

PRICE: Rs. 2680.00



भारत सरकार
रेल मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS



SPECIFICATION
FOR
NG DIESEL HYDRAULIC LOCOMOTIVE
(2'-6" gauge)
(Excluding Kalka-Shimla Section)

TENDER SPECIFICATION No.- MP- 0.08.00. 47(Rev.0.00)
JUNE-2002

Issued by
vuqla/kku vfHkdYi ,oa ekud laxBu

लखनऊ . २२६ ०११

RESEARCH DESIGNS & STANDARDS ORGANISATION
LUCKNOW - 226 011

CONTENTS

Chapter	Description	Page No
I	GENERAL General, Detailed operating requirements and overall dimensions, Vibration, Noise level, Contractual terms, Design development and approval of drawings, Quality assurance plan, Stage Inspection, Inspection and acceptance test, Performance test, Series manufacture, Commissioning, Maker's Certificate, Descriptive instructions pamphlet, Service and spare parts catalogue, Supply of drawings, Spare parts, Photographs, Training, Service engineering, Testing kit, Warranty.	1 - 11
II	POWER, TRANSMISSION & CONTROL EQUIPMENT Diesel engine, Cooling equipment, Transmission, Axle drive gear boxes, Cardan shaft, Auxiliary alternator, Battery, Control equipment & instrument, Control system, Speed indicator & speed recorder, Flasher light.	12- 17
III	VEHICLE DESIGN Under frame, Bogie design, Wheels, Axles & axle boxes, Draw & buffing gear, Cattle guard, Brakes, Sanding gear, Wind screen, Wiper, Horn, Cab & super structure, Fuel tank arrangement, Electrical fittings, Fire extinguisher, Piping, Painting & marking.	18 - 23

ANNEXURES

Sl. No.	Description	Annex.No
1.	Equipment layout drawing SK.DP - 3666	I
2.	Maximum Moving Dimension SK.DP-3667	II
3.	General Arrangement Drawing SK.DP- 3668	III
4.	TE Vs Speed Curve G/DP - 1130	IV
5.	Particulars of Equipment	V

**Specification
for
NG Diesel Hydraulic locomotives (2'-6" gauge)
(Other than Kalka-Shimla Section)**

CHAPTER I

1. GENERAL

- 1.1 This specification covers manufacture and supply of minimum 700 hp (at site) diesel hydraulic locomotive suitable only for operation on 762 mm (2'-6") gauge sections of South Eastern Railway. This specification shall also be applicable for developing/building a suitable locomotive for other NG section (2'-6") of Indian Railways (excluding Kalka-Shimla Section) by suitably changing the operating parameters indicated in the clauses 2.1.5, 2.1.7, 2.1.9, 2.1.12, 2.1.13, 2.1.18 and 2.1.19.
- 1.2 The locomotive shall be similar or superior to the existing ZDM3 locomotives (Re-powered with hydraulic transmissions with hydrodynamic converters) in operation and should require minimum maintenance and shall be provided with cabs at both ends for better visibility.
- 1.3.1 The locomotive shall be built as B'-B' type and within the overall dimensions as indicated in RDSO Drg. No. SK.DP- 3666 & 3668 placed at Annexure –I&III respectively.
- 1.4 Efforts shall be made to use components interchangeable with the existing Narrow Gauge (NG) ZDM3 locomotives of Indian Railways.

2. DETAILED OPERATING REQUIREMENTS AND OVERALL DIMENSIONS

- 2.1 The locomotive shall conform to the principal dimensions and operating requirements specified hereunder :-

.1	Gauge	: 762 mm
.2	Type	: B' - B'
.3	Service	: Mixed traffic
.4	Installed Horsepower	: Minimum 700 hp at site (cont. rating)
.5	Nominal axle load	: 9.0 t
.6	Site conditions	: Ambient Temperature Maximum = 55 °C, Minimum- 0 °C Altitude = 0 - 2500 meters above MSL Relative humidity = 0 – 100% RH
.7	Adhesive weight	: 36 t minimum
.8	Wheel diameter over tread	: New : 700mm Condemning : 640 mm
.9	Max. operating speed	: 50 km/h
	Max. test speed	: 55 Km/h
.10	Schedule of moving dimensions	: Indian Railways Schedule of maximum, minimum and recommended dimensions-1922, revised and reprinted in 1963.

- .11 Overall dimensions : The equipment layout and overall dimensions of locomotive shall be within the maximum, minimum and recommended dimensions specified in Indian Railway schedule of dimensions (NG) 762 mm gauge. The proposed loco with equipment layout should be submitted along with the offer.
The lateral dimension and shape of the locomotive shall be such that while negotiating the sharpest specified curve, the profile is within the extra clearance permitted in the section. Vogel's diagram indicating the throw-over at the end and in the middle with the proposed loco shall be submitted with the offer.
- .12 Sharpest curves and turnouts : The locomotives shall be capable of negotiating sharpest curve of 14° and standard 1 in 8.5 turnout in both directions.
- .13 Ruling gradient : 1 in 80.
- .14 Clearance from rail level : Under fully loaded condition and with wheels worn to condemning limit, no component shall infringe the minimum clearance of 76 mm from rail level.
- .15 Dynamic augment : 30% max.*
- .16 Lateral flange force per axle : 3.3 t max.*
- .17 Unsprung weight per bogie : 2.3 t max.*
(* These should be as low as possible)
- .18 Track structure :The minimum standard of track shall be 60 R rails (15% wear) , wooden sleepers with M +3 density, CST-69 and depth of ballast cushion (50 to 150 mm) below the sleepers on compacted and stable formation.
Permitted irregularities on 'Gauge':
i) on straight : -3 mm to + 6 mm
ii) on curves with radius greater than 175 m : -3 mm to +15 mm
iii) on curves with radius less than 175 m : up to ±20 mm
iv) Unevenness on 2.74 m base : 8 mm
Twist on 2.74 m base : 15 mm(3mm/m)
Alignment on 7.2 m base: 5 mm
- .19 Load to be hauled
- i) **Minimum 450 t on level tangent track at lower speed. #**
 - ii) **12 N.G. coaches with gross weight of approx. 22 t each at maximum operating speed. #**

(# The tenderer shall indicate the balancing speed in both the cases with supporting calculations)

2.2 The performance of the locomotive shall meet tractive effort (T.E.) versus speed graph specified in RDSO G/DP- 1130, placed at Annexure - IV. TE Vs Speed curve shall be submitted along with the offer.

2.3 Vibration

The equipment, sub-system & their mounting arrangement shall be designed to withstand satisfactorily the vibration and shocks encountered in service.

2.4 Noise Level

The noise level in the driver's cab shall be kept as low as possible by limiting the noise through appropriate measures (acoustic insulation, sound absorption). The noise level in the driver's cab with doors and windows closed shall be < 70 dB (A).

3. CONTRACTUAL TERMS

3.1 The contractor shall have experience in design and manufacture of diesel hydraulic locomotives and must have manufactured at least ten numbers in last five years (excluding toy locomotives). The details of such locos supplied in the last 5 years shall be furnished, indicating the places where the locos were supplied. The details shall include gauge, maximum gradient, curvature, haulage capacity, type of engine, transmission, hp, speed etc. Certificates of performance from the users shall be submitted along with the offer,

3.2 To facilitate the examination of tender offer, the tenderer is required to offer comments clause by clause of this specification either conforming the acceptance of the clause and elaborating each details, where necessary, or indicating deviations there from. A comprehensive specification of the locomotive offered shall also be submitted along with the above comments.

3.3 The contractor shall be entirely responsible for the execution of the contract strictly in accordance with the terms and conditions of the specification notwithstanding any approval which RDSO or the Inspecting Officer may have given: -

- of the detailed drawings prepared by the contractor,
- of his Sub-contractors for materials, components and sub assemblies,
- of other parts of the work involved in the contract,
- of the tests carried out by the contractor/sub- contractor or RDSO or the Inspecting Officer.

4. Design Development & Approval of drawings

4.1 The contractor shall develop the design based on the details given in this specification and sound engineering practices. The entire design data shall be submitted in metric units with calculations to RDSO within 8 weeks from the date of placement of order.

RDSO shall give remarks within 3 weeks and the firm shall submit the drawings for approval within next 4 weeks after incorporating the above corrections /modifications.

- The detailed calculations shall cover :-
- Hauling capacity calculation.
 - Braking effort and EBD calculation on plane section with maximum load/without load.
 - Calculation of centre of gravity of locomotive from rail level, details of weight transfer calculation , tractive effort versus speed curve .
 - Locomotive balancing calculations in longitudinal and lateral modes.
 - Life rating calculation of axle box bearings.
 - Stress analysis of all the major stress parts of the locomotive like under frame, bogie, primary suspension springs, secondary suspension springs, axle calculation, brake rigging including hand brake .
 - Calculation for safety against derailment. Calculation for stability of the locomotive against wind force shall be supplied.

4.2 The equipment layout & general arrangement of locomotive shall generally be to RDSO Drg. No. SK.DP. – 3666, & 3668. Contractor shall prepare a full set of working drawings in standard sizes complete in all respects. The drawings shall include general arrangement of locomotive, equipment layout and power pack arrangement & mounting details, diagram showing maximum and minimum moving dimensions, under frame assembly (section and details), Bogie arrangement (section and details), Wheel axle and axle boxes, Suspension arrangement (primary & secondary), brake schematic & rigging arrangement including hand brake and its details, Sanding gear arrangement with details, cab superstructure with two end cabs & control panel layout details, fuel tank arrangement with details, pivot lubricating arrangement, engine & transmission cooling arrangement with radiator mounting details, exhaustor & compressor drive arrangement, axle drive gear box, control system & cubicles etc. Apart from it, submission of any additional drawings shall be indicated by RDSO to the contractor during design approval stage and contractor has to comply it. All drawings shall include description of equipment, weight, quantity per loco, material specification, welding symbol, tolerances etc.

4.3 The **drawings** complete in all respects shall be submitted in triplicate to RDSO within 8 weeks from the date of placement of order. RDSO shall give remarks within 3 weeks and the firm shall submit the drawings for approval within next 4 weeks after incorporating the above corrections /modifications.

4.4 Materials used for manufacture of the locomotive shall comply with the relevant IRS or BIS specifications. Alternate materials can be used only with the prior approval of RDSO. Where IRS or BIS specifications do not exist, the contractor shall submit proposed material specification for approval of RDSO.

4.5 "Approval" to the drawings denotes general "acceptability" of the design features. Notwithstanding such an approval, the contractor will be wholly and completely responsible for the adequacy of the design of the loco offered. The contractor when submitting proposals on designs for approval of the RDSO shall draw specific attention to any deviation or departure from the specification involved in his proposals or drawings.

- 4.6 To facilitate filing of drawings in RDSO, it is essential that each drawing prepared for the manufacture/operation/maintenance shall be marked so that it can be identified. The contractor shall, therefore, ensure that all prints submitted are marked legibly at the right hand bottom corner. The following information is required in respect of each drawing submitted:
- .1 Contractor's drawing Number
 - .2 Contractor's name and date of submission
 - .3 Contract Number
 - .4 Nomenclature of the locomotive
 - .5 Description

5. **QUALITY ASSURANCE PLAN**

- 5.1 The contractor shall formulate Quality Assurance Plan (QAP) detailing the methodology proposed to be followed to ensure quality product. QAP shall cover quality assurance procedures to be followed during all stages of design, planning, procurement, manufacture, testing, commissioning and servicing. The contractor shall define the role of each functional group in the organisation for achieving the required quality of the products and submit a comprehensive document of QAP.
- 5.2 The tenderer whose bid is accepted shall be required to submit a detailed "Quality Assurance Plan" which shall supplement the "Quality Assurance Manual" by giving details of how the quality of specific product is proposed to be assured. Manufacture of locomotive shall commence only after "Quality Assurance Plan" is approved by the purchaser.
- 5.3 The above shall apply to contractor as well as sub- contractors.

6. **STAGE INSPECTION**

- 6.1 All the materials, components, fittings, sub-assemblies etc., covered by this specification shall be subjected to inspection by the Inspecting Officer and shall be to his entire satisfaction.
- 6.2 The inspecting officer shall have powers to:
- Adopt any means as deemed fit to satisfy himself that the materials used are strictly to the specifications.
 - Take samples for such tests as he may consider necessary, by an approved metallurgist selected by him, whose report shall be final and binding on the contractor.
 - Visit at any reasonable time and without previous notice, the contractor's and sub-contractor's works to inspect the progress and quality of the work. The contractor and sub-contractor(s) shall provide free of charge all facilities viz. equipment, labour, gauges etc. required for this purpose.
 - Reject materials or fittings not conforming to the relevant specification. Such rejected parts shall be replaced by the contractor without extra charge.

6.3 Tests of materials and fittings shall, as far as possible, be carried out at the respective manufacturer's works. All tests shall be at the cost of the contractor.

7. **Inspection and Acceptance tests of Prototype locomotive.**

The contractor shall manufacture prototype locomotive for inspection and acceptance of purchaser or his authorized representative before commencement of series production.

8. **Performance Test**

8.1 The tenderer shall **submit the test schedule during design approval stage** and these will be mutually agreed between RDSO and contractor.

8.1.1 The prototype locomotive will be subjected to various performance, dimensional, functional tests etc. at manufacturer's works as per the approved test scheme.

8.1.2 A test scheme shall be finalized based upon the inspection of prototype for the remaining locomotives.

8.2 **Weighment**

On completion of the prototype, the weights upon each wheel in full working order shall be ascertained by fully calibrated measuring equipment. The locomotive shall be weighed 4 times successively, to get the arithmetic mean.

Check shall be made to ensure the following:

- .1 Total weight is within $\pm 2\%$ of nominal weight.
- .2 Axle load is within $\pm 2\%$ of nominal axle load.
- .3 The difference between the loads on two wheels of same axle shall not be more than 4% of the axle load.

The weighment will be done on the prototype only.

8.3 **Oscillation Trial**

The prototype locomotive shall be cleared for oscillation trial only after it has successfully cleared the tests under Clause 8.1 & 8.2. The trial will be conducted on track stretches in run down condition up to a speed 10% higher than the operating speed. The trial scheme for oscillation trial, braking and haulage capacity shall be finalized by RDSO.

8.3.1 **Acceptance Criteria for oscillation trial.**

- .1 The lateral/transverse forces lasting more than 2 meters shall not exceed $0.85 (1 + P/3)$ tones, where P is the axle load in tonnes.
- .2 Isolated peak values exceeding the above limit are permissible provided the record shows a stabilizing characteristics of the locomotive subsequent to the disturbances.

- .3 A simultaneous assessment of the lateral force exerted by the adjacent axles at a point where a high lateral force is exerted by a particular axle.
- .4 A derailment coefficient should be worked out in the form of ratio between the lateral force (H_y) and the wheel load(Q) continuously over a period of $1/20^{\text{th}}$ second, the value H_y/Q shall not exceed 1.
- .5 The values of acceleration recorded at a location as near as possible to the bogie pivot shall be limited to 0.3g both in vertical and lateral directions. The peak value up to 0.35g may be permitted, if the records do not indicate a resonant tendency in the regions of peak value.
- .6 A general indication of the stable running characteristics of the locomotive as evidenced by the movement of the bogie on straight and curved track, and by the acceleration reading and instantaneous wheel load variation.
- .7 In the case of such locos where measurement of forces is not possible, evaluation shall be in terms of ride index which shall not be greater than 4, a value of 3.75 is preferred.

8.3.2 **Braking trials:**

Braking trials for both stationary and running shall be conducted as per requirement of Chapter III.

8.3.3 **Haulage Capacity:**

Trial runs shall be conducted over the sections specified by the purchaser with maximum load as specified to ascertain the hauling capacity of the locomotive.

9. **Series Manufacturing of the locomotive :**

If any modification is required on any assembly/sub-assembly/equipment after the above tests on the prototype then the same will be carried out by the contractor at his cost. **Series manufacture shall not commence until and unless the prototype has been approved by the purchaser or his authorized representative.**

9.1 **Inspection and Acceptance tests of balance locomotives.**

The inspection of the balance locomotives will be carried out as per clause 8.

10. **Commissioning of the Locomotive**

The locomotive shall not be dispatched or packed until it has been passed by the Inspecting Officer. Such passing shall in no way exonerate the contractor from obligation in respect of quality and performance of the equipment. In the event of dispute between the Inspecting Officer and the Contractor, the decision of the Purchaser shall be final and binding.

- 10.1 The consignee railways shall inform the contractor after the locomotive has reached at site. The locomotives shall be commissioned by the contractor within 4 weeks after intimated by the consignee. The consignee railways will issue a commissioning certificate after it has been successfully commissioned.

11. **MAKER'S CERTIFICATE**

- 11.1 Copies of Maker's certificate guaranteeing the performance of the locomotive shall be submitted in duplicate along with the delivery of each locomotive.
- 11.2 Test certificates of major vendor items shall also be supplied along with each locomotive.

12. **DESCRIPTIVE INSTRUCTIONS PAMPHLETS**

The contractor shall supply to RDSO and the User Railway, adequate number of descriptive instruction OEM pamphlets/manual/brochure pertaining to items like Diesel Engine, Hydraulic transmission, Axle drive, Cardan shaft and brake equipments etc. The pamphlet shall include Dis-assembly and assembly procedure with suitable illustration and diagram/drawing with exploded view along with general arrangement, brake arrangement & schematic, electrical wiring diagram and lubrication diagrams/charts.

13. **SERVICE AND SPARE PARTS CATALOGUES**

- 13.1 Detailed operating manual, maintenance and service manual and driver hand book shall be specifically prepared for the locomotives and atleast 3 copies each of the same shall be supplied free of charge per loco to the consignee and three copies to RDSO. The draft contents of the manuals shall be submitted for approval to RDSO within 4 weeks of clearance of the prototype.

The manual shall include chapters on :

- General characteristics
- Locomotive design and its details including under frame design
- Power equipment & details with mounting
- Fuel, oil and cooling water circuit.
- Grease, oil chart with specification and quantity
- Bogie design & suspension details
- Wheel, Axle & axle set assembly with axle box bearing details
- Brake rigging arrangement with schematic diagram of pneumatic circuit
- Wiring diagram with complete illustration of components
- Controls and safety features & their test procedure,
- Special tools etc.

- 13.2 The manual shall include Dis-assembly and assembly procedure with specific mention of any special tools required for carrying out the above work.

- 13.3 Manual shall include a separate chapter indicating the service and condemning/wear limits & tolerances for various assembly/sub-assembly, where ever applicable.
- 13.4 The manual shall contain a separate chapter pertaining to standard schedule of examination covering all equipments i.e. engine, transmission, axle drive, cardan shaft, controls, brake rigging, suspension etc for trouble free day to day maintenance of locomotive as per Railway maintenance norms.
- 13.5 A separate booklet containing Driver's operating instruction accompanied by suitable illustration and diagram and lubrication chart shall be prepared.

14. **SUPPLY OF DRAWINGS**

The contractor, after inspection and approval of the prototype shall correct, wherever necessary, the drawings and schedule of material conforming to the prototype unit. The contractor after incorporating all changes and modifications shall furnish three copies of final drawings along with schedule of material to RDSO within 4 weeks of clearance of the prototype. Two copies of drawings shall be supplied with each locomotive to the consignee.

One complete set of drawings shall be supplied on reproducible tracing paper with two sets of hard copies and magnetic media in Auto Cad release 14 or 2000 on CD to RDSO after the final approval of Prototype unit. The drawings shall include general arrangement of locomotive, equipment lay out and power pack arrangement, diagram showing maximum and minimum moving dimensions, under frame assembly (section and details), Bogie arrangement (section and details), Wheel, axle and axle boxes, Suspension arrangement (primary & secondary), brake rigging arrangement including hand brake and its details, Sanding gear arrangement & details, cab & superstructure with details, fuel tank arrangement & details, pivot lubricating arrangement, engine, transmission & radiator mounting details, engine cooling arrangement, exhaustor & compressor drive arrangement, axle drive gear box with torque arm assembly, control system & cubicles,

15. **SPARE PARTS**

- 15.1 The tenderer shall submit a list of spare parts and special tools, both indigenous and imported, indicating the name and address of the manufacturers as detailed below:
List – A: Catalogue of unit spares, indigenous and imported, of the principal assemblies of the locomotive such as the diesel engine, transmission, cardan shaft, axle drive, compressor, exhaustor, brake equipment etc. with price.
List – B : Recommended maintenance spares for two years initial requirements. The tenderer shall submit the list of such spare parts giving their detail description, source of supply, part number of the supplier and price of each part.
- 15.2 The tenderer shall be responsible for ensuring subsequent availability of spare parts for efficient working of the respective equipments.
- 15.3 The tenderer shall also submit time bound plan/proposal for indigenous availability of imported components.

- 15.4 A spare part catalogue listing all components manufactured or purchased by the tenderer shall be prepared and the draft of the same shall be submitted to RDSO for approval within 4 weeks of clearance of the prototype. The contractor shall furnish three copies of spare parts catalogue to RDSO and two copies with each locomotive to the consignee free of cost.

All manuals shall be dispatched to the address of the Director General(MP), Research Design and Standards Organisation, Ministry of Railways., Manak Nagar, Lucknow – 226 011.

16. PHOTOGRAPHS

- 16.1 During manufacture colour photographs shall be taken of various assemblies/sub-assemblies especially of the bogie, under frame, power pack and body in various stages of production and of parts, which cannot be conveniently photographed after assembly. After completion, photographs of side and end views of locomotive as also of the interior layout will be taken.

The photographs shall not be less than 380 mm x 255 mm for the side view of the completed locomotive, or less than 255 mm x 200 mm for other views and shall be taken on non-curl film. The negative and three prints of each photograph shall be furnished to RDSO, the prints being mounted on sheet to form complete sets.

17. TRAINING

- 17.1 The contractor shall provide training at the manufacturer's place for at least six working days for adequate number of Indian Railway personnel so that they acquire full knowledge of major assembly/sub-assembly used in locomotive. The training should help IR in trouble-shooting, maintenance and operation of the locomotive.
- 17.2 Besides the above, adequate number of maintenance and operating staff shall also be trained in the homing shed during the commissioning of the locomotive.

18. SERVICE ENGINEERING

- 18.1 The contractor shall provide, at his own expense, the services of competent engineers during the guarantee period and also during the first major overhaul of such nos. of locomotives as may be agreed upon. The service engineers shall be available for testing/commissioning of the locomotive, training of operating and maintenance staff. The service engineers shall also advise the Railways on maintenance, testing and operating facilities considered necessary for efficient performance of the locomotives.
- 18.2 The contractor shall submit a proposal for AMC with quotation for major equipments for trouble free maintenance of locomotive.

19. TESTING KIT

The contractor shall indicate testing equipment required for ensuring optimum performance and trouble free service of locomotive as well as their major assemblies and sub-assemblies. The tenderer with complete quotations shall submit details of testing equipments.

20. **WARRANTY**

The tenderer shall at his expense, replace any part of the equipment failing or proving unsatisfactory in service and attributed to defective/faulty design, defective material or bad workmanship within a period of 24 months from the date of its commissioning. The period of warranty would stand extended by the duration for which the locomotive remains inoperative. Further, any design modification made in the equipment as a result of any defect/ fault/short coming in the original design, the period of 24 months would commence from the date the modified equipment is put into service.

CHAPTER II

POWER, TRANSMISSION AND CONTROL EQUIPMENT

1. DIESEL ENGINE

- 1.1 The diesel engine shall be as per following details :-
- | | | |
|----|--------------------------------------|--|
| .1 | Make | Cummins India Ltd. Pune. |
| .2 | Type/Model | VTA-1710 L |
| .3 | Type of cycle | 4 cycle |
| .4 | Number & arrangement | 12 cylinders V-type Turbo charged after cooled |
| .5 | Traction rating under Site condition | 700 hp minimum |
| .6 | Minimum idling speed | 600 rpm |
- 1.2 The supplier shall indicate the total horsepower required for auxiliaries with break up power requirements for each of the auxiliary machines at rated output.
- 1.3 The diesel fuel oil used shall be to Indian Standard Specification No. 1460 (1995), read with Amendment No.2-1999.
- 1.4 The engine shall be provided with a flywheel mounted flexible coupling. The coupling shall be of adequate capacity to withstand high deflection and torque (at starting, stopping and due to any misfiring of the cylinders) so that no damage is caused to transmission and engine components in service.
- 1.5 The detailed tensional vibration analysis of the complete dynamic system under normal engine working as well as under conditions of one cylinder misfiring for the complete operating range including 10% over speed shall be furnished.
- 1.6 Filters for engine intake air shall be of adequate airflow capacity/filtering efficiency to ensure satisfactory performance under dusty environment.
- 1.7 The tendered shall submit graphs showing the BMEP/engine output torque and SFC at all notch levels in case a stepped throttle control is proposed. In case steeples control is proposed, the graphs for above parameters may be given at 25%, 50%, 75% and full load.
- 1.8 The tenderer shall furnish a copy of type Test report of the engine by a statutory body in support of their claim regarding performance, reliability and specific fuel consumption. In case the engine offered is not type tested earlier, the testing shall be carried out in the presence of RDSO's authorized representative.
- 1.9 The exhaust emission shall be below the limit laid down as per the latest norm for industrial engines. The tender shall indicate the value under various load conditions.
- 1.10 The tenderer shall submit along with his offer, complete engine data as per **Annexure-V**, as applicable to the engine offered.

1.11 Air intake arrangement with filters & vacuum restrictor indicator, ducts and exhaust arrangement shall be compatible with engine system and shall be located within the overall dimensions of the engine hood.

2. Cooling equipment.

2.1 The cooling system shall be of adequate capacity to dissipate the heat load of the engine together with heat dissipating requirement of the transmission oil to the extent of 30% of the maximum horsepower input to the transmission under most adverse site conditions.

2.2 The fan and the cooling arrangement shall be of adequate capacity to cope with the service demands under the most severe temperature conditions. The maximum water temperature shall not normally exceed 95°C and the safe operating temperature of the engine. The system shall be adequately pressurized and vented to avoid all possibilities of cavitations.

2.3 The calculations in support of above shall be submitted mainly of :-

- Cooling requirement for all sources of heat (with break up)
- Heat dissipation characteristics of the radiator and its resistance characteristics.
- Radiator fan characteristics showing the air flow verses total head at different fan speeds.
- Cooling system-matching calculations.
- Schematic cooling circuit diagram showing water, oil and air flow through each equipment.
- Mounting arrangement of radiator assembly, fan drive arrangement shall be submitted along with the offer.

2.4 The type of cooling arrangement and layout shall be discussed and finalized during design approval stage before commencement of manufacture of prototype locomotive.

3. HYDRAULIC TRANSMISSION

3.1 Hydraulic transmission using hydro – dynamic elements with hydraulically reversible arrangement shall be used. The transmission shall be of proven design for rail road application and preferably of indigenous make. It shall be offered with built-in Hydro-dynamic braking device. The transmission shall include all the necessary accessories, standard attachments and safety devices.

3.2 Transmission shall be suitable for multiple unit operation.

3.3 The transmission shall be suitable for cardan shaft connection with the diesel engine and axle drive gearboxes.

3.4 Special care shall be taken to ensure reliable and efficient performance of the transmission without developing a temperature beyond the safe permitted limit during full load operation. The system shall not call for any special care on the part of the driver to protect the transmission from damage under any circumstances.

- 3.5 The performance of the locomotive with this transmission shall not be inferior to the graph shown in Annexure-IV.
- 3.6 The tenderer shall furnish a copy of type Test Report of the transmission from a Statutory body in support of their claim regarding performance and reliability. In case the transmission offered is not type tested, the same will be type tested in presence of RDSO representatives. The schedule of testing will be finalized during design approval stage.
- 3.7 In case an indigenous transmission is offered by the tenderer , in that case, the tenderer must indicate the number of such transmissions manufactured and supplied in the last five years. The performance report of such supplied transmissions from the user shall be submitted.
- 3.8 The tenderer shall submit along with his offer, complete data as per Annexure – V, as applicable to the transmission system offered.

4. AXLE DRIVE GEAR BOXES

- 4.1 The primary and secondary axle drive gearboxes shall be of proven design and robust in construction, preferably indigenous and shall be capable to transmit continuous rated horsepower/maximum torque with adequate safety margin. The tenderer shall furnish the maximum torque transmission capacity of the axle drive gearbox at start.

5. Cardan shaft

- 5.1 The cardan shaft shall be of robust design and well proven in performance capability, suitable for transmitting rated horse power and maximum torque encountered during operation. The tenderer shall furnish detailed technical data of the cardan shaft offered, between engine and transmission, transmission to axle drive and between two axle drives of the powered bogie.
- 5.2 The tenderer shall submit along with his offer, complete data as per Annexure – V, as applicable to the cardon shaft offered.

6. AUXILIARY ALTERNATOR

- 6.1 Engine driven (preferably engine mounted) auxiliary alternator with rectifier equipment for the speed range between idle and maximum of engine speed shall be provided to supply 24V DC. This auxiliary alternator shall cater to:-

- .1 Two headlights, one at each end, shall be 250 W, 24 V, sealed beam type with provision of dimmer.
- .2 Cab lighting load at 24V, approx. 40 W.
- .3 Battery charging and controls.

7. **Battery**

- 7.1 Lead acid storage batteries to IS:7624 of 24 V, 490 AH capacity with a fuse protection and of reputed make shall be provided in the locomotive. The battery shall cater to the following loads:
- .1 Six cranking of engine at 10 secs. Interval.
 - .2 All auxiliary generator load of the locomotive for two hours in case of auxiliary generator failure.
- 7.2 Terminals for charging the batteries from external charging equipment shall also be provided. The location of the batteries shall be such that there is no danger of their getting damaged due to tools and equipment inadvertently falling on them. If the cells are packed in two rows in the battery box, two rows shall be separated by a hylam sheet.

8. **CONTROL EQUIPMENT AND INSTRUMENT**

- 8.1 Adequate control equipment including gauges, instruments, safety devices shall be provided for safe and satisfactory operation of the locomotive. The equipment shall be so arranged on the control desk that it will be within the easy reach of the driver with a central control stand. The layout of the instrument panel shall be ergonomic.
- 8.2 Interlock shall be provided such that the locomotive can be operated from **one end only at a time**.
- 8.3 The loco shall generally work as a single loco. The loco control system shall have the provision to modify to operate two locomotives in multiple. The tenderer shall quote for single and multiple control separately.

9. **Gauges, Instruments and safety devices:**

The following gauges, instruments and safety devices shall be provided for safe and satisfactory operation of the locomotive:

A. **Diesel Engine**

- .1 Engine starting switch/push button.
- .2 Engine throttle master controller
- .3 Lube oil pressure gauge
- .4 Lube oil temperature gauge
- .5 Cooling water temperature gauge
- .6 Battery charge/discharge Ammeter
- .7 Engine hour meter and engine speed indicator
- .8 Engine stop switch/push button
- .9 Engine Emergency stop switch/push button
- .10 Glow type Fuel level indicator similar to WDM₂ loco.
- .11 Cooling water level indicator
- .12 Booster Air Pressure gauge

All gauges shall be of proven and reliable design with self illuminating dials. Graduations of the gauges shall be in metric units. The instrument panel shall be arranged in the form of a desk and suitably located on the control panel to ensure better crew efficiency and faster response.

B. Transmission

- .1 Transmission oil pressure gauge
- .2 Transmission oil temperature gauge

C. Other gauges

The locomotive shall be provided with the following gauges pertaining to brake system. All the gauges should be LED type self illuminated.

- .1 Main reservoir pressure gauge : 6 inches
- .2 Brake cylinder pressure gauge.
Duplex type indicating brake
cylinder pressure of both the bogies : 4 inches
- .3 Vacuum train pipe gauge : 4 inches
- .4 Vacuum reservoir gauge : 4 inches
- .5 Vehicle speedometer cum speed recorder (km/h)

D. Safety Devices

- .1 Water temperature high :Engine to idle
- .2 Transmission oil temp. high :Engine to idle
- .3 Low lube oil pressure :Engine to shut down
- .4 Engine speed high :Engine to shut down
- .5 Radiator water level low :Engine to shut down
- .6 Emergency engine stop :Fuel supply to engine cut off
- .7 Emergency brake application :Engine to idle
- .8 Provision of dead man device

E. Audio-visual Signals / Reference Panel Lights

- .1 Lube oil temperature high
- .2 Water temperature high
- .3 Low water level
- .4 Low lube oil pressure
- .5 Engine overspeed
- .6 Engine shut down by safety relay
- .7 Engine starting
- .8 Battery discharging

10. CONTROL SYSTEMS

- a. The control system of the locomotive shall have provision for multiple unit operation.
- b. The locomotive builder shall submit the pneumatic and electric control diagram for all systems of the locomotive for approval of RDSO.

11. **SPEED INDICATOR CUM RECORDER**

Speed indicating and recording equipment of 0 -100 km/h range, shall consist of an axle box mounted opto-electronic speed sensor, one speed indicator, one recorder cum indicator unit with micro controller containing FLASH EEPROM internal memory for calculating and recording the journey data a portable FLASH memory card for external memory. The recorder shall be suitable for recording speed-time distance and other required data continuously for 30,000 Km. The equipment shall conform to RDSO specification No. MP-0.3700-01 (Rev.02) of 2001. In case of offered locomotive with two cabs, one cab shall have recorder-cum-indicator and other cab only indicator.

12. **FLASHER LIGHT**

The locomotive shall be provided with Flasher light using high intensity LEDs conforming to spec. No. ELRS/Spec/Flasher Light/0017 (Rev.0) of Dec.'2001.

CHAPTER III

VEHICLE DESIGN

1. UNDERFRAME

- 1.1 The under frame shall be constructed from rolled steel sections and plates conforming to IS: 2062 and shall be designed to withstand the maximum static squeeze load of 200 t without any sign of permanent distortion.
- 1.2 Provision shall be made for lifting the locomotive complete with all equipment but without bogies by either overhead cranes or high lift jacks. For this purpose necessary lifting points shall be provided on the under frame of the locomotive. These points shall be clearly marked. Provision shall also be made for lifting the locomotive at the headstock, for re-railing.
- 1.3 Provision shall be made in the end structure of under frame for the fitment of draw and buffing gear as used in the existing diesel locomotives in service on 762 mm gauge sections of IR.
- 1.4 The under frame shall be provided with suitable cut-outs, mounting pads and brackets for fitment of engine, transmission and other equipments.
- 1.5 Fuel tank shall be suitably located in the underframe.
- 1.6 During construction of under frame suitable pre-camber shall be provided. The calculation of pre-camber is required to be submitted.
- 1.7 For laying out pipes, holes may be required in the webs of the longitudinal member of the under frame which shall be drilled and must not be flame cut. These holes should be drilled at the neutral axis of the webs. In one vertical plane, not more than one hole should be drilled. If more holes are required, these should be staggered in vertical plane as far apart as possible. For more than 40 diameter holes, compensating patches shall be welded on the webs before drilling the holes.
- 1.8 The under frame shall be provided with bogie pivot adaptable to standard ZDM3 loco bogies as used in the existing locomotives as per CLW drawing no. –1D/12.02.101

2. BOGIE DESIGN

- 2.1 The bogie shall be 2-axle, 2-stage suspension type and fabricated from steel to IS: 2062. The bogie frame arrangement and details shall be in accordance with CLW Drg. No. 1D/26A.04.101, 102 and 103.
- 2.1 Bogie suspension arrangement and details shall be in accordance with CLW Drg. No. 1D/12A.07.119. Two hydraulic dampers of adequate capacity shall be provided across secondary suspension as shown in CLW Drg. no. 2D/12A.07.115

- 2.3 Axle box guide assembly and details shall be same as in the existing bogies of ZDM3 locomotives so as to make the bogies, wheel set, axle box and axle with final drive arrangement completely interchangeable with the existing ZDM3 locomotives.

3. **WHEELS, AXLES AND AXLE BOXES**

- 3.1 The wheels shall be monobloc, multiwear, heavy duty made from rolled steel to IRS R-34 (With latest alteration) similar to those used in Narrow Gauge locomotives.
- 3.2 Material of axle shall be to 25 Cr Mo 4 V (DIN 17200) and IRS specification R43(latest revision) and the design shall be finalised in consultation with the axle box roller bearing manufacturer, axle drive gearbox manufacturer and RDSO.
- 3.3 Roller bearing grease lubricated axle boxes shall be provided on axle Journals.
- 3.4 The wheels, axles and axle boxes shall be completely interchangeable with the existing ones fitted in ZDM3 locomotives as individual units also as a complete assembly.
- 3.5 Distance between wheel flanges shall be 698.5 ± 0.5 mm.
- 3.6 The wheel profile of the locomotive shall be to RDSO drawing No. 12.05.07.

4. **DRAW AND BUFFING GEAR AND CATTLE GUARD**

- 4.1 Draw and Buffing Gear shall be specified by the user railways and shall be as being used on the existing diesel locomotives in service.
- 4.2 The locomotive shall be provided with cattle guards at both ends.

5. **BRAKES**

- 5.1 The locomotive shall be provided with brake system that shall supply compressed air for brake on the locomotive in conjunction with vacuum brake on trailing stock. Brake valve/equipments should be in accordance with RDSO General specification No. MS005(Revised) of brake equipment for diesel and electric locomotives.
- 5.2 All wheels of the locomotive shall be provided with brakes.
- 5.3 The brake rigging components shall be completely interchangeable with those fitted in existing ZDM3 locomotives.
- 5.4 50 mm bore vacuum train pipe shall run throughout the length of locomotive and terminate on end beams. The ends shall be provided with standard fittings as per Indian Railway Specification No. R-3 or as per the existing ZDM3 locomotives.
- 5.5 It shall be ensured that :- Brake cylinders are provided with shear checks and welded on bogie frame. Moving components of brake-gear are provided with safety straps to prevent them from falling on the track in the event of their failure.
- 5.6 The locomotive shall be equipped with both exhaustor and compressor.

- .1 The exhauster shall be to SLM-Maneklal VL-30 model or its equivalent.
 - .2 The locomotive shall be provided with air compressor-having capacity (FAD) of 350 lpm at 8 Kg/Cm² at idle speed of the engine with suitable governor to cut-in and cut-out the compressor at 7 and 8 Kg/Cm² pressure respectively.
 - .3 The compressor shall be ELGI-TRC-1000 model or its equivalent. These equivalent exhauster and compressor shall be of proven design & performance and shall be completely interchangeable with the existing equipment with particular reference to capacity, dimensions, drive and mounting arrangements.
- 5.7 Sizes and shapes of 'V' belts and pulley grooves shall conform to the specification IS:2494.
- 5.8 A hand brake actuated by a wheel, shall be provided to hold light locomotive on a grade in emergency, which will also be used as parking brake. The hand brake shall act on two wheels of bogie through the set of shoes and rigging provided for the power brake, similar to existing ZDM3 locomotives.
- 5.9 There shall be provision for three types of brake operating valves in loco cab as mentioned below:
- .1 Two independent brake valves, one each near two side windows for application of air brakes on loco.
 - .2 Two automatic brake valves, one each near two side windows for application of vacuum brakes on trains and simultaneous synchronized air brake application on loco.
 - .3 One emergency brake valve located suitably within the approach of the driver from either seat in the cab for direct destruction of vacuum for application of brakes on train and loco.
- 5.10 Automatic and independent brakes valve should be of graduated and self lapping type in brake application and release.
- 5.11 Arrangement shall be provided to isolate driver's brake valve of inoperative control stand.
- 5.12 The system shall provide automatic application of brakes on loco and train during train parting. Engine should also come to idle during train parting.
- 5.13 Suitable automatic drain valves shall be provided on each main reservoir.
- 5.14 The loco shall be provided with brake cylinders with brake block arrangement having brake power of 80% of loco weight at 100% rigging efficiency similar to ZDM3 loco arrangement. Brake cylinder pressure shall not generally exceed 3.8-kg/sq. cm.
- 5.15 Provision shall be made for working the locomotive in Multiple unit operation from brake point of view.
- 5.16 Provision shall be made for operating blow-down cock from the cab itself so that Main air reservoir can be released.

- 5.17 The supplier shall submit details of brake system covering brake schematic diagram, working principle, literature on brake equipment proposed along with offer and get the brake system approved from RDSO before manufacture of the prototype.

6 **SANDING GEAR**

- 6.1 Pneumatic sanding shall be provided on outer side of the wheels of both the bogies and shall be effective in either direction of travel. There shall be one sand box for each wheel and shall be bogie mounted. It shall be preferably of pedal type so that it may be possible to operate with foot.

6.2 **WIND SCREEN WIPER**

Pneumatic wind screen wiper and sun visor of approved design shall be provided on front and rear looking windows.

6.3 **HORNS**

The locomotive shall be provided with two horns in accordance with RDSO Specification No. MP. 0.99.00.04.

7 **CAB AND SUPERSTRUCTURE**

- 7.1 The locomotive shall be of hood type design with cab at both ends having aerodynamic profile for better view during operation.
- 7.2 Cab sides shall be provided with drop windows. Louvre windows shall also be provided on each side.
- 7.3 Entrance doors, opening inwards, shall be provided on both sides of the cab. Reliable locks shall be provided so that the cab be securely locked. Also suitable fastening shall be provided to secure the doors in open position.
- 7.4 All window and door glasses shall be of the shatter proof type plate glasses set in sun and heat resisting synthetic rubber sections. The size of all window glasses shall be standardized with those provided on ZDM3 locomotives.
- 7.5 Cushioned hand rest shall be provided on the lower edge of the sliding window.
- 7.6 Pneumatic windscreen wiper and Sun visor of approved design shall be provided on front and rear looking windows.
- 7.7 Two upholstered collapsible and adjustable seats shall be provided in each cab for driver and assistant driver.
- 7.8 Rain water gutters over the windows and doors and drain pipes in cab shall be provided in such a way that free drainage of water is possible.

- 7.9 The cab paneling shall be of decorative laminated plastic material. The shade shall be finalised in consultation with RDSO.
- 7.10 The cab shall be fully insulated using non-hydroscopic materials. Particulars of heat insulation shall be submitted to RDSO.
- 7.11 Two fans shall be provided on the driver's cabin in suitable locations for driver and assistant driver.
- 7.12 Provision for a tool box shall be made in driver's cab to keep essential tools for emergency use as well as driver's personal belongings.
- 7.13 Provision of charging of walkie talkie in the cab shall be provided during run.
- 7.14 Suitable hand rails and foot steps shall be provided. Any protrusion inside the cab shall be finished smooth and sharp edges rounded off.
- 7.15 The equipment compartment shall be thoroughly braced and firmly secured to the under frame. It shall be designed so as to ensure maximum accessibility for repair and maintenance of the equipment. Water tightness shall be ensured and rainwater shall be drained off under the body by means of suitable drains. Attention should be paid to eliminate water or dust pockets in floors and other structural members of under frame.
- 7.16 Equipment layout in the cab shall be made in a compact desk type cabinet easily accessible to driver and asst. driver. The cab structure and the layout of the instrument panel shall have prior approval of RDSO for ergonomic purposes.

8 FUEL TANK ARRANGEMENT

- 8.1 The capacity of the fuel tank will be such that the locomotive shall be able to cover a minimum distance of 400 km without re-fuelling. It shall have atleast minimum capacity of 1400 litres.
- 8.2 Fuel level gauge of the tank shall be of glow rod indicator type and suitably located so that it is easily visible. Level indicator plate shall be graduated to indicate the total capacity of the tank and shall be located in the middle.

9. ELECTRICAL FITTINGS

- 9.1 The cable layout shall be so done that number of junction boxes; cubicles etc. is minimum and shall be suitably located to facilitate easy maintenance.
- 9.2 Two plug points, one on either side of under frame shall be provided for use of portable electric lamp. Portable electrical lamp with 10 m flexible cable shall also be supplied with each locomotive.
- 9.3 Suitable and independent lighting arrangement shall be provided for the inspection panel so that all instruments and gauges could be illuminated properly when ceiling light is switched off. For cab lighting, a suitable fluorescent tube light of adequate capacity shall be provided.

10. FIRE EXTINGUISHERS

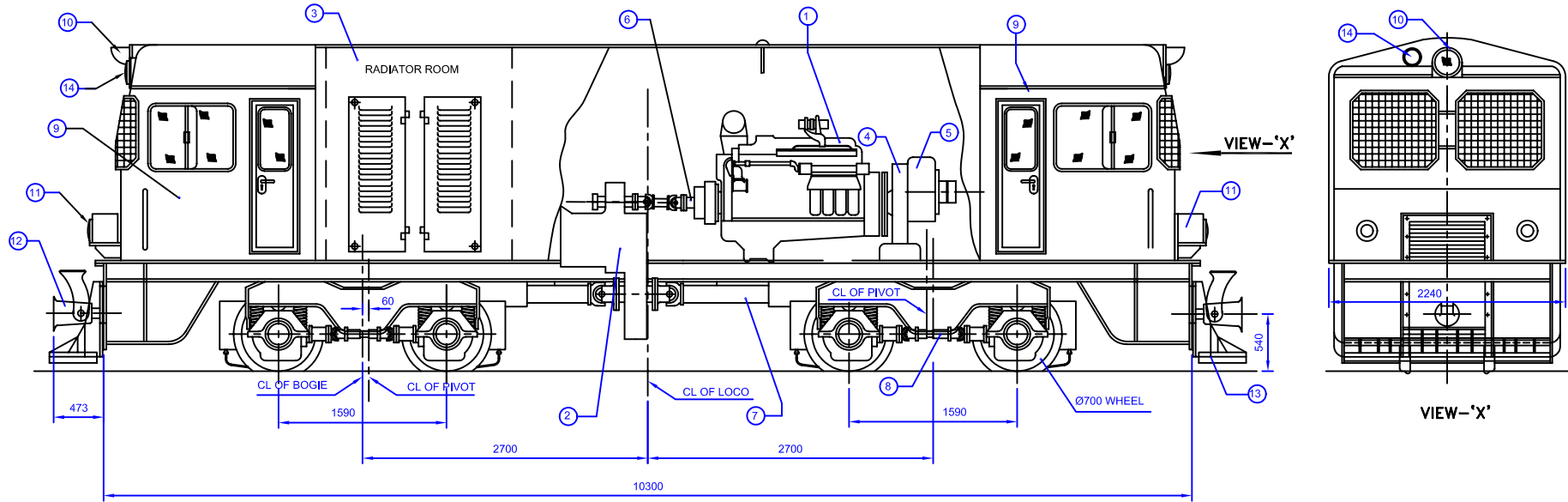
- 10.1 Two fire extinguishers of approved make and capacity shall be provided in each cab of locomotive.

11. PIPING

- 11.1 Steel pipes used shall conform to IS:1239 and taper pipe threads shall be used as per specification IS:554.
- 11.2 In the pipe layout, bends shall be avoided to the extent possible. Where bends are unavoidable, pipes should be bent with maximum possible radius. It shall be ensured that there is no change in section of pipe over the bends. It should be possible to pass a ball of a diameter not less than 90% of the bore of the pipe.
- 11.3 Pipe joints shall be made with standard and approved design of unions and couplings. Drilling holes in the main pipe and welding the branch pipe at right angles over it shall not make 'T' joints. Instead, they should be formed by using standard connection or by weld-lets of approved design.
- 11.4 It should be ensured that pipes are thoroughly cleaned to be free from dirt, sand, scale etc. and ends are free of burrs before being fitted.
- 11.5 Threaded joints shall be sealed only with the approved thread sealants, such as Teflon tape. Care shall be taken that sealing material does not enter the pipe when screwing in and, thus, block the passage.
- 11.6 Leaky joint shall not be sealed with external application of a sealing compound; but joints shall be opened and remade.
- 11.7 During inspection, pipe joints shall be tested with soap and water to detect leakage.
- 11.8 Size of pipes and pipe joints shall generally conform to those used in existing ZDM3 locomotives for interchangeability.

12. PAINTING AND MARKING

- 12.1 The locomotive shall be delivered finish painted. The scheme for marking and painting of the locomotive shall be approved by RDSO and the purchaser. The individual number of the locomotive will be advised by the Railway Board.



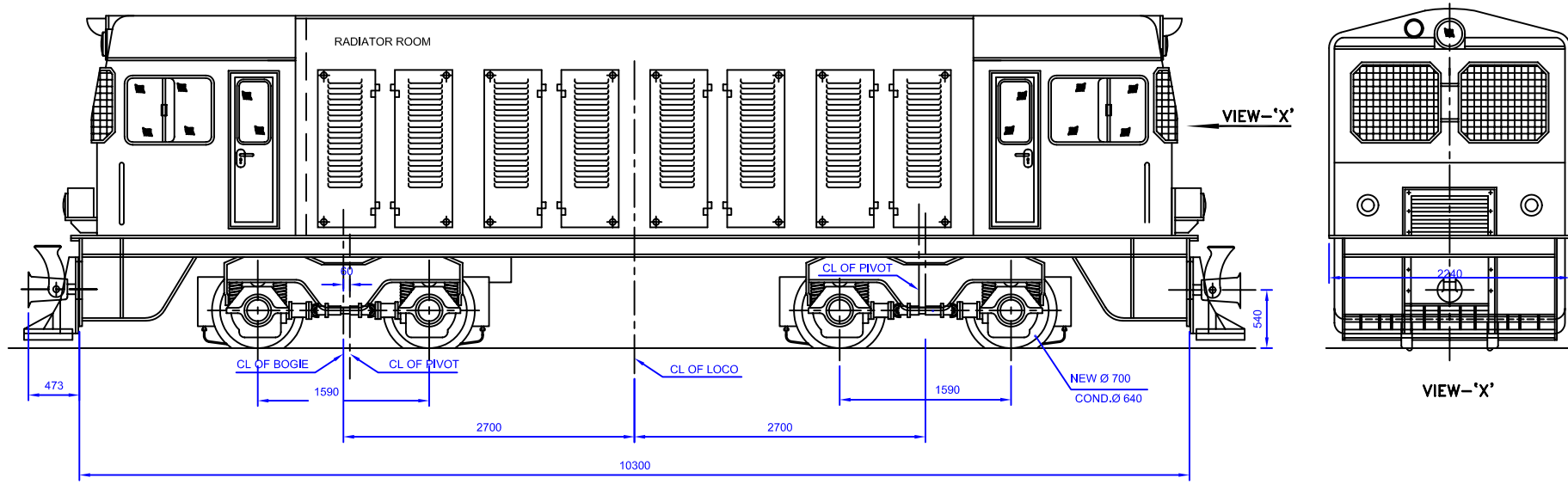
- 1. DIESEL ENGINE VTA-1710
- 2. H.Y.D. TRANSMISSION
- 3. RADIATOR COMPARTMENT
- 4. COMPRESSOR
- 5. EXHAUSTER
- 6. CARDAN SHAFT
- 7. CARDAN SHAFT
- 8. CARDAN SHAFT
- 9. DRIVER'S CAB
- 10. HEAD LIGHT
- 11. MARKER LIGHT
- 12. ABC COUPLER
- 13. CATTLE GUARD
- 14. FLASHER LAMP

D	50
C	25
APPD.	6.3
(M.P. SINHA)	0.8
DT 17/02/03	0.1

SYMBOL	Ra um (MAX)	TOLERANCES ON UNTOLERANCED DIMENSIONS TO IS: 2102 ()
~	50	
∇	25	
W	6.3	
W	0.8	SURFACE ROUGHNESS TO IS: 3073
W	0.1	WELDING SYMBOLS TO IS: 813

ALT	No. OF PLACES	REF. No	DESCRIPTION	ALT. NOTE No.	SIGN	DATE

1	SNo.	I.R. PART No.	DESCRIPTION	No. / LOCO	Wt(Kg) EACH	MATL	SPEC.
APPLICABLE FOR TENDER SPECIFICATION No. MP.0.0800.47 (Rev. 0.00 JUNE 2002)			EQUIPMENT LAYOUT OF DIESEL HYDRAULIC LOCOMOTIVE (2'-6') 762mm GAUGE FOR SER				
SCALE : 1:25			REF:-		FIRST ISSUED		
INDIAN RLYS. R.D.S.O. (MP)			DRG. No. SK. DP. No. 3666		SUPER SEDES SUPER SEDED BY		

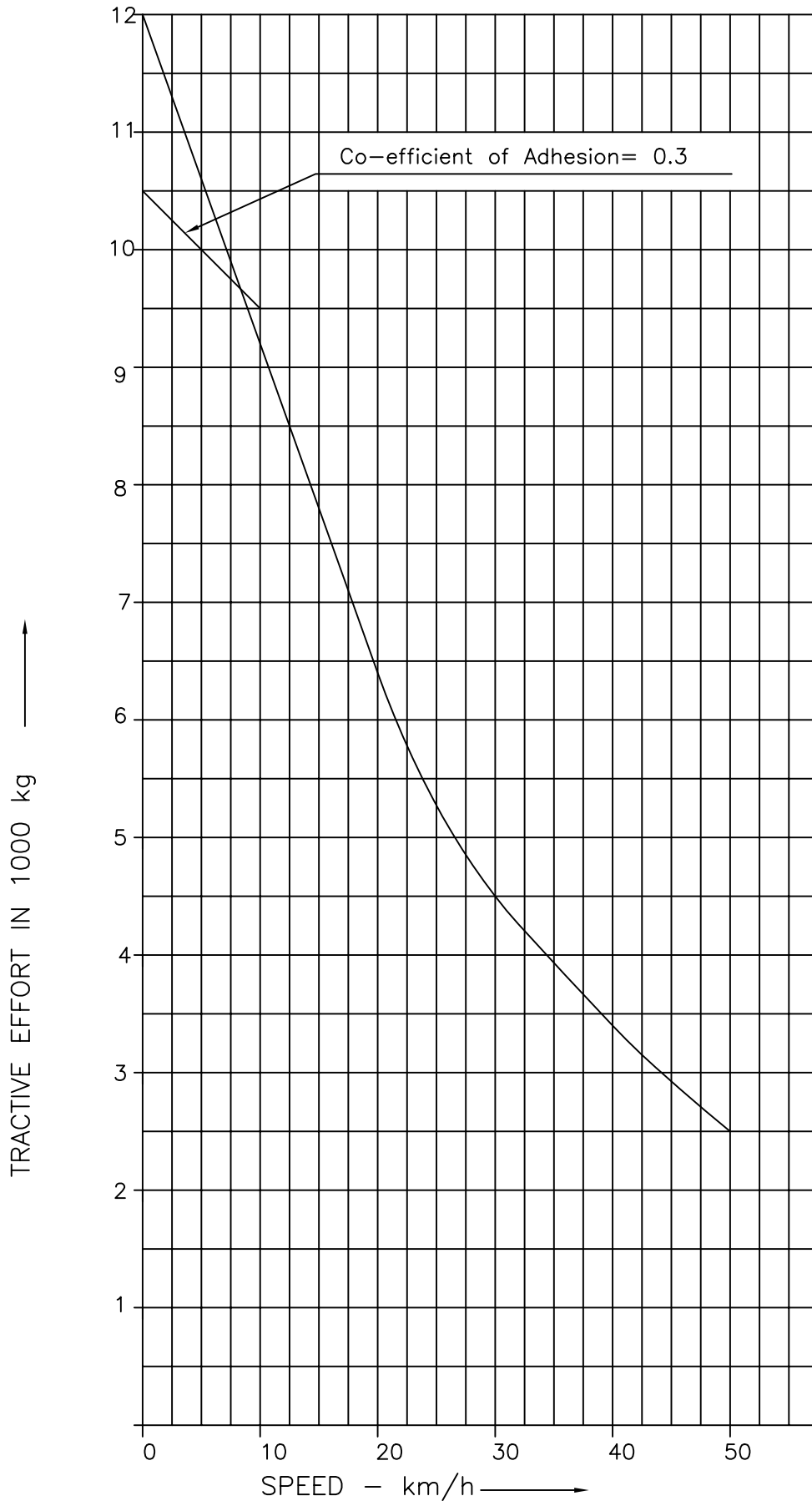


MAXIMUM AXLE LOAD - 8.75t

D	DRG
C	DRG
APPD.	(M.P. SINHA)
DT	17/02/03

~	50	SURFACE ROUGHNESS TO IS:3073
∇	25	
∇	9.3	WELDING SYMBOLS TO IS: 813
∇∇	0.8	
∇∇∇	0.1	TOLERANCES ON UNTOLERANCED DIMENSIONS TO IS:2102 ()
∇∇∇	Ra um (MAXY)	

SNo.	I.R. PART No.	DESCRIPTION	NO. / LOCO EACH	WTRG)	MATL	SPEC.
1		GENERAL ARRANGEMENT DIAGRAM OF DIESEL HYDRAULIC LOCOMOTIVE (2'-6") 762mm GAUGE FOR SER				
SCALE :- 1:25		REF:-	FIRST ISSUED			
ALT.	No. OF PLACES	REF. No	DESCRIPTION	ALT. NOTE No.	SIGN.	DATE
			INDIAN RLYS. R.D.S.O. (MP)	DRG. No. SK. DP. No. 3668		SUPER SEDES SUPER SEDED BY



DJP Tewari

C

APPD.

Dt 24/4/02

APPLICABLE FOR:-

TENDER SPECIFICATION No. MP-0.0800.47 (Rev.0.00) June-2002

DRG.

NO: G/DP-1130

Annexure -V

PARTICULARS TO BE SUPPLIED BY THE TENDERER

1. The following particulars pertaining to diesel engine and auxiliary equipment shall be submitted by the tenderer :-

1.1 Diesel Engine

- I General Data
 - .1 Exact description and model of the engine
 - .2 Rated output of the engine under UIC and site condition
 - .3 Rated engine speed
 - .4 Number and arrangement of cylinders
 - .5 Cylinder bore
 - .6 Piston stroke
 - .7 Compression ratio
 - .8 Mean piston speed
 - .9 BMEP at rated output
 - .10 Normal no load idling speed
 - .11 Peak firing pressure
 - .12 Full test result and data pertaining to UIC or equivalent engine tests
 - .13 Specific fuel consumption at various throttle position with tolerance band under UIC and site conditions Indicate the lower calorific value of the fuel used in arriving at the specific fuel consumption figure.
 - .14 Fuel oil consumption at idle speeds (normal & low)
 - .15. Lube oil consumption at rated output as percentage of fuel oil consumption
 - .16 Derating calculation for site condition
 - .17 Safety devices provided
 - Overspeed
 - Low lube oil
 - Overload
 - High cooling water temperature
 - High lube oil temperature
 - High exhaust temperature
 - High intake temperature
 - Any other
 - .18 Number of engines of this type in traction service
 - .19 Weight of engine excluding oil and water
 - .20 Weight of water contained in the engine
 - .21 Weight of oil contained in the engine
 - .22 Weight of major equipment
 - Turbocharger
 - Charge Air cooler
 - Crank case bare
 - Piston and connecting rod
 - Cylinder liner
 - Cylinder head

- .23 Temperature of exhaust gas at turbo inlet at rated output under UIC and site conditions
- .24 Method of starting giving details of equipment
- .25 Estimated period between top and major overhaul
- .26 Periodicity of overhauling the following critical items
 - Turbocharger
 - Piston and piston rings
 - Air and exhaust valve
 - Main bearings
 - Connecting rod bearings
 - Fuel injection pump
 - Fuel injectors
- .27 Special design features of engine high-lighting the measures which have been taken to achieve : -
 - Lower specific fuel consumption
 - Lower lube oil consumption
 - Reduced thermal and mechanical loading of critical components
 - High reliability
 - Maximum availability
- .28 General arrangement and dimensional details
- .29 Characteristic curves for torque, output and specific fuel consumption for different setting of the fuel injection pump
- .30 Torque-speed curve which the manufacturer considers to be the maximum torque that should be used for rail traction.
- .31 The curve of fuel consumption for no-load running commencing from the minimum idling speed, expressed in kg/h

II Fuel injection system

- .1 Type of fuel injection system
- .2 Nozzle opening pressure

III Turbocharger

- .1 Number of turbocharger used per engine
- .2 Make and model
- .3 Exhaust gas/mechanically driven
- .4 Air flow at rated output
- .5 Speed of turbocharger at rated output
- .6 Types of bearings
- .7 Details of lubrication
- .8 Whether pre and post lubrication provided

IV Charge Air cooler

- .1 Type of cooler
- .2 Details of mounting indicating whether cooler can be removed without removing turbocharger

- V Exhaust System
 - .1 Type of exhaust system
 - .2 Method of cooling
 - .3 Number of exhaust gas entry segments
 - .4 Whether the exhaust manifold is shrouded/ insulated

- VI Piston and rings
 - .1 Material specification of piston & rings
 - .2 Method of cooling
 - .3 Shape of bowl in piston crown
 - .4 Number and configuration of piston rings

- VII Valves
 - .1 Material specification of valve
 - .2 Single/composite type
 - .3 Whether valve rotators used
 - .4 Recommended tappet clearance
 - .7 Angle of valve and seat

- VIII Cylinder Head
 - .1 Material
 - .2 Coolant flow distribution
 - .3 Whether reclaimable by welding

- IX Cylinder Block
 - .1 Material
 - .2 Whether cast or fabricated
 - .3 Is the mounting rigid or on resilient pads
 - .4 Experience regarding block distortion

- X Crankshaft
 - .1 Material specification
 - .2 Type of bearings calculate bearing loads
 - .3 Particulars of vibration damper

- XI Cylinder Liner
 - .1 Material
 - .2 Dry or wet liners
 - .3 Water sealing arrangement between liner and cylinder block

- XII Connecting Rod and Bearings
 - .1 Material of connecting rod
 - .2 Material composition of bearing shells

XIII Governor

- .1 Make and type
- .2 Minimum idle speed, rated full load speed and droop characteristics
- .3 Torque available on the output shaft
- .4 control/ safety feature provided

XIV Cooling Water System

- .1 Detail of cooling circuit
- .2 Type of water pump and its characteristic viz. delivery vs. flow resistance
- .3 Is the cooling system pressurised ? If so, upto what pressure ?
- .4 Max. permitted cooling water temperature at inlet & outlet of circuit
- .5 Normal cooling water temperature at full load under UIC and site conditions
- .6 Radiator construction and dimensional details

XV Lube Oil System

- .1 Details of circuit
- .2 Lube oil pressure at full & idle speed
- .3 Max. temperature at hottest point
- .4 lube oil pump characteristic and power absorption at various points
- .5 Details of all filters used in the lube oil circuit
- .6 Efficiency of filtration and periodicity of attention

XVI Fuel system

- .1 Schematic fuel oil circuit
- .2 Details of fuel oil lift pump and its drive
- .3 Details of filters used in fuel oil circuit
- .4 Periodicity of attention

XVII Intake air system

- .1 Details of engine intake air system
- .2 Type of primary and secondary stage filters and their efficiency
- .3 Pressure drop permitted at the operating point for new and dirty filters
- .4 Periodicity of attention

1.2 Air compressor

- .1 Make
- .2 Model
- .3 Maximum pressure
- .4 Capacity (at idle & full speed of engine)

- .5 Installation drawing showing overall dimensions.
- .6 Weight - dry/full supply
- .7 Cooling
- .8 Graph showing speed Vs. horse power & capacity

1.3 Auxiliary Alternator

- .1 Make
- .2 Model
- .3 Continuous / short time rating with details of voltage and current regulation
- .4 Installation drawing showing overall dimensions.
- .5 Weight

1.4 Hydraulic Transmission

- .1 Make
- .2 Type
- .3 Maximum input hp
- .4 Complete transmission characteristic curves including input power, output power, input & output torque, transmission efficiency for 100%, 75%, 50% & 25% of full load, against output speed.
- .5 Basic characteristic curve of torque converter/ hydraulic coupling
- .6 Normal & max. permissible oil temp. of torque converter
- .7 Weight of transmission dry & with full supply

1.5 Reversing Arrangement

- .1 Method of reversing with full details
- .2 Ratio - forward & reverse

1.6 Axle Drive Gear Box

- .1 Make & Type
- .2 Gear ratio
- .3 Installation and detail design drawings
- .4 Horse power rating & torque and speed characteristic

1.7 Cardan Shaft

- .1 Make & Type
- .2 Torque rating, life rating and permissible angularity
- .3 Minimum compressed length with permissible length compensation
- .4 Installation drawings

-----X-----