



# BEML LIMITED BANGALORE



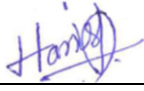
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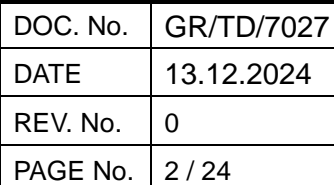
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## PTS for Vehicle Body Shell Tests (Squeeze Test)-5RS-DM Project

Approved	03.12.2024	HARISH BM	
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	Date	Name	Signature


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## 1. Introduction.

BEML Limited is a Mini Ratna company under ministry of Defence, Govt. of India. BEML have business verticals in Rail & Metro, Defence, Mining & Construction sectors. The Rail & Metro products are designed & developed at Bangalore complex.

Bengaluru Metro Rail Corporation Limited (hereafter BMRCL) has placed an order for design and development of 318 Metro cars. This Procurement Technical specification (PTS) document describes the detailed technical requirements of Vehicle body shell tests (Squeeze Test) and needs to be complied by testing agency.


All tests mentioned in this PTS to be carried out at BEML, premises Bangalore for 5RS-DM project, while the intended vendor shall be responsible for all works required in this PTS with respect to stable test rig building, instrumentation, execution of tests (providing supports to structure and application of Loads, etc), data acquisition, preparation of test reports .

## 2. Definitions and Abbreviations

The following definitions and abbreviations are applicable to the PTS.

### 2.1. Definitions

- **“Employer”** means Bengaluru Metro Rail Corporation Limited (BMRCL), its legal successors and assignees.
- **“Engineer”** means any person nominated or appointed from time to time by the Employer to act as an Engineer for the purposes of the Contract and notified as such in writing to the Contractor.
- **“Engineer’s Representative”** means any Assistant of the Engineer appointed from time to time by the Engineer
- **“BEML”** means the Contractor for procurement of testing services for 5RS-DM Project.
- **“Vendor”** means agency/firm which provides testing services to BEML.
- **“PTS”** means BEML’s Procurement Technical Specification.

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## 2.2. Abbreviations

- DMC : Driving Motor Car
- BMRCL: Bengaluru Metro Rail Corporation Limited.
- EN : European Norms
- ERGS : Employer's Requirement General Specification
- ERTS : Employer's Requirements Technical Specifications
- M Car : Motor car
- T Car : Trailer car
- TBD : To Be Determined
- UIC : International union of Railways
- JIS : Japanese Industrial Standard
- DAQ : Data Acquisition System
- UDL : Uniformly Distributed Load

## 3. Precedence of Documents


The PTS shall be read in conjunction with the General Terms & Conditions (GTC) of the tender, ERGS, ERTS and addendums if any. To the extent that any provision of the PTS is inconsistent with any provision of the General Terms & Conditions of the tender (GTC), the provisions of the GTC shall prevail.

To the extent that any provision of GTC is inconsistent with any provisions of the ERGS and ERTS, the provisions of ERGS and ERTS shall prevail.

This PTS no way relieves the Supplier from any requirements specified in the technical specification. If a conflict is discovered among any of the above contract documents, the following order of priority shall govern:

Order of Precedence	Document Title
1	ERTS
2	ERGS
3	International Standards
4	PTS

Table No.1: Document Precedence

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#### 4. Qualification criteria

Intended vendor shall be a reputed service provider in the field of structural testing of rolling stocks as per European standards. Company profile and the infrastructure details shall be submitted by the firm during tender stage.


The vendor shall provide all the required documents to prove their expertise and for obtaining the vendor approval from GC/BMRCL

The intended vendor shall fulfill following requirements.

1. Shall be a Public / Private company registered in their country of operation.
2. Consultants in individual capacity are not eligible.
3. Shall have relevant experience on similar work for international clients for Metro or passenger train projects.
4. Preference will be given to firms having experience in executing similar work for Indian projects.
5. Firm shall bring portable jigs /test setup/ instruments to India.
6. Intended vendors shall provide at least 3 Purchase order(PO) copies / service certificates for similar work.

#### 5. Information to be provided by vendors

1. Total number of years of experience in testing service.
2. Total number of projects executed on similar line along with list of projects executed in India, if any
3. Brief write up on projects executed.
4. Facilities available for testing.
5. Copies of company registration to be attached. Company organization structure to be enclosed along with turnover for the past 3 years.
6. Copy of accreditation Certificate as per International Standards.
7. Areas of interest / expertise.
8. For type testing work, willingness to bring portable jigs / instruments to BEML facilities at Bangalore, India or at identified site in India.
9. Lead time required for placement of portable test bench at BEML and time

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required for execution of test from the date of PO placement.

10. Firms shall request for all relevant data required to carryout squeeze test at Bangalore and BEML will provide relevant data required for the testing.
11. Firms shall give a consent to sign confidentiality agreement with BEML after placement of PO.

#### 5.1. Unclear aspects

After the tender, supplier shall follow the definition and opinion of design team of BEML. However, in case of any conflict or ambiguity, Engineer's decision shall be final and binding.

## 6. Technical Requirements

### 6.1. General

The purpose of vehicle shell tests (squeeze test) is to ensure the strength of the shell structure as per EN 12663. The loads shall be applied by mechanical/pneumatic/hydraulic means as per the EN standards. Sensors and instruments of reputed make shall be used to measure the parameters like strain, loads applied and displacement.

The vendor shall ensure and incorporate and provide all necessary equipment, systems or sub-systems, facilities, interface etc., generally used/provided for testing activities within quoted price, notwithstanding whether these have been specifically mentioned in the ERGS/ERTS or otherwise. In case of any necessary provision required to be incorporated, the vendor shall commit to incorporate the same into design at any stage for ensuring full compliance to ERTS.

The vendor shall provide techno commercial offer separately for following both the options, else their offer is liable for rejection at any stage of tendering.


OPTION 1: Testing service for DM Car (One Car).

OPTION 2: Testing service for DM Car and T- Car (Two Cars).

BEML will be free to choose option 1 or option 2 as mentioned above.

Detailed scheme of testing for each and every load case should be brought out clearly by the intended vendors. Engineers/Staff deputed by the vendors shall be capable enough to trouble shoot any issues, that may surface during the testing.



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The vendor shall submit detailed scope of work showing activities to be carried out by BEML and Vendor

Intended vendors shall provide complete details of computer hardware/workstations and software that will be used for testing purpose.

#### 6.1.1. General Provisions

Below is the list of provisions/facilities which will be made available to qualified vendor.

Sl.No	Descriptions
1.	Overhead Cranes and crane operators.
2.	Fork lifts and Driver.
3.	Man power for handling sandbags and movement of equipment.
4.	Required Electricity and Un-interrupted power supply (UPS)
5.	Welding/cutting/machining facilities available in BEML Limited, Bengaluru

Table. No 2 General Provisions

Additionally, the following test loading attachments are available from our earlier projects. Suppliers are encouraged to utilize them if it meets the requirements.

Sl. No	Description
1.	Compressive / Tensile Load application attachment.
2.	Waist rail / Cantrail load application attachments
3.	Whole vehicle / rerailment Lifting Load Attachments
4.	Bolster supports.
5.	Actuator Supporting Stands


Table No. 3 Load Application Attachments.

Vendors willing to make use of the same for the test rig may visit BEML to check suitability of available attachments to their test rigs. Other than the jigs/fixtures/attachments mentioned above, other jigs/fixtures/attachments required will be in the vendor's scope.

#### 6.1.2. Design Deliverables

The vendor shall provide BEML with all necessary drawings, reports, calculations, specifications, technical data and similar documents of design, system assurance and safety plan, data backup plan with respect to PTS.

These drawings and documents shall be delivered in English language with the data format

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of, respectively, latest AutoCAD (2015) release. (Document - MS Word, spread sheet - MS excel, data base files - MS Access, Presentation file - MS Power Point).


The drawings shall contain minimum of three (3) views (for example, front view, top view and left side view). The vendor shall provide STEP/IGES (Neutral format) file or CATIA file of 3D model of all testing fixtures & 2D drawings to BEML's review.

In the event that a statutory body (e.g. Government of India Ministry of Railways, RDSO, Commissioner of Metro Railway Safety, etc.) requires design information in a particular format, it shall be incumbent upon the supplier to provide the same, as directed by the BEML.

### **6.1.3. Testing and Commissioning**

Vendor shall depute experts to commission the test rig. BEML and/or Engineer representative have the right to witness any of these tests at any stage of test progress.

- The vendor shall provide the required information for testing and carry out the tests. In the event that any test components is failed, the vendor shall, at his own expense, take whatever action is deemed such as rectification, re-adjustment or design changes to the satisfaction of BEML/Engineer, in order to meet the testing requirements.
- The vendor shall carry out the routine test of equipment and assembly and also submit the reports.
- All defects and shortfalls in the vendor's system, discovered during all tests, shall be rectified to the satisfaction of BEML/Engineer.
- The vendor shall provide full instrumentation to conduct all tests and carry out modifications as required.
- All test procedures, reports including all maintenance activities and check lists shall be submitted and approved by BEML/Engineer.
- The results of all tests shall be submitted to BEML/Engineer,
- Intended vendor shall carry out a safety audit of test rig during testing period on every day basis and submit the report.

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## 7. Scope of Supply

### 7.1. General

The vendor shall provide testing services including test rig building, strain gauge mounting, and testing as per EN 12663-1, instrumentation, data acquisition and preparation of technical reports.

The vendor shall consider any other load cases (Max 3 Load Cases) other than mentioned in EN 12663-1 suggested by BMRCL/ BEML at the same cost.


## 8. Reference & Standards

- EN-12663-1, Railway Applications-Structural Requirements of Railway Vehicle bodies- Feb, 2024

## 9. ERTS Requirements.

Vendors shall note & comply below mentioned Clauses of ERTS

ERTS Clause No	ERTS Requirements- 6.10 - Car Body Strength
6.10.1	The mechanical strength of the car body structure shall comply with the requirements of EN 12663 P III category or equivalent UIC standards for metro trains
6.10.2	The mechanical strength of the car body structure shall comply with the requirements of EN 12663 PIII or equivalent UIC 566 standard except for the compressive load, which shall be 1000kN applied at the end of the car body at the centreline of the coupler and shall be compatible in respect of crashworthiness. The tensile force shall be reduced in the same ratio as the compressive force EN 12663 PIII or equivalent UIC 566 standard.
6.10.3	EN 12663 for P-III category or equivalent UIC standards for metro trains (heavy metro train), defines also: i) Structural resistance (stationery and fatigue strength). ii) Types of burden for design purposes. iii) Maximum permissible stresses for materials. iv) Requirements for resistance tests.
6.10.4	In addition, body structure shall be such as to withstand without damage buffing at low speed as well as particular stress generated by possible raising after derailling. Moreover, the deflection under the body as a result of the loads to which it is subjected shall not under any circumstances prevent the correct working of the doors.
6.10.5	The number of passengers seated shall be taken as one per seat and standing as 10 per square meter. The weight of each passenger shall be taken as 65kg, for the purpose of strength analysis

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6.10.6	For a welded construction, the camber on coach body under loaded condition with 10 persons/m <sup>2</sup> shall be such that the structure shall not sag below the horizontal plane throughout the vehicle's 35-year life. However, for shells fabricated with modular elements, the coach shall be built with a suitable camber under tare condition. It shall be ensured that the downward deflection of the coach with 10 person/m <sup>2</sup> loading shall be within the permitted deflection throughout the service life of 35 years to ensure proper operation of doors under all loading conditions. Detailed calculations shall be submitted by the Contractor for the expected deflection so as to confirm that the deflection is within permissible limits under all conditions throughout the life of the coach <b>(CDRL-6-5)</b> . Tests for stresses etc. as well as other tests as per relevant standard for the method of construction deployed shall be carried out under specified loads.
6.10.7	The Contractor shall carry out a stress analysis of the car body (including torsion mode) as well as for important structural components that affect safety or availability, using the Finite Element Method <b>[CDRL-6-6]</b> . Separate analyses shall be demonstrated and submitted for car bodies having different basic structures. The analysis shall demonstrate that all static and fatigue strength requirements of the car body and equipment mounting are met.
6.10.8	All equipment, mountings and fasteners of components shall withstand the forces and impacts as specified in EN 12663 without any part of the equipment becoming detached, and without any permanent deformation to the car-body.
6.10.9	Assessment of fatigue load shall be in compliance with EN 12663 or comparable
<b>20.9 Vehicle Body Shell Tests</b>	
20.9.1	Car body strength test shall be carried out and a lifting test shall also be performed in accordance with EN 12663, under simulated loads and as specified in ERTS clause 6.10 as type test.

Table No. 4 ERTS Clauses.


## 10. Expected Test Schedule and Place.

March - April (2 Months) – 2025 (Tentatively)

The load test is proposed to be carried out at BEML Ltd, Bengaluru India

## 11. General Description of Carbody.

DM car is proposed for testing and DM car has **CAB** end and **NON-CAB** end which has the similar design of T/M-car( T-Car may also be tested, if required). The major dimensions of DM Car and T Car are as follows.

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Sl. No.	Descriptions	DM-Car (mm)	T-Car (mm)	Remarks
1	Carbody length	20875	20800	
2	Under frame width	2755	2755	
3	Carbody structural width	2762	2762	
4	Distance between bolster centers	14700	14700	
5	Roof height (Curved Roof)	2715	2715	From top of under frame
6	Coupler height from rail level	790	790	From top of rail

Table No.5 General Description of carbody


## 12. Mechanical Properties of Materials.

Sl. No	Material	Yield Strength in MPa	Tensile Strength in MPa	Young's Modulus in GPa	Poisson's Ratio	Remarks
1	SMA490BW (t≤16)	365	490	206	0.3	JIS G3114
1	SMA490BW (40<t≤75)	335	490	206	0.3	JIS G3114
2	SUS301L-DLT	345	690	180	0.3	JIS G4305
3	SUS301L-ST	410	760	180	0.3	JIS G4305
4	SUS301L-HT	685	930	180	0.3	JIS G4305

Table No.6 Mechanical properties of materials-carbody

## 13. General Clauses.

1. Firms should bring out detailed plan on execution of test.
2. Time Plan should be provided by the vendors.
3. Method/Technology/ Scheme developed by vendors should be shared to BEML.
4. Minimum Three readings to be taken for each and every Load Case.
5. Testing firms should provide a valid calibration certificate for each and every equipment /Instrument ( Mechanical or Electronic) that will be used for test.


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#### 14. Load Cases

Sl. No.	Load cases-DM Car		ERTS	Remark
15.1	Vertical load		4.6.1	EN 12663-1 : 6.3
15.2	Compressive load at coupler(a)			EN 12663-1 : 6.4
15.3	Compressive load at coupler(b)			EN 12663-1 : 6.4
15.4	*Tensile load at coupler(a)		-	EN 12663-1 : 6.4
15.5	*Tensile load at coupler(b)		-	EN 12663-1 : 6.4
15.6	Compressive load at waist rail	Cab End	-	EN 12663-1 : 6.2.3
		Non- Cab End		
15.7	Compressive load at cant rail	Cab End	-	EN 12663-1 : 6.2.3
		Non- Cab End		
15.8	Lifting at one end of the vehicle	Cab End	4.6.2	EN 12663-1 : 6.3.2
		Non- Cab End		
15.9	Lifting the whole vehicle	Cab End	4.6.2	EN 12663-1 : 6.3.2
		Non- Cab End		
15.10	Lifting Load Case-Displaced Support.	Cab End	-	EN 12663-1 : 6.3.3
		Non- Cab End		
15.11	Service condition		-	EN 12663-1 : 6.3
15.12	Natural Frequency of Carbody			EN 12663-1 : 6.9
15.13	Roof Load			On curved Roof

Table No. 8 Load cases

\*Note: Tensile load will be applied in the range of 750kN

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Sl. No.	Load cases-T Car	ERTS	Remark
15.1	Vertical load	4.6.1	EN 12663-1 : 6.3
15.2	Compressive load at coupler(a)		EN 12663-1 : 6.4
15.3	Compressive load at coupler(b)		EN 12663-1 : 6.4
15.4	*Tensile load at coupler(a)	-	EN 12663-1 : 6.4
15.5	*Tensile load at coupler(b)	-	EN 12663-1 : 6.4
15.6	Compressive load at waist rail	-	EN 12663-1 : 6.2.3
15.7	Compressive load at cant rail	-	EN 12663-1 : 6.2.3
15.8	Lifting at one end of the vehicle	4.6.2	EN 12663-1 : 6.3.2
15.9	Lifting the whole vehicle	4.6.2	EN 12663-1 : 6.3.2
15.10	Lifting Load Case-Displaced Support.	-	EN 12663-1 : 6.3.3
15.11	Service condition	-	EN 12663-1 : 6.3
15.12	Natural Frequency of Carbody		EN 12663-1 : 6.9
15.13	Roof Load		On curved Roof

Table No. 9 Load cases

\*Note: Tensile load will be applied in the range of 750kN

## 15. Testing Instruments & Test Rig

Vendors should use only reputed make of instruments for testing purpose. The complete test setup will have a suitable and stable rig, hydraulic actuators, data acquisition systems, strain gauges, deflection gauges, networking cables etc. It will be vendor's responsibility build test rig and conduct tests in all respects as per EN 12663-1


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Item	Instrument	Remarks	Spec /Range	Make	Calibration Date	Calibration due on
Load-Applying Devices	Sand Bags	To apply vertical load	25 kg each	NA	NA	NA
	Hydraulic Actuators	To apply compressive and tensile load at coupler level	Supplier/Vendor shall provide all relevant data pertaining to instruments.			
		To apply compressive load on the waist/cant rail level				
		To apply bogie(weight) load				
Load-Measuring Apparatus	Load Cell / Load Indicator	To measure vertical load				
		To measure compressive and tensile load at coupler level				
		To measure compressive load on the waist/cant rail level				
		To measure bogie(weight) load				
Strain-Measuring System/ DAQ	Data Logger	To Record the data				
	Scanning Switching Box	Signal processor				
	Strain Gauge	Single axis type and rosette type				
Deflection-Measuring Devices	Deflection Gauge	To measure deflection of side sill				

Table No.10 Details of Testing Instruments

In case of vendors wishes to use any specialized equipment, written consent must be taken from BEML with detailed write up on the purpose of equipment.



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## 16. Measuring Parameters.

Carbody should withstand loads as per the standards mentioned above and it is verified by measuring strain and deflection values. The strain will be measured using strain gauges. Deflection gauges will be used to measure the deflection. The obtained strain values will be substituted in Eqn.1 to calculate stress.

$$\frac{\sigma}{\varepsilon} = E \quad \text{Equation No.....1}$$

Where

$\sigma$  - Stress in MPa,  $\varepsilon$  - Strain, E - Young's Modulus in MPa

Strain gauges & deflection gauges will be mounted at designated locations on carbody. These locations will be based on the finite element analysis of carbody. strain gauges including (single Axis & Rosette) & deflection gauges will be used for testing.

## 17. Acceptance Criteria.

The measured stress levels should be within the allowable stress of each material  
Carbody should not show any plastic deformation for any load case.

## 18. Selection of Carbody for Testing.

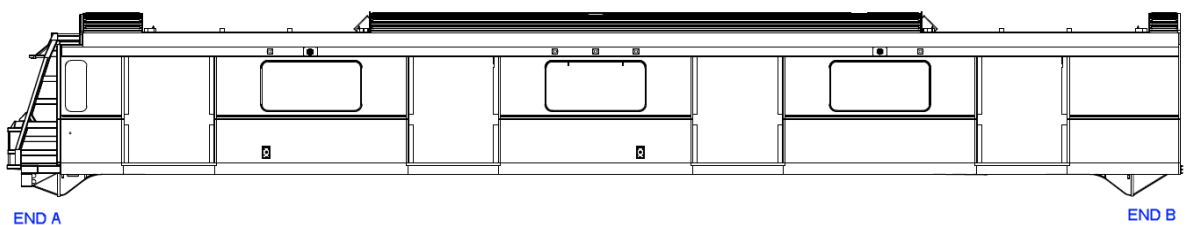


Fig No.1 Driving motor Car

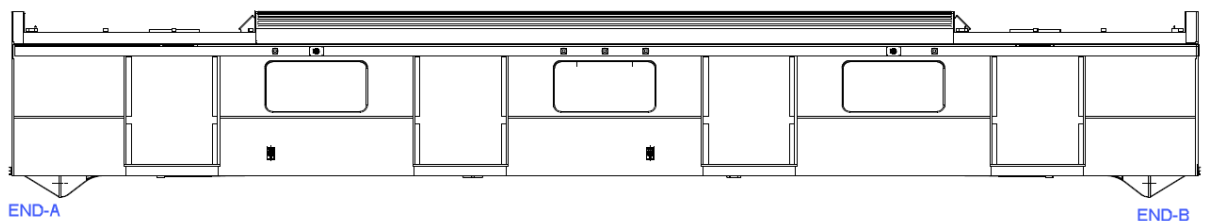



Fig No.2 Trailer Car

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## 19. Deliverables

The deliverables are listed below.

Sl. No	Particulars	% of Payment Release	Remarks
1.	Type Test Procedure of Vehicle Body Shell Tests	20%	
2.	Position of Portable Test rigs and rig erection	20%	
3.	Completion of static Load Cases & Natural Frequency Cases	20%	
4.	Submission of Report to BEML	20%	
5.	Upon approval from GC/BMRCL	20%	

Table No.11 List of Deliverables.

The type test procedure of vehicle body shell tests shall have all details pertaining to all load cases as per EN 12663 with pictorial representation of loads and support positions.

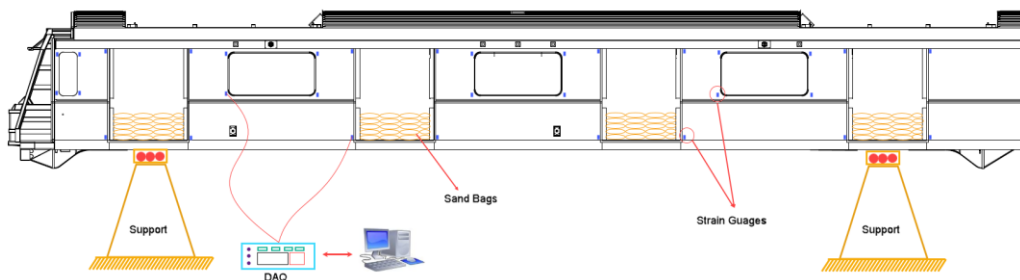


Fig No.4 General Test set-up-Carbody Tests.

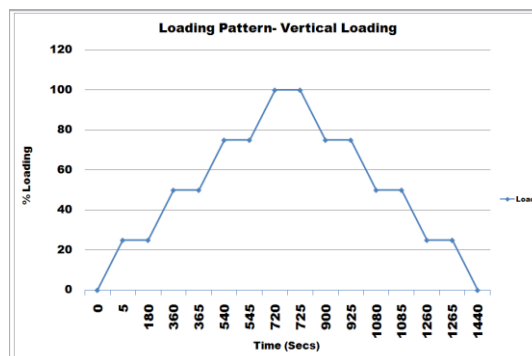




Fig No. 5 Loading Pattern

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#### 19.1. Natural Frequency of Carbody

Natural Frequency of carbody structure to be measured as per Clause No. 6.9 of EN-12663-1.

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## 20. Results Summary

The summary of results will be tabulated as below.

Sl. No.	Load case	Description			Remark
		Max Stress	Max Displacement	Location	
1	Vertical Load Case				
2	Compressive Load (a) Case				
3	Compressive Load (b) Case				
4	Tensile Load (a) Case				
5	Tensile Load (b) Case				
6	Compressive Load at Waist Rail Level				
7	Compressive Load at Cant Rail Level				
8	Lifting at one end of vehicle				
9	Lifting the whole vehicle				
10	Roof Load Test				
11	Service condition				

Table No.11 Result summary Table.

A summary of test results shall be prepared after finishing load test, and the final report shall be submitted after completion of the all tests.

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## 21. List of Documents enclosed

- ERGS of MRS1
- ERTS of MRS1
- Notice of No Objection for vendor.

## 22. PTS, ERTS & ERGS Compliance

The vendor shall provide compliant proposal for the carbody testing as per Employer's Requirements Technical Specification (ERTS)-Clause No.4.6, 15.9 and Employer's Requirements General Specification (ERGS)-Chapter 2, EN 12663-1 and PTS.

The vendor shall submit, along with the technical offer, the Clause by Clause Compliance for the above mentioned specific clauses of ERTS, ERGS and this PTS as follows:

**Complied:** "Complied" shall be indicated by the vendor where the vendor is able to comply the clause.

**Noted:** Where a clause merely provides information, and no other comment is necessary, "Noted" will suffice. Any Clauses among PTS, ERTS, ERGS, which are not applicable to be indicated as "NOT APPLICABLE" in compliance column.


**Offers with Non-compliance and deviations of the clauses of ERTS, ERGS & PTS as mentioned above are liable for rejection.**

## 23. Project Management

Along with the technical offer, the vendor shall submit a Project Management Plan which shall provide a clear over-view of the Vendor's Organization, the management system and methods to be used for completion of the project. The organization resources for the successful execution of test as per schedule.

The Project Management Plan shall provide the following information:

The names, qualifications, positions and current resumes of key executive, supervisory and engineering staff to be employed full-time for the works. A narrative describing the sequence, nature and inter-relationship of the main Contract activities including timing for exchange of information.

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Procedure for documentation control.

The vendor shall nominate a suitably qualified and experienced English speaking engineer from his staff to be Project Manager. The proposed Project Manager shall have total experience of minimum 15 years and shall have been the Project Head in at least one Rolling Stock Project in last 10 years. The proposed project Manager shall be the employee of the vendor. The CV of the Project manager shall be submitted along with the technical offer.

To fulfill the vendor's obligations during the Testing and Commissioning and the Defect Liability Period, the vendor shall nominate experienced maintenance engineers and organize deployment before undertaking testing activity.

## 24. Submittals with Technical Offer


The vendor shall submit all documents as per Appendix-1.

Note: Incomplete submissions are liable for rejection

SL. No.	Details	Submitted	Not Submitted	Ref Doc.
1	Complete Technical offer for vehicle shell tests as per EN 12663-1	<input type="checkbox"/>	<input type="checkbox"/>	
2	Supporting documents for qualification criteria as per chapter 4	<input type="checkbox"/>	<input type="checkbox"/>	
3	Duly filled Vendor approval form along with certificates if required.	<input type="checkbox"/>	<input type="checkbox"/>	
4	Chapter wise comments against the PTS	<input type="checkbox"/>	<input type="checkbox"/>	
5	Clause-wise comments to ERTS & ERGS (only for specified chapters)	<input type="checkbox"/>	<input type="checkbox"/>	
6	List of equipment and accessories to be used for test.	<input type="checkbox"/>	<input type="checkbox"/>	
7	Project Management Plan and CV's of personnel of the team	<input type="checkbox"/>	<input type="checkbox"/>	
8.	Notice to No objection certificates filled in forms.	<input type="checkbox"/>	<input type="checkbox"/>	

Table No.12: Submittals details.

Vendors shall offer their comments against each clause of PTS


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Brief scope of work.

The document gives brief scope of work for conducting carbody load test for new car units designed and manufactured by BEML. Load test is conducted to assess the strength of carbody. In this test different loads like vertical load, compressive load and tensile loads are applied on carbody. Maximum stress and maximum displacements are to be measured during test and recorded. Tests are to be carried out in M/s BEML Premises

**Brief scope of work is as follows:**

- Tests shall be performed as per guidelines given in international standards EN12663 (not limited to):
- **EN12663: Railway Applications-Structural requirements of railway vehicle bodies.**
- Test procedure to be made by agency based on the inputs provided by BEML.
- Portable test rigs along with necessary calibrated instrumentation to be brought to BEML facilities
- Setting up of the rig.
- Marking of max stress and max displacement locations based on FEM Report(FEM report is input from BEML)
- Suitable Strain Gauges (Single axis & Rosette) and Dial gauges are to be mounted on locations marked.
- Strain Gauge Mounting- Standard procedure to be followed as per best practice.
- Positioning of deflection gauges. (Latest Calibration Certificate to be provided)
- Compression & tensile Loads to be applied using Hydraulic Actuators. (Latest Calibration Certificate to be provided)
- Compressive/Tensile Load Range:  $\pm 1200\text{kN}$  (to be applied at coupler region)
- Compressive Load Range :  $\pm 500\text{ kN}$  (to be applied at waist rail & Cant Rail)
- Lifting Load Range :  $\pm 310\text{ kN}$  (For application of Lifting Load (Bogie Weight))

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- Vertical Load Range: 700 kN (to be applied as uniformly distributed load on the floor using sand bags- BEML scope)
- Data to be captured using suitable data acquisition system (DAQ)
- Agency should verify complete testing system for any concealed flaws before actual beginning of the test.
- A dummy run to check the error free signals from mounted strain gauges.
- Supplier shall insure all his testing equipment before positioning at BEML
- Following are the Load cases to be executed during testing. More details will be provided during execution

Sl.No	Load Cases	Sl.No	Load Cases
01	Vertical Load	07	Compressive Load at Cant Rail Level
02	Compressive Load I : With Tare Weight	08	Lifting of One End of Vehicle
03	Compressive Load II : With Laden Weight	09	Lifting of Whole Vehicle
04	Tensile Load III : With Tare Weight	10	Roof Loading.
05	Tensile Load IV : With Laden Weight	11	Service Load Case
06	Compressive Load at Waist Rail Level	12	Carbody Stiffness and Torsional Stiffness.

Table No.12 List Load cases

- Agencies should inform BEML Ltd about any requirement of civil construction required for the test in advance.
- The results shall be tabulated for all the tested conditions, graph shall be provided for relative Displacement for side sill of carbody - All load cases.
- Carbody Stiffness and torsional stiffness.
- Preliminary & final Test report to be provided.
- A Detailed Review presentation of test at BEML.
- Tele / Video Conferencing (as required)