



BEML LIMITED
BENGALURU
R & D CENTER

Doc. No.	GR/TD/4919
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Page No.	1/17

MRS1 Project

**Procurement Technical Specification
of Bulkhead Panel and Accessories**

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	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	3/17

Table of Contents

1. Introduction.....	5
1.1. General	5
1.2. Train Composition.....	5
1.3. Climatic & Environmental Conditions	5
1.4. Vehicle Performance Requirements	7
1.5. Track structure Parameters	8
1.6. Current Collection System	9
1.7. Signalling System	9
1.8. Principal Notional Vehicle Dimensions/ Leading Particulars	9
2. Definitions	10
3. Qualification Criteria	11
4. Standards	11
5. Design Criteria	11
6. Technical Requirements	12
6.1. Aluminium Sandwich Panel	12
6.2. Aluminium Honeycomb Core	12
6.3. Aluminium Skin	12
6.4. Aluminium casting.....	13
6.5. Adhesive	13
6.6. Accessories	13
6.7. Test Requirements of Aluminium Sandwich Panel	13
6.8. Fire Safety	13
6.9. Service Life	14
6.10.Weight.....	14
6.11.Workmanship and Finish	14
7. Quality Assurance Program	14
8. Scope of Supply	14
8.1. Bulkhead Panel.....	14

	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	4/17

8.2. Accessories	15
8.3. Submission of Documents	15
8.4. Submission of Samples	15
8.5. Packing	15
9. Type Tests & Routine Tests.....	15
9.1. First Article Inspection (FAI).....	16
10. Appendices	17
11. Submittals with Technical Offer	17

	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	5/17

1. Introduction

1.1. General

This Procurement Technical specification (PTS) specifies the technical requirements of Aluminium honeycomb sandwich bulk head panels to be fitted in the DM, M & T cars of 'MRS1' contract for Mumbai Metro Line-2 & 7.

BEML will carry out all required works and activities as Contractor to the Employer for MRS1 project, while the subcontractor shall be responsible for all works required in this PTS with regard to bulkhead panel and shall be responsible for supporting the BEML activities as contractor for MRS1 project.

The scope of work includes all items of work which may be required to meet the performance requirements, reliable and efficient operation of trains and meeting the best international practices even if not specifically mentioned in this PTS.

1.2. Train Composition

The rake formation shall generally be as follows:

3 Car unit formation : DM – T – M –
6 Car Train formation: DM –T–M – M – T – DM

In case of 8-car formation (if required):

2 Car train formation : – T – M –
8 Car Train formation: DM – T – M – T – M – M – T – DM

where,

DM : Driving Motor Car

T : Trailer Car with pantograph

M : Non -Driving Motor Car

1.3. Climatic & Environmental Conditions

The Metro cars shall operate reliably and safely under the climatic and environmental conditions of Mumbai. Accordingly, the bulkhead panel shall be designed to operate with satisfactory performance under the following conditions.

	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	6/17

Description	Limiting Values
Maximum ambient temperature (See note below)	36 °C
Minimum temperature	14.3 °C
Humidity	≥ 95% RH
Rainfall	The annual precipitation is 2,078 mm with 34%(709mm) falling in the month of July.
Atmosphere during hot season	Extremely dusty including bird feathers
Maximum wind speed	150 km/h
Vibration and Shocks	The sub-systems & their mounting arrangements shall be designed to withstand satisfactorily the vibration and shocks encountered in service as specified in IEC 61373 and IEC 60571.
SO ₂ level in atmosphere	80 – 120 mg/m ³
Suspended particulate matter in atmosphere (TSPM)	360 – 540 mg/m ³
Flood Proofing	The traction sub-systems mounted on the under-frame will be designed to permit propulsion of the train at 10 kmph through water up to a depth of 50mm above rail level. Traction sub-systems shall be made splash proof in accordance with International Standards
Life	The Metro car is designed for min. 35 years of life. Accordingly, the subject items & accessories shall also not deteriorate in their performance for 35 years

Note:

- 1) The temperature of the metal surfaces of the vehicles when exposed directly to the sun, for long periods of time, may be assumed to rise to 70 °C.
- 2) Any moisture condensation shall not lead to any malfunction or failure.
- 3) Adequate margin shall specially be built into the design particularly to take care of the higher ambient temperatures, high humidity, dusty and corrosive conditions, etc. prevailing in Mumbai area.

	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	7/17

1.4. Vehicle Performance Requirements

The vehicle performance requirements with fully loaded train and tangent track are as per the following table.

Item		All Corridors
Safe speed	With inflated secondary suspension	90 kmph
	With deflated secondary suspension	80 kmph
Maximum operational speed	With inflated secondary suspension	80 kmph
	With deflated secondary suspension	70 kmph
Minimum Design Average Acceleration rate for fully loaded (AW3) train on level tangent track shall be as under: 0 kmph to 40 kmph 0 kmph to 60 kmph 0 kmph to 80 kmph		1.0 m/s ² 0.75 m/s ² 0.40 m/s ²
Minimum Operational Average Acceleration rate for AW2 loaded train on level tangent track shall be as under: 0 kmph to 35 kmph 0 kmph to 60 kmph 0 kmph to 80 kmph		1.20 m/s ² 0.80 m/s ² 0.45 m/s ²
Average Service braking rate from 80 kmph to standstill for fully loaded(AW3) train on level tangent track.		1.0 m/s ²
Average Service braking rate from 80 kmph to standstill for AW2 train on level tangent track.		1.1 m/s ²
Average Emergency braking rate from 80 kmph to 0 kmph for fully loaded trains on level tangent track		1.3 m/s ²
Jerk rate (Maximum)		0.75 m/s ³
Annual running distance of one train (for design purpose)		150,000 km
Note : The specified average minimum acceleration shall be the finally achieved values inclusive of the specified jerk rate.		

	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	8/17

1.5. Track structure Parameters

The MRS1 cars will operate with the track parameters as specified in the following table:

Description	Elevated and At-grade Corridor		Underground Corridor
	Ballasted	Ballast less (DFF)	Ballast less (DFF)
Track Laying Gauge	1435 mm		
Rail Type (Main Line & Depot)	60 EI (UIC 60) 880/HH	60 EI (UIC 60) 1080/HH	60 EI (UIC 60) 1080/HH
Rail Profile	UIC 861-3		
Inclination Of Rail	1 in 20		
Sleeper Spacing (Main line)	600 mm ± 10mm	600 mm ± 10mm	700 mm ± 10mm
Sleeper Spacing (Depot)	650 mm ± 10mm	Not applicable	
Ballast Cushion Depth(Main line)	300mm	Not applicable	
Ballast Cushion Depth (Depot)	250mm	Not applicable	
Standard Rail Length	13m and 18m	18m	
Rail Panel Lengths	Longer than 200m		
Minimum Radius of Curvature	200m-Underground 110m-Elevated 100m-Depot		
Minimum Turn out Radius.- (Main line)	1 in 9 - 300m radius 1 in 7- 190m radius		
Minimum Turn Out Radius Depot	1 in 7 - 190m radius		
Maximum Cant Permissible	110 mm		
Maximum Cant Desirable	110 mm		
Maximum Cant Deficiency Permissible	85mm		
Maximum Cant Deficiency Desirable	85 mm		
Maximum Permissible Cant Gradient	1 in 440		
Maximum Desirable Cant Gradient	1 in 720		
Turn-out Speed : Turnout (1 in 9) R-300	45 km/h	45 km/h	40 km/h
Turn-out Speed : Scissors (1 in 9) R-300	45 km/h	45 km/h	40 km/h
Turn-out Speed : In Depots (1 in 7) R-190	35 km/h	35 km/h	25 km/h
Turn-out Speed : Turnout (1 in 7) R-190	35 km/h	35 km/h	25 km/h
Turn-out Speed : Turnout(1 in 12) R-410	50 km/h	50 km/h	50 km/h

	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	9/17

Turn-out Speed : Turnout(1 in 12) R-410	50 km/h	50 km/h	50 km/h
Turn-out Speed : Turnout (1 in 8.5) R-218	30 km/h	30 km/h	30 km/h
Turn-out Speed : Turnout(1 in 8.5) R-218	30 km/h	30 km/h	30 km/h
Maximum Gradient Main Line	4%		
Maximum Gradient Depot Connection	4%		
Minimum vertical curve radius of curvature	1500m		

1.6. Current Collection System

System Particulars	For all sections and depot
Supply Voltage System	25kV AC single phase 50Hz
Current Collection	Through Pantograph

1.7. Signalling System

Item	Description
Train Control System	CBTC based On board Continuous Automatic Train Control system (CATC) consisting of i) Automatic Train Protection ii) Automatic Train Operation (ATO) iii) Automatic Train Super-vision (ATS) iv) Attended/Unattended train operation (GoA2/GoA3/GoA4)
Train Control mode	i) Automatic mode ii) Coded Manual modes iii) Restricted Manual mode iv) Run on Sight mode v) Cut-out mode vi) UTO vii) Standby

1.8. Principal Notional Vehicle Dimensions/ Leading Particulars

Description		Dimension
Gauge		1,435 mm
Maximum Length over body(including end-fairings)	DM car	22,010 mm
	T and M cars	22,010 mm
Maximum Length over couplers for all cars		23,000 mm

	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	10/17

Maximum Width over Body		3,200 mm
Minimum Passenger Saloon Headroom		2,050 mm
Locked down pantograph height for 25kV AC cars from rail level at Car Centre Line		4,048 mm
Maximum Floor height above rail level of any unloaded vehicle		1,130 mm
Minimum Floor height above rail level of fully loaded vehicle		1,100 mm
Maximum height of coupler above rail level for unloaded vehicle		815 mm
Minimum height of coupler above rail level for fully loaded vehicle		740 mm
Bogie Wheel Base	Maximum	2400 mm
	Minimum	2200 mm
Distance between bogie centres	Maximum	15,100 mm
	Minimum	14,400 mm
Wheel diameters	New	860 mm
	Fully worn	780 mm
Maximum axle load		17 Tonne (including all tolerances as per IEC 1133-1992)

2. Definitions

The following definitions are applicable to the PTS.

- **"Employer"** means Delhi Metro Rail Corporation Limited (DMRC), its legal successors and assignees.
- **"Subcontractor"** means the Supplier who supplies the required bulkhead panel to BEML for MRS1 project.
- **"Contractor"** means the persons or person appointed by the Employer to undertake the execution of the works for MRS1 project..
- **"Contract"** means the contract between Subcontractor and BEML in relation to the supply of bulkhead panel for MRS1 project.
- **"Engineer"** means any person nominated or appointed from time to time by the Employer to act as the Engineer for the purposes of the Contract and notified as such in writing to the Contractor.
- **"Engineer's Representative"** means any Assistant of the Employer appointed from time to time by the Employer.
- **"BEML"** means the Contractor to procure the bulkhead panel for MRS1 project cars.

	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	11/17

3. Qualification Criteria

- (i) Subcontractor shall be an Aluminium fabricator with Aluminium honeycomb sandwich panel and shall have experience in design, manufacturing, testing and commissioning of such panels.
- (ii) The subcontractor shall have manufactured and supplied similar fabricated items using aluminium honeycomb sandwich panels and such supplies should have been in use and have established their satisfactory performance and reliability on at least three Mass Rapid Transit Systems in revenue service over a period of three years or more (in each MRTS) either outside the country of origin in three different countries or in an MRTS in India. Supporting documents for the same shall be submitted along with the technical offer, preferably, satisfactory Revenue service performance certificates for a period of 3 years or more from end users/ Metro Operators .
- (iii) Along with the technical offer, the subcontractor shall submit the filled Vendor credential form along with all the required supporting documents.
- (iv) The firm should undertake to provide the support during DLP period either by themselves or through sister company or a partner in India. The firm shall submit detailed proposal in this regard along with the technical offer.
- (v) The firm should give an undertaking to supply spares for a minimum period of 10 years from the date of last car supplied by BEML under this contract.

4. Standards

The design, testing and manufacturing of the bulkhead panel and accessories shall conform to the latest editions of internationally recognized Standards viz., Indian, American, European, Japanese, ISO, etc.

5. Design Criteria

The bulkhead panel proposed by the subcontractor shall comply with the following Design criteria.

- (i) The design of interior fittings shall be safe under all conditions of passenger impact, during emergency braking and buffing under fully loaded condition.
- (ii) All non-metallic materials shall satisfy the fire property requirements of flammability, toxicity, smoke emission limitations etc. specified in EN45545 Part 1 to 7 latest editions.
- (iii) All interior surfaces must be finished with good blending and good slow ageing properties to provide a pleasant, high-quality interior and for ease of cleaning and maintenance. No material shall degrade or stain when exposed to food, drink, graffiti, or any cleaners used by the maintenance personnel. No material shall produce any odour that would be noticeable or irritating to passengers.

	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	12/17

- (iv) All internal panel surfaces shall be smooth finished with modern low flammability, low smoke emission, anti-graffiti, and low toxicity materials. All internal panels shall be resistant to graffiti, scuffing, vandalism, and cleaning agents (properties of cleaning agent shall comply with the Anti-Graffiti Protection Standard NFF 31-112)

6. Technical Requirements

The bulkhead panel supplied shall comply with the environmental conditions and design criteria specified at clause 1.3 and 5 respectively and the following technical requirements.

The bulkhead panel shall be of aluminum honeycomb sandwich panel type with aluminium honeycomb core encased in an aluminium cast frame and covered with aluminium sheet on both sides using adhesive.

The bulkhead panel shall meet the requirements of EN45545, HL3 latest editions in respect of fire, smoke, toxicity and heat release rate.

6.1. Aluminium Sandwich Panel

The bulkhead panel shall be of Aluminum honeycomb sandwich panel of 40mm total thickness with Aluminum sheet (skin) of 1 mm thick on either side.

Aluminium honeycomb sandwich panel shall be produced by means of the process which bonds aluminium sheet and aluminium honeycomb core with Adhesive. The subcontractor shall submit the detailed manufacturing process proposed for the bulkhead panel.

6.2. Aluminium Honeycomb Core

The aluminium honeycomb core in the bulkhead panel shall be to specification as below.

Cell size : 9 mm.
Density : 54 kg/m³.
Alloy : A3003 H18 / A3104 H18

The foils of the core shall be suitably treated to improve anti-corrosion properties. Details shall be submitted along with the technical offer.

6.3. Aluminium Skin

The skin shall be made of aluminium alloy to grade A1050-H14. The bonding area of skin shall be abraded / treated suitably to ensure excellent bonding between Al. honeycomb core and aluminum casting. The skin shall be anodized as per IS 1868 AC15.

	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	13/17

6.4. Aluminium casting

The frame of Bulkhead panel is made of aluminium casting to grade LM 25. The bonding area of frame shall be abraded to ensure excellent bonding between Aluminium honeycomb core and Aluminium skin.

6.5. Adhesive

The adhesive used for bonding aluminium honeycomb core to aluminium skin and frame shall be a proven epoxy glue. TDS of the proposed type of adhesive and the details of previous projects in which the proposed adhesive was used by the subcontractor and its performance reliability shall be submitted along with the technical offer. The subcontractor shall guarantee the performance of the bulk head panels for a service life of 35 years with the proposed glue.

6.6. Accessories

The accessories such as cover, hinge, helical coil, packing rubber, spring latch & pin pole shall meet the tender drawing requirements. Technical data sheet of all the accessories from OEM shall be submitted along with the technical offer.

6.7. Test Requirements of Aluminium Sandwich Panel

TEST	TEST METHOD	TEST REQUIREMENT (Minimum Value)
Drum peel strength (mm-N / mm)	ASTM D 1781	≥ 60
Bending load (N) (3 point loading)	ASTM C 393	≥ 2000
Flatwise compression strength (MPa)	ASTM C 365	≥ 1.5
Tensile lap shear strength (Mpa)	ASTM D 1002	≥ 9

6.8. Fire Safety

The bulkhead panel shall be selected to reduce to the maximum extent practical the heat load, rate of heat release, propensity to ignite, rate of flame spread, smoke, emission and toxicity of combustion gases.

The bulkhead panel shall confirm to fire safety requirements of EN 45545, Category 4-A (HL3) R1 requirements.

	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	14/17

The fire performance deliverables shall be provided in accordance with following table.

Sl. No.	Deliverables	Remarks
1	Fire safety plan	As per EN45545 HL3
2	Fire safety Test Reports including heat release rate.	As per EN45545 HL3

Fire safety test reports as per EN 45545 of aluminium honeycom sandwich panels supplied to previous projects shall be submitted for reference.

6.9. Service Life

The subcontractor shall ensure a guaranteed revenue service life of 35years for the bulkhead panel.

6.10. Weight

The subcontractor shall keep the weight of the complete bulk head assembly to a minimum and submit the estimated weight along with the technical offer.

6.11. Workmanship and Finish

The subcontractor shall ensure that the finished unpainted bulkhead panel shall be free from delamination, uneven bonding, undulation, dent and other visual defects that would impair usability of the bulkhead panel.

7. Quality Assurance Program

The subcontractor shall hold ISO 9001/ IRIS certification and shall manufacture the product accordingly. The subcontractor shall submit a copy of ISO 9001 / IRIS certification along with the offer. The subcontractor shall monitor and control the Quality systems as per ISO 9001/IRIS guidelines. BEML and/or DMRC's representative may periodically conduct compliance audits of the Subcontractor's Quality management system.

The subcontractor shall submit Quality Assurance Plan (QAP) based on ISO 9001 / IRIS guidelines.

8. Scope of Supply

8.1. Bulkhead Panel

The bulkhead panel shall be supplied confirming to tender drawing and PTS, as a minimum. The bulkhead panel shall be supplied in unpainted condition.

	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	15/17

8.2. Accessories

The cover with spring latch, pin pole and packing rubber shall be supplied in loose condition.

8.3. Submission of Documents

The subcontractor shall submit the following documents as a minimum, as per the timelines specified by BEML.

- ✓ Type test procedure document covering all the physical, mechanical & fire safety type tests.
- ✓ FAI Procedure document.
- ✓ Type test & FAI reports.
- ✓ Fire safety test reports on the panels produced for this project.
- ✓ Weighment document with actual weight of bulkhead panel.
- ✓ Material test certificates.
- ✓ Dimensional check sheets for each bulkhead panel.

8.4. Submission of Samples

The subcontractor shall submit 1 no. of unpainted bulkhead sample, meeting the technical requirements of this PTS and drawing dimensions, before FAI.

8.5. Packing

The subcontractor shall pack properly in order that in transit and after supply of the bulkhead panel to the place allocated by BEML, no damage to the bulkhead panel shall occur.

9. Type Tests & Routine Tests

The bulkhead shall be type and routine tested in accordance with relevant standards and specifications. All such tests shall be carried out at the subcontractor's cost, wherever performed, in the presence of and to the satisfaction of BEML and DMRC, who reserves the right to witness any or all of the tests and to require submission of any or all test specifications and reports.

BEML and DMRC reserve the right to reasonably call for additional tests, if necessary.

The subcontractor shall carryout the following type tests and routine tests, as a minimum.

	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	16/17

Sl. No.	Kind of Test	Test Method	Type Test	Routine Test
1	Visual Inspection	-	O	O (100% Supplies)
2	Dimensional Inspection	-	O	O (100% Supplies)
3	Weight	-	O	O (100% Supplies)
4	Fitment trials in carbody	-	O	-
5	Drum Peel Strength	ASTM D 1781	O	-
6	Bending Load	ASTM C 393	O	-
7	Flat-wise Compressive Strength	ASTM C 365	O	-
8	Tensile lap shear strength (Mpa)	ASTM D 1002	O	-
9	Fire Safety including Heat release Rate	EN 45545, HL3	O	-

The type test procedure document shall be prepared by the subcontractor and BEML/DMRC approval shall be obtained before conducting the tests.

The routine test reports shall be submitted along with every batch of supplies.

9.1. First Article Inspection (FAI)

The subcontractor shall offer the unpainted bulkhead panel for First Article Inspection by BEML/ DMRC in accordance with the BEML/DMRC approved FAI plan prior to serial production in order to confirm that the item produced fully complies with the technical specifications, System design and manufacturing process.

The Subcontractor shall ensure that the produced bulkhead panel is compliant to all requirements prior to inviting for testing and FAI. The pre-test result prior to official testing/FAI shall be submitted with the invitation letter to request BEML/ DMRC witness.

At the FAI, the subcontractor shall make available all pertinent design and manufacturing process documentation, test records, material certifications, etc.

During FAI ,if any inspections or tests indicate that specific hardware or documentation does not meet the specified requirements, the appropriate items shall be repaired, replaced, upgraded, or added by the Subcontractor at their own cost, as necessary to

	Procurement Technical Specification of Bulkhead Panel and Accessories for MRS1	Doc. No.	GR/TD/4919
		Date	09.01.2020
		Rev. No.	-
		Page No.	17/17

correct the noted deficiencies. After correction of deficiency, all tests necessary to verify the effectiveness of the corrective action shall be repeated.

If FAI has to be repeated due to non-compliances/ deficiencies noticed, the cost towards the same and the cost towards BEML/DMRC visit to subcontractor's place for witness of re-FAI shall be to subcontractor's responsibility.

Upon acceptance of the FAI by BEML/DMRC, the subcontractor can proceed to manufacture all pertinent hardware. The hardware must meet or exceed the quality standards set at the FAI, and must incorporate any comments made by BEML/DMRC at the FAI.

Subcontractor shall note that BEML/DMRC FAI clearance will not relieve the subcontractor's responsibility towards design, development, testing, manufacture and supply during the revenue service.

At any point of time, during the execution of the contract, if BEML/DMRC has any concerns about the quality of the product supplied, BEML/DMRC reserves the right to randomly draw samples from any of the supply lots and the subcontractor shall carryout the type tests at accredited outside labs and shall submit the reports.

10. Appendices


- Vendor credential form.
- Technical offer Submittals Check List.

11. Submittals with Technical Offer

The Subcontractor shall provide as a minimum, the following along with the technical offer.

1. Complete Technical Offer for bulkhead panel.
2. Technical data sheet of adhesive, aluminium honeycomb core, aluminium casting, aluminium sheet, packing rubber and accessories.
3. Load test and fire safety test report copies of earlier projects.
4. Supporting documents for Qualification Criteria compliance (Clause 3).
5. Duly Filled Vendor credential form along with supporting Documents including QAP & ITP for MRS1 project, company profile with infrastructure facilities, product range etc.,
6. Clause wise comments against PTS Document No. GR/TD/4919.

<u>Vendor Credentials - Bulkhead Panel</u>								
Sl. No.	Product	OEM & the manufacturing plant address	Technical Specification	Bulkhead panel drawing	Project	Year of Supply	Qty. Supplied	Supplied to
1	Bulkhead Panel (Aluminium honeycomb sandwich construction)							
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								

	TECHNICAL OFFER SUBMITTALS CHECK SHEET	Project MRS1
Aggregate	Bulkhead Panel and Accessories	PTS DOC No.: GR/TD/4919
BEML Enquiry/ RFQ Reference :		

Sl. No.	DETAILS	SUBMITTED	NOT SUBMITTED
1	Complete Technical Offer for bulkhead panel.	<input type="checkbox"/>	<input type="checkbox"/>
2	Technical data sheet of adhesive, aluminium honeycomb core, aluminium casting, aluminium sheet, packing rubber and accessories.	<input type="checkbox"/>	<input type="checkbox"/>
3	Load test and fire safety test report copies of earlier projects.	<input type="checkbox"/>	<input type="checkbox"/>
4	Supporting documents for Qualification Criteria compliance (Clause 3).	<input type="checkbox"/>	<input type="checkbox"/>
5	Duly Filled Vendor credential form along with supporting Documents including QAP & ITP for MRS1 project, company profile with infrastructure facilities, product range etc.,	<input type="checkbox"/>	<input type="checkbox"/>
6	Clause wise comments against PTS Document No. GR/TD/4919.	<input type="checkbox"/>	<input type="checkbox"/>

Note : Incomplete submissions are liable for Rejection.

Signature of the Bidder with Seal