistance system to achieve full penetration even in caked ballast bed. The Tamping units shall be equipped with a vibration control system. While lowering the tamping units the system should increase the mechanical induced vibration for easy penetration.

3.15. The machine shall be provided with a computerized unit for the overall control of its working system for all possible track geometry requirements (precision mode).The system shall be so designed that for working on tracks with pre-decided target geometry, the standard track geometry data as well as correction values can be entered prior to work either directly on system or via USB,CD or DVD. For working on tracks with unknown target geometry, it shall be possible to determine the correction values by making a measuring run and subsequent geometry compensation of the recorded data considering obligatory point and constrains of lifting and lining etc. The machine shall also be capable of correcting/smoothen alignment of the track on curves by working in smoothening mode/compensation mode when theoretical track geometry is either not known or not required to be known and when due to location of track defects, the track slewing values are expected to be so large that they cannot be implemented without additional measure and it is decided to smoothen the curve rather than bringing it to the targeted/design profile. Interactive processing of the target profile by the operator shall be possible. Important tamping parameters like datum rail, general lift, single insertion or double insertion, design or smoothening mode, time of start and finish of work, squeezing pressure, squeezing time, vibration pressure and tamping depth etc. shall be displayed in graphic as well as text form on a colour monitor. Pre and post tamping graph shall be superimposed and also it should be capable to display in tabular from at desired distance. It shall be possible to guide the lifting and lining system of the

machine continuously and automatically by this unit. The software shall be windows based. The hardware shall be sturdy for operations under conditions of shock, vibrations, dust, electromagnetic influences from outside and interruption of power supply. The unit shall have memory storage not less than 500 GB to keep records of minimum 100 km of work performed, new track geometry obtained and enables transfer of the data via USB port on a memory stick as required. Any software required to read this retrieved data should be supplied with the machine as an integral part of the machine offered.

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

3.17. The machine shall be equipped with an electronic device for measuring and recording the following track parameters:

i) Alignment on minimum 7.2 m chord length.
ii) Longitudinal level on minimum 3.6 m chord length.
iii) Cross level difference and twist at every 0.6 m or less (twist shall be reported in mm/m on 3.0 m base).
iv) Super elevation.
v) Lifting value.

The hardware shall consist of a touch panel computer with flash disc and an ink-jet printer. There should be provision to fix threshold value of above parameters and it shall be possible to draw reports to allow evaluations when threshold values are overstepped. Standard deviations shall also be calculated in 200 m sections for the track parameters i.e. alignment of the reference rail, longitudinal level and twist. It shall have an inbuilt storage to store the above parameters of minimum 100 km of tamping work. The storage however shall not be less than 500 GB for this purpose.

3.18. Important tamping parameters like datum rail, general lift, single insertion or double insertion, design/precision or smoothening/compensation mode, time of start and finish of work, squeezing pressure, squeezing time, vibration pressure and tamping depth etc shall be shown on a display in the working cabin. It shall have an inbuilt storage to store the above parameters of minimum 100 hours of tamping work. The storage however shall not be less than 500 GB. It shall be possible to draw these data from the system itself after work via USB port on a memory stick for the purpose of record and analysis.

3.19. A programmable logic control system shall be provided in the machine so that the works like lifting, lining, tamping and work drive of machine will commence only when all conditions for their working/movement are fulfilled.

3.20. To monitor the working of machines, closely from anywhere in the country from any location, suitable number of IP based cameras are to be installed. The cameras shall be fixed on machine at such location that the live video of the important working units of machine which are working on track, location of worksite and post-work track can be seen by the authorized person with commonly used browsers in India over the internet. Camera shall be password protected, decentralized and IP based. It shall have recording function built-in and thus can record directly to any standard storage

media, such as SD cards. Internal memory space of 500 GB shall also be available.

3.21. In case of failure of the up and down cylinders of tamping unit and lifting unit, there shall be an arrangement for lifting the tamping units and lifting unit mechanically by lifting equipment like trifor/chain pulley etc.. Any other alternative arrangement for mechanically lifting tamping unit in such failures may also be provided.

3.22. The machine shall be equipped with a centralized computer-based control and monitoring system which shall monitor the health of machine working system such as engine (lubricant oil pressure, temperature, rpm with engine running hours etc.), hydraulics (hydraulic pressure in different units, temperature, oil level in tank etc), pneumatic (pressure of main reservoir, brake cylinder and others section), electrical (charging/discharging rate, voltage etc.). There shall be provision of recording and logging of machine working hours and such gauge shall also be displayed on the monitor of the computer installed in operator cabin. All these data shall be displayed on a monitor installed in working cabin and there shall be facility to store these data for 100 engine running hours. Minimum storage of 500 GB shall be available for this purpose. Arrangement for providing 4G/5Ginternet connection for sending data in soft format directly from the computer shall also be available for shall have recorded data. It shall also have facility to interface with Human Machine Interference (HMI)/Display and various other sensors. The data transfer unit shall be compatible with the Track Machine Management System (TMMS) of Indian Railways.

3.23. The ALC/AGC (automatic guiding control) system/software shall be capable of recording pre and post tamping track parameters i.e. unevenness, cross level, alignment in analogue format at every 1 m interval. Also the ALC/AGC (automatic guiding control) system/software shall be capable to work out the “standard deviation” (SD) of the track parameters before and after tamping to assess the correct picture of the quality of work done by the machine.

3.24. The machine shall be capable to work in manual mode also in case of failure of computer/software/display units along with provision of manual feeding of required data. Necessary calculation chart shall be provided with each machine.

3.25. The machine shall be capable to rectify the track parameters by compensation mode/smoothening mode and Geometry mode/Design mode.

3.26. All inputs values like general lift, super elevation etc. shall be also displayed on the panel board in addition to display unit of ALC/AGC (automatic guiding control).

3.27. Tamping tools provided with machine shall have wear resistant/carbide tips.

4.0 ENERGY SUPPLY

4.1. Energy in the machine shall be supplied on the machine either by the diesel-electric supply system, or the system that uses the overhead line voltage. With the diesel-electric supply system, a generator shall supply power. This generator shall be powered by a diesel engine. With supply via the overhead line system, the machine shall be operated using the electricity from the overhead line through pantograph.

4.2. In diesel-electric mode, a diesel engine powers the induction generator. This generator shall supply the energy to power converter. Power transfer during driving and working in diesel-electric mode shall be as follows:

- Diesel engine

- Generator
- Power converter
    - Supply of auxiliary operating systems.
    - Actuation of electrical traction motors on the axle gearbox.

4.3. In overhead line mode, the overhead line shall induce the transformer. This transformer shall supply the energy to power converter. Power transfer during driving and working via the overhead line shall be as follow:

- Contact line
- High-voltage module
- Transformer
- Power converter
    - Supply of the auxiliary operating systems.
    - Actuation of electrical traction motors on the axle gearbox.

5.0 DIESEL ENGINE:

5.1. The machine shall comprise of a robust and sturdy traction system powered by 25 KV AC through overhead equipment. Electrical equipment such as traction transformer, heat exchanger, vacuum circuit breaker and pantograph etc. shall be suitably accommodated in the machine. The machine shall also be diesel powered to use in situations like neutral zone, non-electrified section and in emergency. The diesel engines shall preferably be indigenous with proven record of service in tropical countries with wide service network in India. Robust construction and low maintenance cost are of particular importance. The manufacturer of the engine shall have acquired quality assurance certification of ISO: 9001. Adequate allowance shall be made for de-rating of diesel engine under the most adverse climatic conditions mentioned in clause 2.13.

5.2. High speed diesel oil to Indian standard specification shall be normally used. A minimum fuel tank capacity sufficient for continuous operation for 8 hrs will be desirable. However fuel tank capacity shall not be less than 800 litres.

5.3. The supplier shall furnish the engine 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, details of diesel engine and its controls to assess its conformity with the engines already operating on track machines on Indian Railways. If the machine design incorporates an engine, not already operating with the purchaser, the model of the engine is liable for change as per the technical requirements and the maintenance logistics with the purchaser after technical negotiations with the supplier. Nothing extra shall be payable on this account.

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

5.5. For starting the engine, storage batteries of well-known indigenous make with wide service network in India shall be provided. The engine shall normally be push/pull button start type or key type. A battery management system to be provided. It should report too low battery voltage to the machine operator and protect the battery from deep discharge. There shall be also an indicator for charging battery displayed on the panel board.

5.6. Since the engine has to work outdoor under extreme dusty conditions, the air intake

system shall be designed suitably so as not to allow dust through air intake system.

5.7. There is a likelihood of dust deposition over the engine body and surrounding area over the lubricants spillovers. These shall be easy to access for daily cleaning and routine maintenance. For water cooled engines, the engine cooling radiator shall be easily accessible for regular maintenance like checking the coolant level and topping up of the coolant whenever necessary. Such maintenance activity shall not require the staff to climb up the machine roof. 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.

5.8. The engine parameter monitoring gauges like temperature, rpm, engine running hours and lubricant oil pressure shall be direct reading type mounted on the engine backed up by electrical/mechanical gauges in the operator's cabin showing the absolute readings along with safe limits suitably coloured. There shall be audio-visual warning (safety mechanism) to the operators in case of any of the parameters exceeding the safe limit and also engine will shut down automatically.

5.9. Suitable and rugged mechanism shall be provided to start the prime mover at minimum/no load and gradual loading after the start of the prime mover. A fail safe clutch mechanism, if required may be provided to meet this requirement.

5.10. The engine power take off shall be coupled to the main gearbox through a flexible coupling/cardon shaft (propeller shaft). The engine shall be mounted on suitable anti-vibration mountings.

5.11. The engine shall have electronic control module (ECM) or similar arrangement for taking out operating parameters on real time basis such as rpm, fuel consumption, fuel oil pressure, load, temperature, pressure and diagnostic data as well as trip and historical data. These data shall be displayed and stored on a centralized computer and monitoring system as mentioned in clause 3.21 above. It shall also be possible to transfer these data on USB device through the centralised computer based control.

5.12. In order to adhere to pollution control norms, the diesel engine shall be electronically controlled emmissionized engine with minimum compliance of EPA Tier 2/EURO stage-2/BS-II standard or higher emission norms and sufficient space to be kept in machine to fix devices to upgrade to higher emission norms in the future.

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

5.14. The tenderer shall supply engine driven alternator of adequate capacity as standard accessory for charging battery for engine cranking, lighting and other controls.

5.15. The machine shall comprise of a robust and sturdy generator powered by a diesel engine. With the diesel-electric supply system, a generator supplies power to power converter and then to traction motor, tamping drive etc.

5.16. The generator should be of a reputable make, suitable for the required kVA/kW rating, and capable of continuous operation.

6.0 DRIVE MECHANISM:

6.1. The machine shall be provided with an efficient traction drive system for traction during the operation. It shall be equipped with separate power train circuits for high speed travelling in travelling mode and slow cyclic movement in working mode.

6.2. The machine's driving system shall be through electric motor fitted directly on axle gear box or distribution gearbox with gear shift arrangement capable of achieving full speeds in travel mode in both the directions and slow cyclic movement in working mode. The driving mechanism for travel drive shall be rugged to perform satisfactorily during the life cycle of the machine. The tenderer shall submit full technical data of the power transmission system at the time of tender.

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

6.4. Adequate control equipment including gauges instrument and safety devices shall be provided in working and driving cabins near operator's seat

6.5. The tenderer shall provide the necessary technical details including circuit diagrams and detailed specifications of all electronic/electrical, hydraulic & pneumatic parts to confirm the above requirements.

6.6. 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 of going on top of the machine for day-to-day maintenance schedules.

6.7. The pneumatic circuit shall be provided with air dryer and air lubricator for the smooth working of pneumatic components.

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

6.9. Onboard system for online monitoring the quality of hydraulic oil in hydraulic circuit and filtration as required shall be provided. The gauge shall clearly indicate if the hydraulic oil is contaminated beyond the permissible limits and requires immediate replacement.

7.0 COOLING SYSTEM:

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

7.2. Adequate heat transfer arrangement for the hydraulic system shall be designed and provided so that under extreme heat conditions as mentioned in para 2.13 above, the

system oil temperature does not go beyond the range specified by the supplier.

8.0 BRAKES:

8.1. The machine shall be fitted with the compressed air-brakes system which shall apply brake equally on all wheels and provision shall be made to connect air brake system of the machine to that of camping coach when the machine is hauling it. Fail safe braking mechanism system shall be provided so that in case of any failure of brake there shall be arrangement of automatic application of brake. The brakes shall be protected from ingress of water, grease, oil or other substances, which may have an adverse effect on them. The brake shoe lining shall be suitable for high ambient temperature of 55º C. The force required for operating the brake shall not exceed 10 kg at the handle while applying by hand and15 kg on the pedal, when applying by foot.

8.2. Machine shall be equipped with suitable arrangement of braking so that while attached in train formation, as last vehicle the machine can be braked by traction vehicle having compressed air braking system. In addition, the machine shall be equipped with suitable air brake system in the driving cabins so that the attached wagon or camping coach being hauled by machine, can be braked.

8.3. There shall be provision of mechanical emergency brake application using the compressed air in the machine either travelling alone or coupled with the camping coach, in addition to the normal braking system of the machine. The emergency braking distance (EBD) of the machine on the Indian Railways track at the maximum designed speed on a level track shall not be more than 600m. In this regard necessary design calculations for the braking effort and EBD at the maximum design speed of the machine on level track and at falling grade of 1 in 33 should be provided by the supplier. Brake design details are to be submitted as per annexure-V.

8.4. The pneumatic parking brake shall also be spring loaded so that in case of drop in pneumatic pressure below certain value the brake will be applied automatically. There shall be an arrangement to release the parking brake through lever in case of emergency.

8.5. Clearly visible brake lights shall be provided at both the ends of the machine, which will be automatically operated when brake is applied and switched off when brake is released. This will be required to alert the operator of machine following this machine when the machines are working in groups.

8.6. An annexure containing functional requirement on the Brake system of the vehicle is attached as annexure XI.

9.0 HORNS, HOOTERS, SAFETY SWITCHES AND EMERGENCY BACKUP SYSTEMS:

9.1. The machine shall be provided with dual tone (low tone & high tone) electric/pneumatic horns facing outwards at each end of the machine at suitable locations for use during travelling and to warn the workmen of any impending danger. Control shall be provided in close proximity to the driver permitting the driver to operate either horn individually or both horns simultaneously. The horns shall be distinctly audible from a distance of at-least 400 m from the machine and shall produce sound of 120-125 dB at a distance of 5 m from horn (source of sound). The higher tone horn shall have fundamental frequency of 370 ±15 hertz. These electric horns shall be operated by means of push buttons provided in the cabins.

9.2. Adequate numbers of safety stop/switches shall be provided all around so that in case of any danger to worker as well as hitting of any obstructions by working unit like OHE/Signal post, signalling cable, joggle fish plate etc. during working, the operator can be warned or the machine can be stopped immediately.

9.3. Machine shall be provided with emergency backup system to wind up the machine in the event of failure of prime mover or power transmission system of the machine. The emergency backup system shall be able to be operated manually also.

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

9.5. In addition, separate electric horns with push bottom type switches shall be provided at suitable locations in all cabin(s) and on machine body for communication between the machine staff about infringement/malfunctioning or any other trouble.

10.0 HOOKS AND BUFFERS:

10.1. The machine shall be fitted with transition coupling as per RDSO specification no. RDSO/2009/CG-22 with latest revision along with side buffers to RDSO drawing no. RDSO/SK-98145 with latest alteration on both ends for coupling it with other vehicles for running in train formation and for attachment with the coach, locomotives and wagon.

11.0 SUSPENSION SYSTEM:

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

12.0 HEAD LIGHT, FLASHER LIGHT, MARKER LIGHT AND OTHER LIGHTING ARRANGEMENTS:

12.1. The electrical equipment to be provided shall conform to relevant standard specifications and shall be suitable for Indian climatic conditions. The machine shall be equipped with twin beam LED headlight assembly, conforming to RDSO specification no. RDSO/2017/EL/SPEC/0134 (Rev.03) with latest amendments ensuring a light intensity of 4.8 lux at ground level at track centre at a distance of 305 m away on a clear dark night, at each end and with two front and rear parking lights, which can be switched to red or white according to the direction of the travel. Powerful swiveling floodlights shall also be provided to illuminate the working area (10 meter radius) sufficiently bright for efficient working during night.

12.2. Powerful swiveling floodlights shall be provided at each corner of the machine to illuminate the surrounding area sufficiently bright for efficient working during night. In

addition minimum twelve power point locations (230/250 V AC socket) shall be provided on outside frame of the machine two in front, two in rear and four on both sides for providing lighting arrangements during night working. The power supply to all the fittings and sockets operated with 230/250 V AC shall be fed by welding plant as mentioned in clause no. 16.5. Illumination survey or light assessment or Lux level survey report shall be submitted by the supplier.

12.3. The amber colour LED based flasher lights producing not less than 500 lux at 1 m and 55 lux at 3 m in line measurement in axial direction from flasher light to RDSO Spec No. ELRS/SPEC/LFL/0017 (Rev-1) of Sept-2004 or latest shall be provided at both ends on the machine to give indication to the train arriving on other line about any impending danger.

12.4. The machine shall be provided with marker light to RDSO specification no. ELRS/SPEC/PR/0022, (Rev-1) October' 2004 or latest.

12.5. In addition to swivelling LED floodlights mentioned in clause 12.1, powerful swivelling LED floodlights shall also be provided at each corner of the machine to illuminate the surrounding area sufficiently bright for efficient working during night. In addition minimum eight power point locations (230/250 V AC socket) shall be provided on outside frame of the machine two in front, two in rear and four on both sides for providing lighting arrangements during night working. Suitable light fittings shall also be provided which will be used during night working otherwise it should be kept at a secure place provided on the machine. The power supply to all the fittings and sockets operated with 230/250 V AC shall be fed by welding plant as mentioned in clause no. 16.5. Illumination survey or light assessment or Lux level survey report shall be submitted by the supplier. Average illumination level shall be 15 Lux on 6 m meter width along the machine both sides and also up to 6 m length on both ends.

13.0 CHASSIS AND UNDER-FRAME:

13.1. The chassis shall be fabricated from standard welded steel sections and of steel sheets, so as to permit transportation of the machine in train formation without endangering safety of the train. The under-frame shall be constructed with rolled steel section and/or plates and shall be designed to withstand a horizontal squeeze load of 102 t at CBC rear stop or 51 t at each buffing point without any permanent distortion. The under frame shall be sufficiently robust for safe travel of the machine in train formation and not necessarily as the last vehicle.

13.2. There shall be provision of properly exhibited/conspicuous jacking and lifting points on the machine under-frame for helping in quick handling of the crane in case of derailment/accident as well as during maintenance at workshop. The jacking and lifting points shall be obstruction free and easily accessible, so that jacks can be fitted/placed conveniently. There should be no any rigid unit along the rail up-to 350 mm from wheel tread and 525 mm above rail level.

14.0 CABINS:

14.1. The machine shall be equipped with fully enclosed air conditioned and pressurized cabins with safety glass window at both ends and all cabins shall be air conditioned. In view of the high ambient temperature prevailing in India, special attention should be paid to free circulation of air and ventilation in the driver's cabin. The air-conditioning units shall not be roof and under-frame mounted for safety and maintenance purpose. However, the electronic equipments shall be so designed that it shall be able to work without air conditioning under the climatic conditions

described in clause 2.13.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. The design of cabin shall be as per UIC Codex-651. Additional driver's cabin shall be provided if the view while driving is not clear for safe travel in both directions.

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

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

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

14.5. Necessary inter-communication system shall be provided inter-connecting all the cabins and shall be so oriented that the operator, sitting in either cabins/working cabin, can distinctly hear the conversation. The volume control adjustment (preset) of inter-communication system shall be provided on amplifier (PCB).

14.6. The machine shall be equipped with speed indicator and recording equipment of range between 0-160 kmph for recording the speed of the machine in real time. The equipment shall conform to RDSO specification no. MP-0-0.3700-07, Rev-07, Aug' 17 or latest. The recorded data shall be retrievable on computer through memory card/pen drive. It shall be provided in the driving cabin at suitable place and recording system shall have sufficient memory to keep the speed record of minimum 15 days which should always be stored for retrieving as per requirement.

14.7. Operators cab camera with recording facility & voice logger shall be provided.

14.8. Control desk shall be suitably modified to accommodate additional switches and indicators required for electric mode such as Panto raising switch, Earthing switch (VCB) opening/closing switch, OHE voltage, etc. A TFT LCD display for driver's cab called DIALS (Digital into Analogue LCD - based System) shall be provided as per RDSO specification No.MP.0.0400.10 (Latest version). Display of DIALS shall suitably be modified to incorporate additional indications required for electric traction.

14.9. The electric supply in the cabin for operation of electrical instruments, gauges etc. shall not be more than of 110 V.

15.0 Safety Features:

15.1. Electron-beam irradiation cross-linked type Power and Control cables of standard metric sizes shall be provided as per specification no. EDPS – 304 and EDPS – 179 respectively or relevant EN specification.

15.2. All electrical machines and control equipment shall generally conform to relevant IEC standards.

15.3. All applicable requirements for working under OHE traction shall be similar to the

guidelines given in the Contract No.IR GP-140R.

15.4. Two Dry Chemical Powder type fire extinguishers (Gas Cartridge type) of 5 kg capacity approx. of well-known make shall be provided one in each cabin. The fire extinguisher shall conform to IS: 2171 – 1985 and gas cartridge shall conform to IS: 4947-1985. Easily accessible fire extinguishers are to be installed in the cabins. The exact positioning is determined within the framework of the interior concept. The chemicals used for extinguishing fire by such fire extinguishers shall not chemically react with electronic equipment/components, PCBs, cables etc.

15.5. Provision for protective earthing against electrical hazard shall be in line with EN 50153: Railway applications - Rolling stock - Protective provisions relating to electrical hazards. All electrical equipment shall be provided with essential interlocks & keys as may be adequate to ensure the protection of the equipment and the safety of those concerned with its operation and maintenance.

15.6. The protective earth connects all metallic parts (e.g. apparatus housing, machine body, work equipment) to the earth potential. To protect the axle bearings from current flow, the current is transmitted to the wheel set via earth brushes. The earthing concept shall be documented.

15.7. Functionally related loads are to be protected by circuit breakers in order to keep the effects of faults low and to facilitate fault location.

15.8. Stand-alone vigilance control device (VCD) of approved make conforming to RDSO specification no. MP-0.34.00.04 (Rev-04), Dec-2008 shall be provided.

15.9. The fire protection on machine shall be designed and constructed in accordance with EN 45545.The applicable Hazard level will be HL-2.The supplier shall furnish the relevant fire load calculations in soft copy. One set shall be sent to the Principal/IRTMTC, Allahabad, one set to be sent to PED/Infra-1, RDSO, and Lucknow, one set to EDTK (M&MC)/Railway Board and one set to Director General/IRICEN/Pune along with supply of first machine by the successful bidder.

15.10. The machine shall have automatic fire/smoke detection systems in accordance with EN 45545. This shall be capable of detecting a smoke/fire in machine. On detection of a possible smoke/fire, the system shall give warning in form of audio visual alert.

15.11. All electrical wiring in the machine shall be done with e-beam cables conforming to RDSO’s Specification No ELRS/SPEC/ELC/0019 Rev.-4 with latest amendment or equivalent EN standard.

15.12. Two nos. 50 t manually operated hydraulic lifting jack (maximum weight 160 kg), with more than 300 mm traversing facility suitable to lift the machine frame at lifting point, should be made provided to meet out the urgency. Also a hydraulic hand pump unit should be provided to operate any other emergent operation of hydraulic cylinders and other such equipment specific to the machine for restoring failed units of the machine during working, shall be provided on the machine.

15.13. Necessary provision should be made to record the conversation between staff present in the cabs for reference during enquiry of any unusual incident/accident.

15.14. Operators cab camera with recording facility & voice logger conforming to RDSO specification no. RDSO/SPN/TC/106/2022 Version 2.0 or latest shall be provided.

15.15. Signal exchange light (signal flashing scheme) similar to Vande Bharat for exchanging signal conforming to CLW specification no. CLW/MS/03/0670 or latest shall be provided in the machine.

15.16. Machine shall be suitable for maintenance and operation, even for changing parts & oil filling under OHE of restricted height.

15.17. The machine shall be compatible for provision of KAVACH system (The Indian Railway Automatic Train Protection system) KAVACH will be provided as per RDSO specification no. RDSO/SPN/196/2020 Version 4.0 or latest.

16.0 TOOLS AND INSTRUCTION MANUALS:

16.1. Each machine shall be supplied with a complete kit of tools required by the operator in emergency and for normal working of the machine. The tenderer shall along with his offer submit the list of tools to be supplied along with each machine. The list of tools to be provided shall also include all tools necessary for maintenance and repair of the entire machine including specialized equipment. All special tools shall be listed and catalogued illustrating the method of application. The list can be modified to suit the purchaser's requirement, while examining the offer.

16.2. Detailed operating manual, maintenance, service manual and user manual indicating capability of machine shall be specifically prepared in English language and four hard copies & soft copies of each of the same shall be supplied with each machine as above, for operation, servicing, maintenance, assembly overhauling, periodic overhauling and troubleshooting guides/manuals.

16.3. The supplier/manufacturer shall also supply diagrams in hard & soft copies 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 dimensional drawings with material description of items like rubber seals, washers, springs, bushes, metallic pins etc. Main features such as type, rpm & discharge etc of items like hydraulic pumps, motors. These shall be specially prepared in English language and four hard copies & soft copies of these shall be provided with each machine. The tenderer shall furnish the details of such other bought out components/assemblies.

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

16.5. One portable diesel operated D.C. welding plant (with the provision of auxiliary output of minimum 5.0 KW, 230/250 V AC for lighting) of reputed make (Preferably made in India) with a minimum capacity 7.5 KVA capacity capable of welding up-to 5 mm electrode (dia) at 60% duty cycle shall be supplied. Sufficient cable or lead shall be provided with the welding plant for day to-day repairing of machine and its wearing parts. The diesel tank capacity shall be not less than 15 liters.

16.6. The firm shall provide detailed technical drawings and specifications of wheels and axles used in the machine along with detailed code of procedure for ultrasonic testing axles of all types and test report of wheel shall be submitted along with other documents. The above details shall be provided in four sets with each machine.

16.7. One set of all the manuals and diagrams in hard as well as soft copies prepared in English language shall also be sent to the Principal/Indian Railways Track Machine Training Centre, Allahabad, one set for PED/TMM, RDSO, Lucknow, one set for DTK (MC)/Railway Board and one set for Director/IRICEN/Pune along with supply of first machine of similar group. In case, there is any subsequent amendment in above documents based on field performance, the amendment/amended documents shall also be sent for above mentioned authorities.

16.8. A draft copy of all documents to be supplied with the machine shall 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 shall be carried out and compliance shall be reported to RDSO as well as the Inspecting officer of the first machine.

16.9. First aid box with prescribed medicines & other items shall be supplied with each machine and first aid box shall be mounted at an appropriate place. List of medicines/items shall be indicated on the first aid box.

17.0 SPARE PARTS:

17.1. The expected life of components/spare parts shall be advised along with their condemning limits. The machine shall be supplied with the necessary spare parts for the operation and maintenance of the machine for a period of two years i.e. working for about 2000 hrs. The tenderer along with the offer shall furnish required spare parts details in a separate list indicating description, part number, quantity, cost, whether imported or indigenous.

17.2. The supplier/manufacturer shall be responsible for the subsequent availability of spare parts to ensure trouble free service for the life of the machine (20 years). It is preferred that the spares shall be stored in India and will be available within seven days (7).

17.3. For indigenous parts and bought out components and assemblies, the source (original equipment manufacturers reference and part no.) and other relevant technical details shall be supplied while offering the first machine for inspection.

18.0 MAKER'S TEST CERTIFICATES:

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

19.0 OPERATORS:

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

20.0 OPTIONAL EQUIPMENT:

20.1. 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.

21.0 WARRANTY:

21.1. The machine shall be warranted for 2000 effective working hours or 18 months from date of commissioning and proving test of equipment or 24 months from date of delivery at ultimate destination in India whichever shall be earlier. Effective working hours for this purpose will be traffic block time during which machine is deployed for tamping work. Warranty period of 18/24 months shall be extended for the period/s of idling or breakdown (during warranty period) on supplier account. The warranty of machine also includes the warranty of engine(s).

Should any design modification be made in any part of the equipment ~~offered~~ during warranty period due to any failure or otherwise, the warranty period of 18 months would commence from the commissioning and proving test of equipment for the purpose of that part and those parts which may get damaged due to defects in the new replaced part. The cost of such modification shall be borne by the supplier.

22.0 INSPECTION OF THE MACHINE:

22.1. 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 specification as above. The machine's conformity/non-conformity with respect to each item shall be jointly recorded before issue of the "Inspection Certificate" and approval for dispatch of the machine as per Annexure–VI enclosed.

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

- Machine to be stabled on straight & level BG track. The length of the track shall be at least 10 m more than buffer to buffer length of machine.

- In order to check maximum moving dimensions in cross section, a sturdy frame of Indian Railways maximum 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.

22.3. The following documents shall be provided to the Inspecting Officer (IO) at least 30 days before the proposed date of inspection:

i) One copy of complete technical literature mentioned in clause 14, in English language, including operation, service field maintenance manuals/instructions user manaul and complete electrical, hydraulic and pneumatic circuit diagrams, trouble shooting charts, component drawings/description and other relevant technical details as a reference documents in soft & hard copies.

ii) Cross section of the machine super imposed on Indian Railways maximum moving dimensions envelope.

iii) Clause by clause comments of the for review. Comments shall state manufacturer's conformity of compliance of each of the requirement stated in each clause, elaborating where necessary the details/manner in which the requirement has been complied. The proforma for the clause-wise comments is given below:

Clause no.	Clause	Comments of Supplier/	Comments of

		manufacturer	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 with serial number wherever applicable.

vi) Draft inspection report to shall be prepared by the manufacturer, containing all annexures mentioned at clause 20.4.

vii) Details of arrangements made for checking maximum moving dimensions for approval.

viii) EMI/EMC test report.

ix) Illumination survey or light assessment or Lux level survey report.

x) Crashworthiness certificate of driving cabin

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.

22.4. List of documents to be annexed in the draft inspection report shall 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 Indian Railways maximum moving dimensions (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.
ix) Manufacturere's certificate on standard followed for design of wheels and axles against clause 2.9 to 2.11.

x) The code of procedure for ultrasonic testing along with ultrasonic testing report of wheels and axles of all types used in the machine against clause 16.6.

The above documents in soft & hard copies shall be part of final inspection report.

23.0 ACCEPTANCE TEST:

23.1. In addition to verification of the various items of specifications covered earlier, the following tests shall be carried out in India at the purchaser's premises by the purchaser's nominee at the time of the commissioning of the machine. The pre-commissioning tests shall be completed and the machine shall be commissioned within 90 days of its arrival at the premises of the final consignee.

23.1.1. Dimensional check of loading gauge, i.e. maximum moving dimensions, buffer heights, clearances, length of machine, bogie distance and clearance on curves etc.

23.1.2. Testing for negotiability of 10º curves and 1 in 8.5 turnouts.

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

23.1.4. Illumination survey or light assessment or Lux level survey to the working and surrounding area of the machine, sufficiently illuminated for efficient working during clear dark night.

23.1.5. Ultrasonic testing of axles shall be done preferably at the purchaser's premises. If not possible at the purchaser's premises, same to be done during at the time of acceptance tests at consignee facility.

23.1.6. Parking brake effectiveness up-to 1 in 33 (3%) gradient.

23.1.7. **Actual output and performance tests to be conducted on first machine-- Refer clause 3.0:**

These tests shall be conducted under-field conditions on Indian Railways. An electrified section shall be chosen for the test.

The general conditions of the tests shall be as follows:

a) The machine crew shall be either trained personnel of Indian Railways or the staff of the supplier.
b) Dry weather, ambient temperature between -5^0 C to 55^0 C.
c) Straight track or curve with radius minimum up to 1000 m.
d) Straight track with gradient up to 1 in 200.
e) Gradients up to 1 in 33 (3%)
f) Rails and concrete sleepers in good conditions and properly fastened.
g) Clean ballast cushion up to 150 mm below the bottom of sleeper and generally not cemented.
h) LWR track
i) Formation good.
j) Regular sleeper spacing of 550 mm to 650 mm on straight track with a tolerance of ±20 mm.
k) General lift during working up to 30 mm.
l) Lifting of track in non-working mode of 150 mm in one go to be conducted at manufacturer's premise/siding.
m) Slewing of track in non-working mode of 150 mm in one go to be conducted at manufacturer's premise/siding.
n) Maximum slew during working up to ±10 mm**.**
o) LWR track with ballast as per standard profile of IR**.**

23.1.8. Illumination for the working and surrounding area of the machine sufficiently illuminated for efficient working during night as per clause no. 12.5.

ACTUAL TEST TO BE CONDUCTED:

a) **Tamping output at the above general conditions of test:**

At the parameters specified in clause 3.9the machine shall be capable of carrying out on plain track, automatic lifting, levelling, tamping and lining at

the peak rate of 3500 sleepers per hour over a period of not less than 10 minutes and an average of minimum 2700 sleeper in an effective tamping hour in case of single insertion. Stoppage of work not attributable to machine shall be discounted. The time shall be counted from actual time of the arrival of the machine at the worksite to actual departure time after completing the work. The setting up time and winding uptime shall be measured and the total time taken by the two operations of setting up and winding up of the machine together shall not exceed 10 minutes.

b) **Lifting Capability:** Lifting of track in non tamping mode of 150 mm in one go.

c) **Slewing Capability:** Slewing of track in non tamping mode of 150 mm in one go.

23.1.9. List of drawings & documents for processing of speed certificate of the machine:

a) The supplier shall submit the drawings, documents and details as per the pro-forma attached as Annexure-XII, Annexure-XIII and Annexure-XIV and duly signed with seal in hard and soft copies in A3 size in high resolution in English language (other than mentioned in Annexure (VIII & IX). The supplier shall submit the documents accommodating the following details:

b) The machine drawing in Maximum Moving Dimension (MMD) to drawing no. 1D (EDO/T-2202)1676 mm Gauge of IRSOD-2022 shall be submitted.
c) All dimensions are to be marked as per IRSOD-2022 in the drawings.
d) Provide sketches of the machine, both in plan and elevation and shall give calculations along with Vogel's diagram to prove that the machine does not cause any infringement while moving on a 10° curve at any cross-section.
e) All types of brakes shall be shown in air brake circuit schematic diagram as per technical specification.
f) Braking distance calculations shall be submitted for level track as well as for falling gradient of 1 in 33 at design speed.
g) The supplier shall submit the self-certification for Electromagnetic compatibility (EMI/EMC) of the machine.
h) Dynamic simulation result of the machine, brake design details of the machine for calculation of emergency braking distance & all other details shall be submitted as per annexure of technical specification.

24.0 Should any modification be found necessary as a result on the test, the same shall be carried out by the supplier at his own expenses.

25.0 TRAINING AND SERVICE ENGINEERS:

25.1. The supplier shall provide at his own expense the services of competent engineers during the warrantee period for warrantee related issues. The service engineers shall be available for the commissioning of the machine for regular service. E-Learning courses module shall be arranged for imparting training to Railways operators. In addition the service engineer shall provide hands on training to Railways staff in calibration, operation, repairing and maintenance of the machine in field to make them fully conversant with the machine. The engineers shall also advise the Railways on appropriate maintenance, testing, operating, repair and staff training facilities that are necessary for the efficient performance of the machines.

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

26.0 SPEED CERTIFICATE:

26.1. **Provisional Speed Certificate:**

Whenever a new rolling stock is introduced in Indian Railways, a provisional speed certificate is issued by RDSO of Indian Railways, Lucknow, based on certain design parameters of the machine. Final speed certificate of the machine is given after conducting detailed oscillation trials of the machine, which is a time taking process. Therefore, issue of provisional speed certificate for the machine becomes a necessity and based on the same the approval of running of the machine on Indian Railways track is taken from Commissioner of Railway Safety.

For issue of provisional speed certificate, following actions are required to be taken by the suppliers.

a) Current supplier , whose models are approved :

The supplier shall give details of the model, year of introduction in Indian Railways, 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 frame i.e. suspension system/arrangement, wheel & axle assembly, bogie, braking arrangement loading pattern of the machine etc. and the distribution of axle loads, lateral forces, unsprung mass, tractive effort and braking force coming on rail and they remain the same. If, there is any change in any of the above parameters action shall be taken as detailed in para (b) below: Machines that are similar shall be decided by RDSO/Railway Board based on data submitted by the firm and decision of RDSO/Railway Board shall be final in this regards.

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

As soon as the supplier completes the design of the machine as per specification, the technical details as per Annexure (VII and VIII) which in no case shall be more than six months from signing of contact, shall be submitted to Track Machine and Monitoring Directorate of RDSO of Indian Railways at Lucknow for processing of provisional speed certificate for the machine so that it can be permitted to move on track. On case to case basis, more technical details (other than mentioned in Annexure (VII and VIII) can also be asked for issue of provisional speed certificate for the machine. The supplier shall submit the dynamic simulation report of the machine on his own cost on professional track vehicle simulation software. The machine shall have to fulfill the acceptance criteria specified at Annexure-IX.

c) New supplier, whose models are new:

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

26.2. **FINAL SPEED CERTIFICATE:**

Final speed certificate of the machine is given after conducting detailed oscillation trials of the machine. For this purpose railway shall conduct running speed tests on

the Indian Railways main line track on one of the machines supplied to them preferably with in warranty period, in accordance with procedure outlined in Annexure-IX with the machine running up-to speed 10% higher than the maximum speed mentioned in clause 2.14 above. However railway could conduct detailed oscillation trial of the machine as per EN-14363. The track geometry for trial (as per EN-14363) shall be as per Annexure-XV. The decision of the railway will be final and binding.

27.0 MARKING & COLOUR OF MACHINE:

27.1. The machine body shall be painted in golden yellow colour of Indian Standard colour code of 356 as per IS:5 or RAL No. 1028 - Melon yellow. The exterior painting shall be polyurethane binder based conforming to RDSO Specification No. M&C/PCN/100/2013 (Specification for Epoxy cum Polyurethane Painting System-two packs for the exterior painting of Railways coaches, Diesel and Electric locomotives and other Industrial Applications) or ISO 12944.

27.2. Following shall be written in black on the machine at appropriate location in English & Hindi as per direction of Indian Railways official.

i) Indian Railways logo of height between 300 mm to 600 mm as suitable on all four faces of the machine.
ii) On both side faces and below the Indian Railways logo, the text “INDIAN RAILWAYS” shall 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 shall be written in black colour and in letter of size less than the size in which Indian Railways is written but not less than 200 mm in any case.
iv) If required, the manufacturers name may be written in size not more than 150 mm and shall not be at more than four locations. Also the manufacturer’s logo may be provided at no more than two locations and shall be of size less than 200mm.
v) Suitable signage to warn the operator and machine working staff against the 25 KV OHE shall be stenciled on the machine at appropriate location.
vi) Speed limit shall be written on both side faces of the machine.

****

Annexure-I

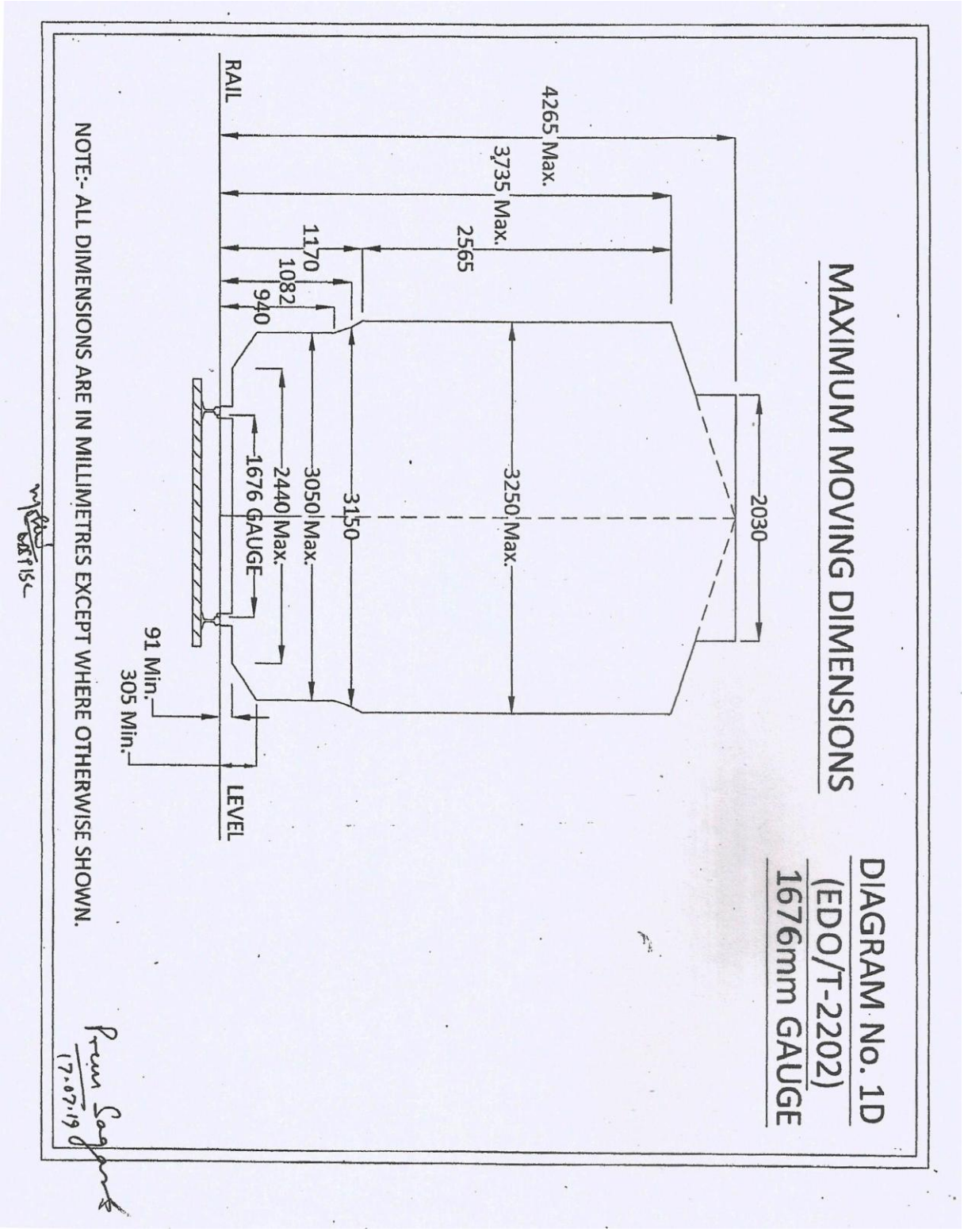


DIAGRAM No. 1D
(EDO/T-2202)
1676mm GAUGE
MAXIMUM MOVING DIMENSIONS
4265 Max.
3,735 Max.
2565
1170
1082
940
2030
3250 Max.
3150
3050 Max.
2440 Max.
1676 GAUGE
91 Min.
305 Min.
RAIL
LEVEL
NOTE:- ALL DIMENSIONS ARE IN MILLIMETRES EXCEPT WHERE OTHERWISE SHOWN.

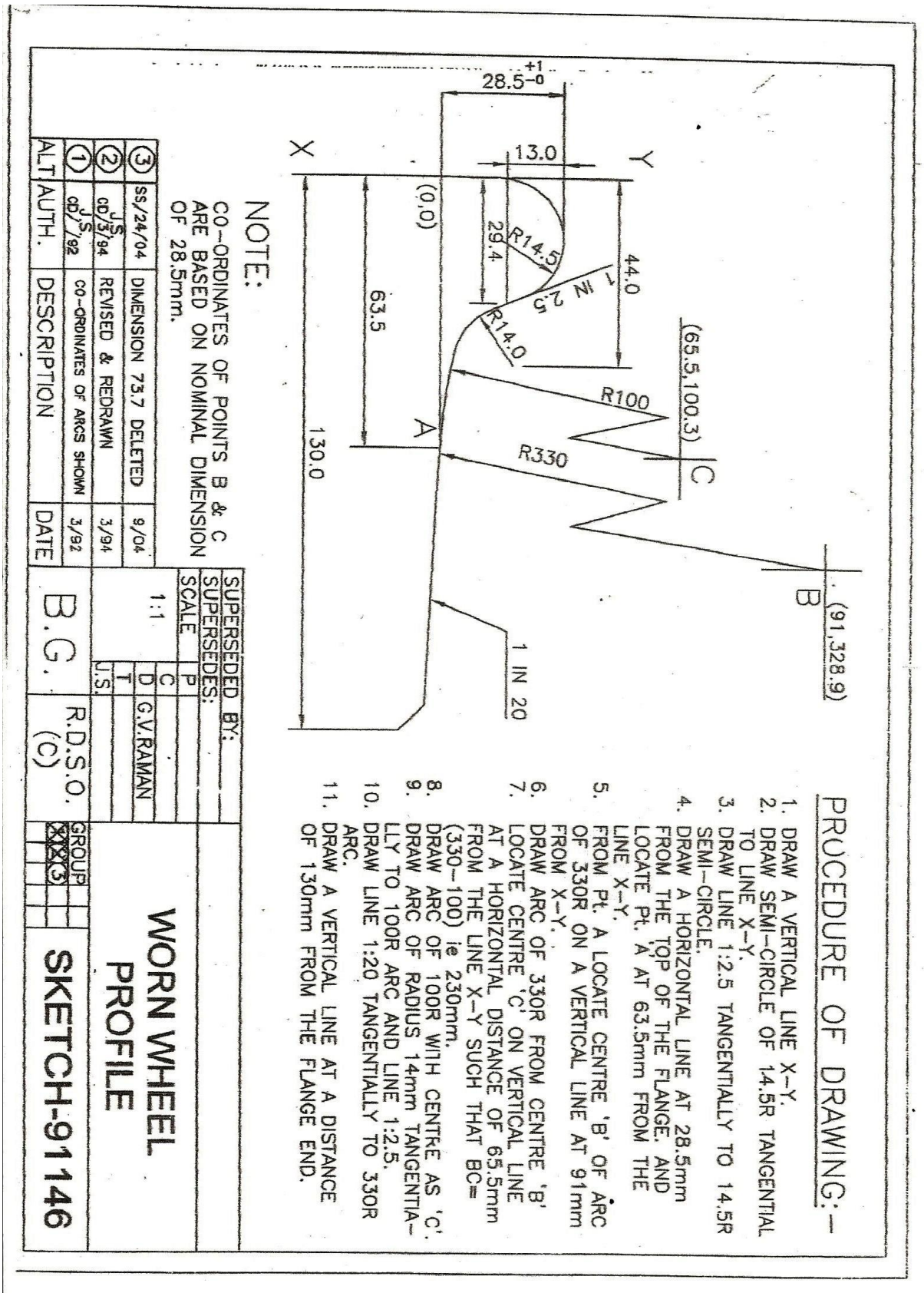
Annexure-II

Machine data to be submitted along with dynamic simulation report of the machine

S.No.	Component's Name	Parameters required						
		C.G. of component in x, y, z direction from rail level in mm (reference point 1st axle)			Mass in kg and mass moment of inertias in kg. m^2 of component in three dimension space about their C.G.			
		X	Y	Z	Mass	Ixx	Iyy	Izz
1.	Super structure with vehicle frame (Machine structure kept on secondary suspension of front and rear bogie)							
2.	Front Bogie frame including brake rigging							
3.	Rear Bogie frame including brake rigging							
4.	Transmission system device (hydraulic. Mechanical or electrical traction motors							
5.	Wheel axle set including axle boxes which constitute the unsprung mass							
6.	Mass of Items included in unsprung mass partially or fully along with their name per axle	1	2	3	4	5	6	Total unsprung mass in tonnes
7.	Total weight of components in tonnes	Front bogie full assembly		Central bogie full assembly	Rear bogie full assembly	Machine frame full structure	Full weight of vehicle (All bogies + 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	Lateral	Longitudinal	Vertic	Lateral	Longitudinal	

		stiff	stiff	stiff	al stiff	stiff	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 on about vertical axis	Rotation about Lateral axis	Rotation about Longitudinal axis
11.	Detail of location of suspension elements	Detail of location of suspension springs and dampers and shock absorbers with support drawing			Detail of location of suspension springs and dampers and shock absorbers with support drawing		
12.	Details of centre pivot arrangement working and location	Provide detail arrangement drawing and description					
13.	Set of drawings and design description	Concerning with general arrangement of vehicle, bogie general arrangement, suspension arrangement details, suspension clearances drawing, detail written description of configuration and loading pattern accompanies design particular of vehicle bogie.					

Annexure-III



PRUCEDURE OF DRAWING:-

1. DRAW A VERTICAL LINE X-Y.
2. DRAW SEMI-CIRCLE OF 14.5R TANGENTIAL TO LINE X-Y.
3. DRAW LINE 1:2.5 TANGENTIALLY TO 14.5R SEMI-CIRCLE.
4. DRAW A HORIZONTAL LINE AT 28.5mm FROM THE TOP OF THE FLANGE. AND LOCATE Pt. 'A' AT 63.5mm FROM THE LINE X-Y.
5. FROM Pt. A LOCATE CENTRE 'B' OF ARC OF 330R ON A VERTICAL LINE AT 91mm FROM X-Y.
6. DRAW ARC OF 330R FROM CENTRE 'B'
7. LOCATE CENTRE 'C' ON VERTICAL LINE AT A HORIZONTAL DISTANCE OF 65.5mm FROM THE LINE X-Y SUCH THAT BC= (330-100) ie 230mm.
8. DRAW ARC OF 100R WITH CENTRE AS 'C'.
9. DRAW ARC OF RADIUS 14mm TANGENTIALLY TO 100R ARC AND LINE 1:2.5.
10. DRAW LINE 1:20 TANGENTIALLY TO 330R ARC.
11. DRAW A VERTICAL LINE AT A DISTANCE OF 130mm FROM THE FLANGE END.

NOTE:

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

ALT	AUTH.	DESCRIPTION	DATE
③	SS/24/04	DIMENSION 73.7 DELETED	9/04
②	CD J.S. 3/94	REVISED & REDRAWN	3/94
①	CD J.S. 3/92	CO-ORDINATES OF ARCS SHOWN	3/92

SUPERSEDED BY:
SUPERSEDES:
SCALE 1:1

P	
C	
D	G.V.RAMAN
T	
U.S.	

B.G. | R.D.S.O. (C) | GROUP XXX3

WORN WHEEL PROFILE

SKETCH-91146

Annexure-IV

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

CPU	Intel Core 13th Gen i-7 processor, speed 4.8 GHz or higher version
Operating System	Latest windows 11 professional or higher version
RAM	32 GB DDR5 or more and expandable up to 128 GB
Storage	Shock protected removable SSD 1 TB expandable up to 2 TB
Display	Minimum 14” Full HD with refresh rate of 144 Hz or better with sunlight readable display, anti-reflective and anti-glare treatment.
Keyboard	LED backlit 61 key QWERTY keyboard with integrated numeric pad. Touchpad with vertical scrolling support.
Wireless	Mobile broadband 4G/5G LTE and GPS support or better, minimum Bluetooth V 5.0 or better.
Durability features	Product shall be fully rugged, durable and meet the latest MIL standard. Moisture/water and dust resistant screen (IP66), Key board and touch pad.
Pre-Loaded Software’s	Latest Antivirus software for 18 months validity Microsoft office standard 2021 or latest complete bundle (Licensed copy with CD backup)
Power supply	Long life Li-ion battery, minimum with 18 hours operating battery backup.
Warranty	5-year warranty

Annexure-V

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

1.	Tare & gross weight of the machine in Kilograms	
2.	Brake power in Kilograms	
3.	Type of Brake blocks	
4.	Brake block area in Square Centimetres	
5.	Brake Rigging Diagram	
6.	Type of Brake system	

Annexure-VI

INSPECTION CERTIFICATE

CERTIFICATE OF INSPECTION OF RAIL CRANE (MODEL No.....) BY INSPECTING OFFICIAL AND APPROVAL FOR DISPATCH OF MACHINES.(STRIKE OUT WHICHEVER NOT APPLICABLE)

This is to certify that I have inspected the machine _____bearing Sr.No._____ from (date)_____to_____at (Place)_____ for its conformity/non-conformity with respect to the laid down Technical Specifications in contract Agreement No._____dated_____ between President of India through Executive Director/Railway Board and M/s. (Name of Supplier) _____ _____.

The detailed inspection note regarding its conformity/non-conformity to the laid specifications is enclosed along with this certificate. It is observed that (strike out whichever is not applicable):-

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

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

1. _____
2. _____
3. _____

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

The machine is approved/not approved for dispatch to_____(Consignee) Indian Railways.

For M/s._____
_____

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

Annexure-VII

Particulars Required in Respect of the Rolling Stock Under Consideration

1. A diagram showing elevation with salient dimensions :

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

      I. Overall length of the vehicle :
      II. Length over head stock :
      III. Length over buffers :
      IV. Distance apart for center of buffers :
      V. Max./Min. height of centers of buffers (above rail level) :

   b) I. Wheel base :
      II. Axle load (max) :
      III. Maximum axle load per meter :
      IV. Type of bogie :
      V. Weight of each bogie :
      VI. Weight of each bolster :
      VII. 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 Railways 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. Sprung weight per axle in tonnes
      I. Driving axle :
      II. Running axle :

8. Sprung mass on primary suspension :

9. Stiffness of suspension coil spring/magi spring :

10. Rate of deflection of primary spring :

11. Number of springs per nest :

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

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

14. 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. :

15. 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	:

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

	at working axle	:
	at transfer axle	:

17. Drawing indicating suspension arrangement details of bogie and axle. :

18. Height of centre of gravity from rail level. :

19. Height of floor from rail level. :

20. Type of coupler provided -Indian Railways Standard

I.	Coupling	:
II.	Buffer	:

21. Engine Make, Model, Power Rating etc.

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

Annexure-VIII

Following information as detailed below is required for processing the case for issue of provisional speed certificate for new machine

Name of the machine----------Model----------

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, solid height, working height, dynamic range, stiffness and locations etc.
5.	Characteristics of the dampers if used, and over all damping factors and locations of dampers. Calculation of the following frequency of the vehicle to be attached :- Bouncing ii) Pitching iii) Rolling Wave length of free axle and bogie
6.	Write up and salient design calculation on suspension system, type of suspension-whether it is of coil suspension with or without dampers and laminated bearing springs and double link suspension.
7.	What are lateral clearance of axle box / horn, wheel flange/rail and other locations for the negotiability of the vehicle on curve and turn out (enclose Vogels Diagram for negotiability on maximum degree of curve and turn out permitted on Indian Railways) of new and worn out wheel.
8.	Wheel and axle assembly drawings
9.	Calculation for flange force
10.	Technical specifications of Vehicle supplied.
11.	Calculation of natural frequency
12.	Calculation of spring characteristics and critical speed of the vehicle.
13.	Simulation result showing ride index, lateral force and acceleration results.
14.	A certificate regarding the speed of the vehicle for which it has been designed.

Annexure-IX

ACCEPTANCE CRITERIA DURING OSCILLATION TRAILS

1. The speed potential of the machine offered by the supplier 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 supplier 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 as per Third Report of the Standing Criteria Committee, Revision-1: Criteria for assessment of stability/riding of rolling stock, (Document No. TG-CR-4.2.3-2, March 2013) with latest amendment over which there are no temporary speed restrictions and which is considered by the Railway as being in a generally run-down condition for mainline standards, but without speed restrictions. The vehicle will be tested generally for new and worn clearance conditions and where relevant for operation in the forward and backward directions. The vehicle selected for tests will be one in average condition for normal maintenance.

2. The criteria applicable for establishing speed potential as per Third Report of the Standing Criteria Committee as applicable on date (21.04.2022) is given below for general information purpose which may be amended from time to time:

i) A lateral force lasting over a length of more than 2 m should not exceed the Prud-Homme's limit of k (1+P/3) tones. Where P is the axle load in tones, k=0.85 for wooden sleepers and k=1 for concrete sleepers.

ii) 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 0.55gboth in vertical and lateral directions. The peak values up-to 0.6 g may be permitted if the records do not indicate a resonant tendency in the region of peak value.

v) In the case of such vehicles where measurement of forces is not possible, the evaluation shall be in terms of ride index based on the accelerations measured as detailed in Para2 (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 with cant deficiency as prescribed in IRPWM-June, 2020 with latest amendment and lateral force and derailment coefficient of accelerations as the case may be.

3. SELECTION OF TEST TRACK (Third report of the standing criteria committee, revision-1: Criteria for assessment of stability/riding of rolling stock, (Document No. TG-CR-4.2.3-2March-2013) with latest amendment:

3.1. Oscillation trials shall be conducted over a section containing the following:

(i) A Tangent (straight) track - of about 1 km length. Efforts shall be made to conduct trials over two such stretches.

(ii) A Station Yard having facing/trailing points, and
(iii) A curved track having about 2ºcurves of length about 700-800m. Normally, above criteria shall be applicable. However, in case of non-availability of 2ºcurves fit for requisite speed, following shall be applicable:

- For C&M I Vol I Standard Track: A curved track having 1.75º to 2.2ºcurve of about700-800 m and a curved track having 0.5º to 1ºcurve of length about 700-800 m.

- For other than C&M I Vol I Standard Track: A curved track having $1.75^0$to 2.2^0 curve of about 700-800 m and a curve track having $1^0$to 1.5^0curve of length about 700-800 m.

3.2. Indian Railways track is classified in two categories:

- Main line track - fit for operation less than 110 Kmph,
- High Speed (C&M I Volume I) track, permitting operation upto 160 kmph.

3.3. Since main line standard track permits speeds less than 110 kmph, in case the test vehicle is designed to run at speeds 110 kmph and beyond, its Oscillation trials become necessary on High-Speed track also.

3.4. A vehicle suspension should be so designed that it should be able to run freely on all Indian Railways tracks (in certain cases, it may become necessary to place a restriction in running of vehicle on some track structures due to various reasons). Since Oscillation trials cannot be conducted all over the Railway system, the section chosen for detailed Oscillation trials should be a representative 'run down' section. The section should generally be such that 90% of Indian Railways track should be better than this section - the philosophy being that if a vehicle manages to run satisfactorily on this track stretch, it will be able to run satisfactorily anywhere else on Indian Railways.

3.5. At present, the track geometry parameters are 'peak based' and not Standard Deviation based. Subject to fulfilment of stipulations of 2.4 above, the parameters of the selected track should be as per the following:

Parameters	Main line Standard (Speeds below 110 kmph)
Unevenness	B or C
Twist	B or C or D
Gauge	B or C
Alignment	B or C

Parameters	Category	Extent of irregularities
Broad Gauge		
(1) Unevenness (3.6 M chord).	A B C D	0-6 mm. (inclusive) 6 mm. (exclusive) to 10 mm. (inclusive) 10 mm. (exclusive) to 15 mm. (inclusive) Above 15 mm
(2) Twist (3.6 M base)	A	0-5.0 mm. on chart (up-to and inclusive of

Note- 1 mm./M = 3.6 mm. on chart		1.39 mm./M)
	B	5-7.5 mm. on chart (1.39 mm./M to 2.08 mm./M inclusive)
	C	7.5-10.0 mm. on chart (2.08 mm./M to 2.78 mm./M inclusive)
	D	Above 10.00 mm. on chart (above 2.78 mm./M.)
(3) Gauge	A	Up-to and ±3 mm. (inclusive)
	B	±3 mm to & ±6 mm. (inclusive)
	C	Above ±6 mm
(4) Alignment (7.2 M. chord)	A	Up-to 3mm versine (inclusive)
	B	More than 3 mm and less than 5 mm versine.
	C	5 mm. versine and above.

For certain trials only limited sections can be available due to constraints of axle load, speeds, bridges, signaling, structures etc. For such limited sections, if test stretches are not available as per above criteria, stretches should generally be selected such that 90% of the track of these limited sections should be better than the stretch chosen for conduct of trials for issue of speed certificate. However, the limitation of trial shall be clearly indicated in speed certificate issued subsequent to such trials.

3.6. After detailed oscillation trials have been completed and the safe speed thereby determined, a 'Long Confirmatory Run' should be conducted in each of the configurations as per requirement. The basic idea of the 'long run' is to confirm that the values of parameters are in general conformity with the values found in the detailed trial section.

(a) Cover a long distance (say, 10-50 kms) at the maximum speed determined by oscillation trials of the configuration.
(b) Cover a few 'hard spots' like level crossings, culverts and bridges as far as possible. Riding of the vehicle over such points (resonance or amplitude build up) will be specially mentioned in the trial report.

Annexure-X

Details of Rails and Sleepers used for different Track structures

Sr. No	Rails		
	Rail Section	**Weight (kg/m)**	**Height (mm)**
1.0	60 kg 90 UTS	60.34	172
2.0	52 kg 90 UTS	51.89	156
3.0	52 kg 72 UTS	51.89	156

Rail as per RDSO specification no. IRST-12-2009 with the latest corrigendum and up to date correction slips issued.

Sr. No	Plain Track Sleepers				
	Description	**Length (mm)**	**Width (bottom) (mm)**	**Height (mm)**	**Weight (kg.) (approx.)**
1.0	Wider Sleeper (Drawing no. RDSO/T-8527)	2750	285	235	350
2.0	Concrete Sleeper (Drawing no. RDSO/T-2495 & 2496)	2750	250	210	300

Annexure-XI

Salient features of the Braking System of the Machine

1.0 Braking System

Machine should be equipped with proper braking system to ensure safety and controls the machine in case of an emergency as well as in routine operation while moving in travel, working and train formation mode.

1.1. The machine shall be fitted with the compressed air brakes system which shall apply brake equally on all wheels and provision shall be made to connect the Indian Railways standard locomotives.

2.0 Vehicle should have provision of following braking mechanism.

2.1. Direct Brakes:

Machine should have provision of direct braking system to be operated by compressed air. The pneumatic valve should be provided to operate at system pressure of 7 kgf/cm^2 with dual type pressure gauge, Air regulator and Reservoir. SA-9 Brake system with hand lever being used in Indian Railways may also be used. Effective braking distance certificate should be submitted at ruling gradient of 1 in 33, 1 in 60 and for flat locations. This system is applicable for machine braking only. This system should be provided in both cabins.

2.2. Indirect Brake:

Indirect Brake should be capable to stop the machine in case of pressure drop and should be compatible to connect with Indian Railways standard locomotives. This indirect braking system should have separate Air reservoir, KE valve and Air charging valve with through connected steel Brake pipes to connect Locomotives in travel mode during pulling of vehicle in train formation. System may have existing braking A-9 type of valve being used in Indian Railways. Manufacture design should have compatibility to connect Locomotive of Indian Railways train brake system. This system should be provided in both cabins.

2.3. Emergency Brakes:

This system should be connected with indirect braking system for sudden braking in emergency. This system shall be equipped with Pneumatic valve. Operation of Pneumatic valve should be with hand lever. This emergency system shall be connected with BP of machine and shall be operative through indirect braking system. This system should be provided in both cabins.

2.4. Mechanical Parking brake:

Machine should be equipped with wheel operated system connected to braking lever with rigid chain link arrangement. This system should be capable to stop the machine in rolling condition during emergency. This shall also be used after parking of machine to prevent rolling of machine in standstill condition. This system should be provided in one cabin only.

2.5. Parking brake:

Machine should be equipped with spring loaded pneumatically operated parking brake system. In this system, braking of one bogie is to be carried out with spring loaded Pneumatic Cylinder. Brake should automatically be applied on wheels if air pressure falls below 3 bar or by application of knob after parking of vehicle.

Annexure-XII

Check list for drawings, documents, certificates etc.

SN	Documents/Drawings	Contract specification clause no.	Submitted (Y/N)
1.	Welding standard certificate.		
2.	Dynamic simulation report		
3.	Worn wheel profile		
4.	The details design calculation along with material parameters and standard followed for manufacturing of wheels and test reports as per standard followed.		
5.	The details design calculation along with material parameters and standard followed for manufacturing of non-powered axle and test reports as per standard followed.		
6.	The details design calculation along with material parameters and standard followed for manufacturing of powered axle and test reports as per standard followed.		
7.	Hauling capacity of machine		
8.	Tenderer shall furnish following information: (i) Make and model of the engine (ii) Name of agency which will provide after sales support and assured supply of spare parts **(iii)** Details of diesel engines and its conformity with the engines already operating on track machines in Indian railways		
9.	Fuel tank capacity		
10.	Supplier shall provide the necessary technical details and circuit diagrams of all electronic/electrical, hydraulic and pneumatic parts.		
11.	Types of brakes (i) Direct (ii) Indirect (iii) Emergency brake (iv) Spring loaded parking brake (v) Mechanical parking brake		
12.	List of safety equipments		
13.	Emergency backup system details		
14.	List of tool kit, manuals (Operating, Maintenance & Spares parts list), circuit diagram (electrical, hydraulic & pneumatic) and technical literature/drawings and troubleshooting guides/manuals in English language for operation, servicing, maintenance, assembly overhauling and periodic overhauling.		
15.	Dimensional drawings with material description of items like rubber seals, washers, springs, bushes, metallic pins etc.		
16.	Detailed technical drawings and specifications (along with dimensional drawings for preparation of ultrasonic testing procedure) of all types wheels and axles used in the machine.		
17.	Details of portable diesel operated D.C. welding generator.		
18.	The tenderer's shall quote, apart from main equipment, separately for the mandatory spares as well as for recommended spares required for two years of operation along with description of part number, quantity, cost, whether imported or indigenous. The expected life of components/spare parts shall be advised along with their condemning limits. The supplier shall be		

	responsible for the subsequent availability of spare parts to ensure trouble service for the life of the machine (25 years).		
19.	Advantages/functions of optional equipment, if provided and also indicate whether such equipment is already in use on machine elsewhere indicating the user railway system.		
20.	Copies of the Maker's certificate guaranteeing the performance of the machine shall be supplied in duplicate along with the delivery of each machine.		
21.	Documents and drawings (duly signed with seal) in English language in hard (A3 size) & soft copies with high resolution		
22.	Infringement Description		

Annexure-XIII

List of drawings		
SN.	**Item**	**Compliance status (Y/N)**
1.0	GA drawing & MMD	
2.0	Suspension drawings	
3.0	Worn wheel profile	
4.0	Bogie arrangement drawing (type of bogie)	
5.0	Coupler & buffer drawing (type of coupler)	
6.0	Air brake circuit drawings	
7.0	Brake rigging arrangement drawing	
8.0	Engine make, Model & power	
9.0	Transmission system details	
10.0	EBD Calculation	
11.0	Vogel diagram	
12.0	Dynamic Simulation Results	
13.0	EMI/EMC certificate	
14.0	Technical Details (Annexure) of technical specifications	

Annexure-XIV

List of dimensions to be marked in drawings and details required to be submitted:

SN	Infringement Description	Status (Y/N)	(To be marked in)
1.0	**Wheels & Axles**		
1.1.	Wheel gauge, or distance apart, for all wheel flanges		Worn wheel profile
1.2.	Wheel diameter on the tread of new carriage or wagon wheel, measured at 63.5 mm from the wheel gauge face.		
1.3.	Projection for flange of new tyre, measured from tread at 63.5mm from wheel gauge face		
1.4.	Thickness of flange of tyre, measured from wheel gauge face at 13 mm from outer edge of flange.		
1.5.	Width of tyre		
1.6.	Incline of tread		
1.7.	Worn out wheel diameter		
2.0	**Height of Floors**		
2.1.	Height above rail level for floor of any unloaded and loaded vehicle		GAD
3.0	**Buffers & Couplings**		
3.1.	Distance apart for centres of buffers		GAD
3.2.	Height above rail level for centres of buffers & CBC couplers Max (unloaded): Min (loaded):		
3.3.	Bogie type		
3.4.	Coupler type		
4.0	**Wheel Base & Length of Vehicles**		
4.1.	Distance apart of bogie centres for bogie vehicles.		GAD
4.2.	Rigid wheel base for bogie truck of any vehicle		
4.3.	Length of body or roof for bogie vehicles.		
4.4.	Length over centre buffer couplers or side buffers for bogie vehicles.		
4.5.	Distance apart between any two adjacent axles		
4.6.	Distance from adjacent bogie centre to end of body or roof on either side of vehicle		
4.7.	Length of the machine over headstock		
5.0	**Maximum Moving Dimensions (In Diagram ID)**		
5.1.	MMD drawing No. is to be mentioned		GAD
5.2.	Maximum width of Vehicle		GAD & MMD
5.3.	Maximum height above rail level at centre		MMD
5.4.	Maximum height above rail level at sides		MMD
5.5.	Minimum height (clearance) above rail level when fully loaded		GAD & MMD
6.0	**Details of joint between vehicles if more than one unit**		**GAD**
7.0	**Technical information of vehicles**		
7.1.	Maximum Design Speed (Own power & In train formation)		GAD
7.2.	Maximum Axle Load (in empty and loaded condition)		

7.3.	Maximum Tractive Effort per axle in tones		
7.4.	Maximum Braking Force per axle in tones		
7.5.	Weight of Vehicle (Tare & Gross) in tones		
7.6.	Height of Centre of Gravity (CG) of vehicle above rail level		
7.7.	Engine Make, Model & power rating		

Annexure XV

Track Geometry as per EN-14363 of Indian Railway Track for Oscillation Trials

Speed Band	Speed (kmph)	Unevenness				Alignment			
		TL90	TL70	TL50	QN3	TL90	TL70	TL50	QN3
SB-I	>130	2.45	1.65	1.30	12.14	1.89	1.23	0.99	8.81
SB-II	>110 &<=130	2.83	2.00	1.57	13.08	2.10	1.43	1.15	8.99
SB-III	>100 &<=110	3.73	2.45	1.90	16.59	2.52	1.63	1.29	10.64
SB-IV	<=100	3.74	2.53	1.97	18.26	2.65	1.72	1.36	12.18