

ISO 9001 : 2008	Specification No:	MP- 0.08.00.102	Revision No: 02	Date Issued: 05/12/2014
Specification Title: New Generation Diesel Engine for Application In 1600hp BG DMUs				

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भारत सरकार  
रेल मंत्रालय  
GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS

**SPECIFICATION  
FOR  
NEW GENERATION DIESEL ENGINE FOR APPLICATION  
IN  
1600hp BG DMUs**

**Specification No. MP- 0.08.00.102 (Rev.- 02)  
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**Issued by**  
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## **PREFACE**

1. **BRIEF DESCRIPTION:**

This document contains the specification of the new generation diesel engine for the application in 1600hp BG DMUs over Indian Railways.

2. **FOREWORD:**

This document is a specification of new generation diesel engines required for 1600hp BG DMUs over Indian Railways. This is the document which indicates the broad characteristics of a diesel engine. The specifications given in this document are generic and are expected to change in future with the development.

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## **PART - I : GENERAL REQUIREMENTS**

### **1. INTRODUCTION:**

- 1.1 The proposed diesel engines shall be utilized for 1600hp BG DMUs over Indian Railways. A standard set of DMU comprises five cars (DPC+4TCs) with one diesel engine per DPC. For break down cranes there shall be one engine per crane.
- 1.2 DPC i.e. Driving Power Car of DMUs shall be fitted with one 1600hp diesel engine as a prime mover for traction requirement. This document contains the technical specification of these diesel engines.
- 1.3 The technical requirements mentioned in this document are the basic features of the diesel engines. It is the responsibility of the manufacturer/supplier to supply the engine as per requirements of this specification.

### **2. ENVIRONMENTAL / CLIMATIC CONDITIONS:**

- 2.1 The engine & its accessories shall be in continuous operation under the following atmospheric and climatic conditions:

i.	Ambient temperature	-10 to 55 °C. The maximum temperature under the sun in summer could reach 70 °C. Provision shall be made by OEM for the satisfactory operation of engine in the extreme atmospheric conditions. For working in extreme cold conditions, the OEM must make provisions for starting aid and anti freezing of various fluids.
ii.	Altitude	From Sea level to 1800 m. The OEM shall provide deration chart for working at higher altitudes i.e. up to 1800 m.
iii.	Humidity	100% saturation during rainy season
iv.	Rainfall	Very heavy in certain areas.
v.	Atmospheric conditions	Extremely dusty and desert terrain in certain areas. The dust content in air may reach a high value of 1.6 mg/m <sup>3</sup> . In many iron ore and coal mine areas, the dust concentration is very high affecting the filter & air ventilation system.
vi.	Coastal area	Humid & salt laden atmosphere with maximum pH value of 8.5, sulphate of 7 mg per litre, maximum concentration of chlorine 6 mg per.

- 2.2 The equipment and their mounting arrangements shall withstand satisfactorily the vibrations and shocks normally encountered in service as indicated below:

(i)	Max. Vertical acceleration	-	3.0 g
(ii)	Max. Longitudinal acceleration	-	5.0 g
(iii)	Max. Transverse acceleration	-	2.0 g
('g' being acceleration due to gravity)			

### **3. SFC and lube oil consumption**

- 3.1 OEM shall indicate the specific fuel consumption & lube oil consumption at maximum rated output & load.

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4. **TRAINING**

The OEM shall arrange training to Indian Railways personnel at their premises or premises of his sub-contractors on operating & maintenance & upkeep of the engine & its accessories supplied for a cumulative period of around 40 man days free of cost at the said premises. The to and fro fare and living expenses shall be borne by Indian Railways.

5. **SERVICE NETWORK:**

OEM should have a wide service network in India (at least 5 points i.e. North, East, West, South & Central zones) for maintaining these diesel engines. Also, OEM shall submit a list of service network with their service points.

6. **SERVICE SUPPORT AFTER SALES:**

OEM must provide spares and service support to Indian Railways for 20 years after sales of engine or engine's codal life, whichever is more.

7. **MINIMUM NO. OF ENGINE SUPPLIED BY OEM:**

OEM shall submit quantity & details of the engine supplied to Railways. For BG DMUs the OEM should have supplied at least 10 engines for similar application to Indian Railways/any foreign Railways.

8. **WARRANTY:**

The OEM shall at his expense, replace any part of the equipment failing or proving unsatisfactory in service due to defective/faulty design, defective material or bad workmanship within a period of 24 months from the date of commissioning in service or 30 months from date of delivery whichever is earlier. The period of warranty shall stand extended by the time taken by the OEM in replacing the defective component from the date of lodging of complaint by the user Railway.

9. **IPR DISCLAIMER:**

The respondents must also provide the following undertakings in signed copies.

9.1 **UNDERTAKING BY EQUIPMENT MANUFACTURE:**

All respondents shall provide a signed copy of the undertaking on "INFRINGEMENT OF PATENT RIGHTS". The undertaking shall be as under:

*Indian Railways shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of similar components in the design & development of this item and any other factor not mentioned herein which may cause such a dispute. The entire responsibility to settle any such disputes/ matters lies with the OEM/ supplier.*

*Details/ design/documents given by them are not infringing any IPR and responsible in absolute and full measure instead of railways for any such violations. Data, specifications and other IP as generated out of interaction with railways shall not be unilaterally used without the consent of RDSO and right of Railways/RDSO on such IP is acceptable to them.*

10. **DECLARATION OF CONFIDENTIALITY OF SUBMITTED DOCUMENTS BY OEM:**

While submitting a new proposal /design, OEM must classify their documents confidentiality declaration, such as:

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## **PART- II : Specification of 1600hp Diesel Engine**

### **1. INTRODUCTION:**

- 1.1 The proposed 1600hp diesel engines shall be utilized for BG DMUs. A standard set of DMU comprises five cars (DPC+4TCs).
- 1.2 DPC i.e. Driving Power Car of DMUS shall be fitted with one 1600hp diesel engine as a prime mover for traction requirement. This document contains the specification of those diesel engines.
- 1.3 **SCOPE OF SUPPLY FOR 1600 HP DIESEL ENGINES FOR BG DMUs APPLICATION:**

The following equipments shall be in the scope of supply. All the assembly & sub assembly shall be within the envelope size mentioned in the **Clause no. 4.**

i.	Complete engine (1600hp continuous rating) with standard accessories and its mountings. The engine shall be supplied with initial fill of lube oil & fuel oil, coolant, one change of lube oil along with lube oil and fuel oil filters after initial commissioning.
ii.	Suitable Anti-vibration mountings.
iii.	Air intakes & air filter assembly with mounting arrangements.
iv.	Exhaust & turbocharger along with after cooler assembly with mounting.
v.	Cooling system with radiator alongwith its mounting arrangements.
vi.	Expansion tank for radiator with glass type water level gauge & electronic type LCWL indicator with a provision to provide in driver's cabin of DPC.
vii.	Engine room ventilation alongwith its mounting arrangements
viii.	Excitation control & speed governing system. The supplier shall facilitate and supply all details required for interfacing of electronic control module of the engine with loco controller.
ix.	Engine driven alternator or through aux. converter for charging battery for engine cranking.
x.	Hydrostatic/electric cooling equipment complete with radiator.
xi.	Hoses and fittings and a suitable engine room ventilation system.
xii.	Centrifuge type lube oil cleaner with mounting. The OEM will provide lube oil cleaning arrangement as per their design.
xiii.	Air compressor with the capacity of 750 LPM at idle rpm and 2600 LPM at rated rpm or more driven with the mentioned engine or motor –compressor –air dryer module of capacity 1000 LPM.
xiv.	Controls & gauges as per <b>Clause no. 2.6</b>

### **2. FUNCTIONAL REQUIREMENTS:**

#### **2.1 DIESEL ENGINE FOR 1600HP BG DMUs:**

- 2.1.1 The engine shall be a fuel efficient diesel engine capable of producing not less than 1600hp (continuous) at 1800 rpm under standard conditions (as per clause 4.2.1 of UIC 623-2 OR, it is 100 kPa, 25°C and 30% Rh) and provided with suitable speed control exciter control.
- 2.1.2 The engine shall work satisfactory with AC-DC and AC-AC transmission system.
- 2.1.3 The offered diesel engine shall meet the emission standard of **UIC-II** or equivalent standard. However, the tenderer shall clearly spell out the emission standards of the engine being offered.
- 2.1.4 The diesel engine shall be supplied with the features of EFI (electronic fuel injection).

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## 2.2 COOLING SYSTEM FOR 1600HP DIESEL ENGINE FOR BG DMUs:

- 2.2.1 The cooling equipment for diesel engine shall be required to work efficiently under climatic conditions specified under **Clause 2 (page no.2)**. Apart from meeting the cooling requirement of diesel engine including after cooler, the cooling equipment shall be required to dissipate heat of lube oil, hydraulic oil used for hydrostatic fans (**in case of hydraulic drive**) with 30% choked condition of radiator. Airflow required for the radiator fan shall be at least 15% more than actually required to make up for any reduction in air flow due to train movement.
- 2.2.2 The initial filling of hydraulic oil for hydrostatic operation of fans in the cooling system as proposed by the supplier shall be in the scope of supply.
- 2.2.3 The drive for hydrostatic pump / electrical motor for radiator fan /ventilation fan shall be from extension of engine crankshaft on free end of engine.
- 2.2.4 Hydraulic hoses of ICF/RDSO approved sources with adequate factor of safety shall be used for cooling system. The hoses shall be properly routed and secured so that it does not fail due to vibration or infringement. The hoses shall be of proper length without undue bend restricting the flow. The metallic /rubber hydraulic pipes mounted & routed on the floor shall be properly covered with suitable cover of adequate strength to protect from damage while carrying out maintenance by maintenance crew and ingress of contaminants.
- 2.2.5 For mounting of radiators, fan drive & ventilation system, ICF drawing no. DMU/DPC7 -6-4-702 (Sheet 1 & 2) for Radiator Room Arrangement & drawing no. DMU/DPC7 -6-4-701 (Sheet 1 & 2) for Engine Room Arrangement shall be followed. The drawings can be collected from ICF, Chennai. Any other arrangement proposed by OEM shall be approved by RDSO.
- 2.2.6 The drawings (with latest alteration) for mounting of fan drive arrangement for radiator and ventilation fan in DPC shall be submitted to RDSO for approval.
- 2.2.7 **Expansion tank:** It shall be provided at a suitable location for ease of maintainability. It shall be provided with water level indicator in the driver's cab. The capacity of the tank may be indicated (in litres) on the tank itself. Its filling point shall be provided with pressurised cap & strainer. The layout of the tank alongwith filling arrangement as proposed by OEM shall be approved by RDSO.
- 2.2.8 Suction type roof mounted radiator fan and ventilation fan shall be provided so that the fan sucks air from side-mounted radiator / side panel filters and blows out through roof opening provided for fan respectively. Layout of radiator fan & ventilation fan arrangement shall be approved by RDSO.
- 2.2.9 During operation at maximum output, the radiator fan and ventilation fan shall not be source for noise and vibration.
- 2.2.10 The tenderer shall submit following details and calculations for the cooling system:
- i. Cooling requirement for all sources of heat (**with break up**)
  - ii. Heat dissipation characteristics of the radiator and its resistance characteristics.
  - iii. Radiator fan characteristics showing the air flow Vs total heat at different speeds.
  - iv. Cooling system-matching calculations.
  - v. Schematic cooling circuit diagram showing water, oil and airflow.
  - vi. Installation drawing of radiator, fan assembly for both cooling and ventilation arrangement shall be provided.
  - vii. Cooling proving trial including testing of hydraulic oil cooler, shall be conducted at contractor's premises to prove adequacy of the offered cooling system for prototype in presence of authorised representatives of purchaser. The maximum temperature of hydraulic oil shall not exceed 70 °C.



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2.2.11 In case The hydraulic oil tank shall be of stainless steel. It shall be provided with oil level indicator, temperature indicator, oil level switch and oil filter with restriction indicator. A micro/limit switch shall be provided and interlocked with delivery side shut-off valve.

### 2.3 **POWER TRANSMISSION FOR 1600HP BG DMUs:**

2.3.1 The contractor shall submit proposed drawings for engine mounting base frame.

2.3.2 The engine shall be mounted with all driven equipment/accessories on a common base design with suitable anti-vibration mountings (AVMs) connecting to the DMU frame structure. The type of AVMs and numbers provided shall be indicated. The deflection characteristics of AVMs shall be submitted.

2.3.3 The contractor shall use threaded fasteners of appropriate quality for coupling engine to the transmission and also to the base rail frame.

### 2.4 **CONTROLS AND GAUGES FOR 1600HP BG DMUs:**

2.4.1 Adequate control equipment including gauges, instruments and safety devices shall be provided for safe and satisfactory operation. All gauges shall be of proven and reliable design. Graduations of all gauges shall be in metric units. Following gauges shall be provided in the cab:

- 
- i. Local engine starting switch/push button
- ii. Battery charging/discharging ammeter
- iii. Local engine stop switch/push button
- iv. RPM meter
- v. Engine lube oil pressure gauge.
- vi. Cooling water temperature gauge (Electronic).
- vii. Fuel oil pressure gauge.
- viii. Water level indicator (Electronic)

2.4.2 The following audio-visual signals or reference panel lights shall be provided.

- i. Low engine lubricating oil pressure.
- ii. Radiator water temperature too high.
- iii. Cranking contactor welding indication

2.4.3 The following safety devices, inter alia, shall be provided:

- i. Water temperature too high - Transmission cut-off and engine will return to idle.
- ii. Low water in radiator - Power to transmission cut-off and engine shut down.
- iii. Low lube oil pressure - Power to transmission cut-off and engine shut down
- iv. Engine speed too high (Over speed trip) - Power to transmission cut-off and engine to shut down.
- v. Adequate protection of an approved design shall be provided against overloads.

### 2.5 **STARTER BATTERY:**

24 V, 450 Ah, low maintenance Lead Acid storage batteries (5 hrs. discharge rate) conforming to RDSO/PE/SPEC/TL/0001-1998 (Rev-0) and approved make shall be provided. Adequate fuse protection is given in positive and negative battery circuit. The battery shall cater to 3 cranking of engine at 10 seconds' interval.

### 2.6 **COMPRESSOR:**

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One air compressor, with the capacity as indicated in scope of supply shall be provided with each engine. OEM shall specify the correct grade of compressor oil suitable for operation of compressor under given condition as per **Clause no. 1(xiv)**. The coupling of compressor with engine shall be as per arrangements offered by supplier and approved by RDSO.

## 2.7 PIPING AND PIPE FITTINGS:

- 2.7.1 Seamless stainless steel pipe bright annealed to ASTM A 269, Gr.304, which can be bent cold, shall be used. The layout of piping shall be as short and straight as possible. Bends should be used throughout, but where elbows have to be used, they shall be of round type. Where the pipes itself are bent, their internal area shall be maintained uniformly.
- 2.7.2 Double ferrule Pipe fitting consisting of body, front ferrule, back ferrule and nut shall be provided. The body and nut will be of carbon steel to ASTM A-108 Grade II with electro cobalt zinc plating with chromic passivation. The front ferrule and back ferrule will be made from Stainless Steel to ASTM A 276 TP 316 SS and conforming to ICF specification no. ICF/MD/SPEC-166 with latest amendments.
- 2.7.3 All pipes shall be adequately clamped to the frame assembly. Compreg to RDSO spec. No. C-9407-type II clamp shall be used.
- 2.7.4 Flexible pipes shall be provided at all the locations prone to vibrations. Flexible hose connections conform to spec. SAE 100R<sub>1</sub> only shall be used.

## 2.8 LUBRICATION:

Grease nipples shall conform to IS specification No. 4009. All the grease nipples & adapters, where used, shall be tack welded to prevent them from unscrewing and falling off in service.

## 3. TECHNICAL REQUIRMENTS:

- 3.1 The OEM shall submit the details of power absorbed by the individual accessories essential for the working of the engine.
- 3.2 The diesel engine shall work satisfactorily with fuel oil to Indian Standard Specification No. 1460 (2005).
- 3.3 Filters for engine air intake shall be provided with restriction indicator to ensure satisfactory performance under dusty environment.
- 3.4 The noise level due to engine and other equipment shall be within the limit as per clause 2.10 of UIC 651 OR.
- 3.5 The engine shall be provided with a flexible coupling to suit traction alternator. 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.
- 3.6 The tenderer shall supply engine driven alternator of adequate capacity as standard accessory for charging battery for engine cranking.

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- 3.7 Suitable provision for lube oil drain arrangement from engine sump easily shall be provided to avoid oil spillage.
- 3.8 Provision of centrifuge lube oil cleaner shall be provided.
- 3.9 The supplier shall time to time inform Railways about the modification to be carried out on the engine.
- 3.10 The supplier shall co-ordinate with Railway administration for carry out any modification suggested by RDSO.
- 3.11 In view of the passenger safety, any modification suggested by RDSO shall be carried out by the supplier and the same shall be in the scope of supply.
- 3.12 Any safety related modifications issued by Indian Railways shall be carried out by the OEM.

**4. MAXIMUM LIMITING DIMENSIONS (ENVELOP) FOR 1600HP DIESEL ENGINE & ACCESSORIES:**

The diesel engine alongwith accessories shall be subjected to the fitment within the following maximum limiting dimensions (Envelop).

Length	Width	Height
3.2m	1.8m	2.0m

- 4.1 The OEM shall provide suitable thermal insulated leggings over exhaust manifolds of the Diesel Engines

**5. DOCUMENTS REQUIRED FROM SUPPLIER:**

- 5.1 The tenderer shall submit notch wise Engine rpm and power alongwith other important parameters responsible for ensuring the reliability of engine.
- 5.2 The supplier shall submit the details of schedules to be carried out on the engine duly indicating the cost of each schedule along with periodicity of each schedule and work out a life cycle cost of the engine as mentioned in 6.3.
- 5.3 The supplier shall submit the details of life cycle costing of the engine assuming a service of **10 hours** per day or more for a specified period of maintenance and life span as indicated by OEM.
- 5.4 The envelope size of the diesel engine shall be kept as low as possible in order to provide spacious pathways on both the sides & easy maintainability from either side within MMD of coach as per BG IRSOD, Revised 2004 or latest. The OEM shall be responsible for ensuring proper alignment of engine and traction alternator (TA). The tenderer shall submit its tentative General Arrangement layout drawing with complete technical details at the time of submitting the tender for scrutiny.
- 5.5 The tenderer shall submit General Arrangement (G.A.) layout drawing indicating the main equipments such as engine compressor, cooling system, mounting arrangement etc. alongwith complete details at the design stage for scrutiny. The same shall be approved by ICF.
- 5.6 The tenderer shall submit General Arrangement (G.A.) layout drawing indicating air intake with filters, ducts and exhaust arrangement shall be compatible with engine system. The same shall be approved by ICF.

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- 5.7 The tenderer shall submit General Arrangement (G.A.) layout drawing indicating the exhaust and silencer arrangement of power equipment. The same shall be approved by ICF.
- 5.8 The tenderer shall indicate the fuel consumption at idle rpm and rated rpm & output.
- 5.9 The tenderer shall furnish a copy of 100 hours Type Testing report of the engine conforming to UIC 623-2 OR in support of their claim regarding performance, reliability & specific fuel consumption. In case, the offered engine is to be used first time in Indian Railways, the 100 hours type testing shall have to be carried out **in accordance with UIC 623-2-OR** in the presence of RDSO's authorized representative and the scheme for type testing shall be finalised by RDSO & supplier jointly.
- 5.10 For all the remaining engines, other than the first engine offered for 100 hours type test, the Routine test report shall be required to be submitted alongwith respective engines at the time of supply.
- 5.11 The supplier shall inform about any modification carried out in the diesel engine & accessories at any stage.
- 5.12 The tenderer shall submit three copies of operating, maintenance & service manual and complete spare parts catalogue along with the details of various sub-systems with illustrations and block diagrams to the engineer at the address given below. Virtual animation of operating, assembly, repair and maintenance with user interface in 3D animation shall also be submitted in exe. file for effective training of end users.

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And one set of Operation & Maintenance manual and spare parts catalogue shall also be supplied free of charge to the purchaser for use on the Railway.

#### **6. SPECIAL TOOLS FOR MAINTENANCE:**

- 6.1 A comprehensive maintenance schedules shall be proposed by the OEM for efficient working of subject diesel engine. A basic list of tools to be used for carrying out the proposed maintenance schedules shall be advised by the OEM. The OEM shall supply one set of tools for 4 diesel engines. The cost of such basic tools shall be included in the cost of proposed engine.
- 6.2 The tenderer will also offer separately a list of special jigs & tools and instruments which shall be essentially required for maintenance. The tenderer shall explain the purpose/justification of the specialized equipment so offered. The tenderer shall supply sets of such jigs, tools and instruments @ one set for 4 diesel engines and shall quote for the same separately if, asked for.
- 6.3 The final decision, for the supply of special jigs & tools , instruments (as mentioned in Clause 7.2 above), is reserved with Indian Railways.

#### **7. RECOMMENDED SPARE PARTS – for diesel engine:**

- 7.1 The OEM will have to quote and submit the detailed description, drawing no., source of supply, part number & price of the unit spares and consumable spares required for maintenance purpose. The Railways reserve the right to order these spares as per the list(s) or part thereof as an option.
- 7.2 **Unit Exchange spare:** The successful OEM shall supply 'unit exchange spares' at the rate of 10% of the total population of that equipment in the tendered quantity. List of such items is as below. These items shall be priced separately in the offer.

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- i. 24V Battery
- ii. Ventilation fan
- iii. Engine (complete with all assemblies)
- iv. Engine Governor
- v. Radiator fan and motor.

The above items shall be provided through the nearest service network of OEM.

- 7.3 The OEM shall be responsible for ensuring subsequent availability of spare parts for efficient working of the respective equipments.
- 7.4 The OEM shall prepare a spare parts catalogue listing all components manufactured or purchased and the same shall be submitted to RDSO for approval within 4 weeks of clearance of the prototype.
- 7.5 The OEM shall be responsible for ensuring availability of spare parts and maintenance support for entire life span of the proposed engine.
- 7.6 In case proposed model is becoming obsolete, the OEM shall intimate Indian Railways well in advance, and continue to cater for the spare parts and maintenance support for the next 5-years.

#### 8. TESTS FOR VERIFICATION & VALIDATION:

The following tests shall be conducted for testing the diesel engine & accessories for compliance and suitability to requirements.

- i. Visual check
- ii. Verification of test certificates and reports submitted.
- iii. Fitment & trials on BG DMUS
- iv. Performance shall be closely monitored and evaluated by RDSO for:
  - a) Reliability under actual operating conditions
  - b) Maintainability of the engine & its accessories
  - c) Fuel & lube oil consumption at rated out & load
  - d) Overall maintenance cost

Notwithstanding anything that may be specified in the specification, the final responsibility for the suitability of the design shall lie with the respondents and shall carry out all modifications for satisfactory functioning during the period of field trials.