



BEML LIMITED
BANGALORE
R & D CENTER

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Date	30/10/2019
Rev. No	3
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**Procurement Technical Specification
of Rubber Profiles & Rubber Packing for
Metro Cars**

	Name	Date	Signature
Approved By	Gayatri. P.V	30 Oct 2019	
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1. Introduction

1.1. General

This document describes the technical requirements of Rubber profiles and Rubber packing used in the Metro cars.

The Supplier shall be responsible for all works required in this PTS with regard to manufacture, inspection and supply of Rubber profiles and Rubber packing and shall be responsible for supporting the BEML activities as contractor for manufacture of Metro Cars.

1.2. Climatic Conditions

The Metro Cars have to operate reliably and safely under the climatic & Environmental Conditions shown in the following tables for the respective cities and correspondingly the rubber profiles & rubber packing installed in the cars shall perform satisfactorily under the following conditions.

a) Metro Cars in Delhi shall operate reliably and safely under the climatic conditions shown in Table-1 below.

Description	Limiting Values
Maximum ambient temperature	47°C (Refer Note below)
Minimum temperature	3°C
Humidity	100% saturation during rainy season
Rainfall	Rain occurs generally from June to September. Average annual rainfall is approximately 650mm. maximum rainfall in any 24h period is 50mm.
Atmosphere during hot season	Extremely dusty
Maximum wind load	150 kg/m ²
Vibration & Shocks	The equipment, sub-systems & their mounting arrangements shall be designed to withstand satisfactorily the vibration and shocks encountered in service as specified in IEC61 373, IEC 60077 and IEC 60571
S02 level in atmosphere	80 - 120 mg/ m ³
Suspended particulate matter in atmosphere	360 - 540 mg/m ³
Life	The Metro cars are designed for min. 30 years life. Accordingly, the subject items shall also not deteriorate in their performance for 30 years in the Car Body

Table-1: Environment conditions for Delhi

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Note: 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.

b) Metro Cars in Kolkata shall operate reliably and safely under the climatic conditions shown in Table-2 below.

Description	Limiting Values
Maximum ambient temperature (See note below)	35.2°C 45 °C (Inside Tunnel)
Minimum temperature	28.6°C
Humidity	60% (100% saturation during rainy season which may be as long as 6 months)
Rainfall	Average annual rainfall is approx. 1582 mm. Maximum recorded rainfall in any 24h period is 306 mm in month of August. Very heavy rain occurs along with high frequency of lightning discharges.
Atmosphere during hot season	Extremely dusty
Maximum wind speed	vehicle stopped on line: 160 km/h Vehicle Running: 130 km/h
SO ₂ level in atmosphere	6.7 – 80 micro g/m ³
NO _x level in atmosphere	16 – 80 micro g/m ³
Respirator Suspended Particles Matter in atmosphere (RSPM)	49 – 120 micro g/m ³
Total Suspended particulate matter in atmosphere (TSPM)	111 – 360 micro g/m ³
Altitude	100 m
Life	The Metro car is designed for min.35 year of life. Accordingly, the subject items shall also not deteriorate in their performance for 35 years

Table-2: Environment conditions for Kolkata

Note:

- 1) The temperature inside of an “inactive” metro train parked in the sun can easily exceed +60°C.
- 2) The rolling stock must be able to operate regardless of the external conditions. They must also be so designed as to avoid abnormal wear due to adverse weather. They can be parked outdoors regardless of the atmospheric conditions.

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c) Metro Cars in Bangalore shall operate reliably and safely under the climatic conditions shown in Table-3 below.

Description	Limiting Values
Maximum ambient temperature	42°C
Minimum ambient temperature	8°C
Humidity	92% saturation during rainy season
Rainfall	Rain occurs generally from May to October. Average annual rainfall is approximately 1065 mm. Maximum rainfall in any 24h period is 178mm.
Atmosphere during hot season	Extremely dusty
Maximum wind speed	Standstill exceptional: 160 km/h
SO ₂ level in atmosphere	6.7 - 80 micro g/m ³
NO _x level in atmosphere	16 - 80 micro g/m ³
Respiratory Suspended Particles Matter in atmosphere (RSPM)	49 - 120 micro g/m ³
Total Suspended Particles Matter in atmosphere (TSPM)	111 - 360 micro g/m ³
Altitude	1000 m
Life	The Metro car is designed for min.35 year of life. Accordingly, the subject items shall also not deteriorate in their performance for 35 years

Table-3: Environment conditions for Bangalore

Note:

- 1) The temperature inside of an “inactive” metro train parked in the sun can easily exceed +60°C.
- 2) The rolling stock must be able to operate regardless of the external conditions. They must also be so designed as to avoid abnormal wear due to adverse weather. They can be parked outdoors regardless of the atmospheric conditions.

d) Metro Cars in Mumbai shall operate reliably and safely under the climatic conditions shown in Table-4 below.

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.

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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

Table 4: Environment conditions for Mumbai

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.

2. Definitions

The following definitions are applicable to the PTS.

- “Customer” means the Order placing authority for the Mass Rapid Transport System (MRTS).
- “Customer’s Representative” means such person appointed by “Order placing authority” to act as Engineer for the MRTS.
- “BEML” means the Contractor for procuring the Rubber profiles and Rubber packing for Metro Project.
- “Supplier” means the OEM for supplying Rubber to BEML.
- “PTS” means BEML’s Procurement Technical Specification.

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3. General Requirements

The Supplier shall supply the rubber profiles & rubber packing as per tender drawing requirements and this PTS. The Supplier shall be responsible and shall ensure that the rubber items supplied meet the environmental conditions specified at Clause 1.2 and do not deteriorate / fail during the life time (35 years) of the cars.

3.1. Defining of unclear aspects

If any term or clause described in the specification is not clear, Supplier shall discuss those with Design Team in BEML, prior to making a contract, to confirm their definitions and opinions.

After making a contract, Supplier shall follow the definition and opinions of Design Team in BEML.

3.2. Responsibility of Supplier

Supplier shall have responsibility for manufacturing, defined performance testing with regard to rubber profiles and rubber packing.

4. Standards

Test and inspection standard applicable for the Rubber shall conform to the national and international standards as per the technical requirements at Clause 7.

5. Scope of supply

Generally the Rubber used as packing rubber/ profiles shall be of Silicon/ EPDM/ Nitrile/ Neoprene rubber and shall conform to the technical requirement at Clause 7.

5.1. Submission of Documents

The Supplier shall submit the technical specification, previous projects type test reports and fire safety test reports along with the offer.

Supplier shall submit the dimensional check sheets and routine test reports along with every batch of supplies.

5.2. Submission of samples

The supplier shall supply 2 nos. A4 size samples of each of the EPDM/ Silicon/ Nitrile/ Neoprene rubbers with material test certificate and test reports before bulk production.

5.3. Packing

Supplier shall pack properly in order to ensure that no damage occurs during transit.

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5.4. Quality Assurance Program

5.4.1. General

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

5.4.2. Quality assurance plan

The supplier shall develop and submit a Quality assurance plan (QAP) to BEML for review and approval based on ISO 9001 guidelines.

6. Technical Requirements

6.1. Technical Requirements for Rubber

The Rubbers supplied shall be to the highest quality and shall conform to the requirements specified in the drawings, this PTS and Purchase order. The physical and mechanical properties shall generally conform to Table-5 below and fire performance to clause 7.2.

Material Physical Properties	Silicone	EPDM	Neoprene	Nitrile	Test methods
Hardness, Shore "A"	70±5	85±5	80±5	80±5	ASTM D2240
Tensile Strength (Min), MPa	7	14	10	10	ASTM D412 Type A dumb-bell test
% Elongation (Min), %	200	100	150	150	ASTM D412 Type A dumb-bell test
Tensile Set (Max), %	20	15	20	20	ASTM D412 (A strain of 50% shall be applied. The straining period shall be 10 min, followed by relaxation for 10 min, prior to measurement)
Compression Set (Max), %	9	14	29	29	ASTM D395 (Type A the temperature of the test shall be 70°C for 22 hrs. The recovery time after compression shall be 60 min)
Tear Strength (min), kN/m	25	25	25	25	ASTM D624
Density, kg/m ³	1000 - 1250				ASTM D1817

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Accelerated ageing	Max. Hardness change ± 5 BS	ASTM D573 (Method B 100 \pm 1 °C for 3 days)
Outdoor exposure resistance	Shall not show cracks	ASTM D1171
Low temperature resistance	Shall not crack at -40 °C	ASTM D2137
Staining test (where applicable)	No staining	ASTM D925
Ozone resistance	Shall not show cracks with a rating greater than 1	ASTM 1149

Table-5: Physical & Mechanical Properties

6.2. Fire Safety

The Rubber Profiles & packing shall confirm to fire safety requirements as per EN 45545-HL3, R22 requirements.

6.2.1. Fire Performance Test Procedure and Criteria

The Fire Performance Test Procedure and Criteria shall be met, but not be limited to, the following requirements:

Property	Test Procedure	Parameter (units)	Criteria For HL3
Burning Behavior	T01 EN ISO 4589-2	Oxygen content (%)	Minimum 32
Smoke generation	T10.03 EN ISO 5659-2, 25kWm ⁻²	D _s Max (dimensionless)	Maximum 150
Toxicity	T12 NFX 70-100-1 and -2 600 ^o C	CIT _{NLP} (dimensionless)	Maximum 0.75
Heat release rate	ISO 5660-1 50kWm ⁻²	MARHE kWm ⁻²	Maximum 60
	ISO 5660-1 25kWm ⁻²		Maximum 50

Table-6

6.3. Dimensional Tolerance

The dimensional tolerances shall conform to ISO 3302-1 for unspecified tolerances in the drawings. The dimensions shall conform to the most stringent grade of tolerance for each of the types (moldings/ extrusions/ sheets) specified in ISO 3302-1.

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7. Inspection & Testing

7.1. General

The Supplier shall perform all tests in accordance with the Standards specified in the drawing, this PTS and purchase order. BEML's and/or Customer's Representative have the right to witness any of these tests at any stage of test progress.

7.2. Visual inspection

The rubber items shall be uniform in quality and condition, clean, smooth and free from foreign matter and imperfections detrimental to the performance of the items.

7.3. Type Test & Routine Test

Type Test

Type tests shall be performed by the supplier under BEML and Customer Representative Participation.

Routine Tests

Routine test shall be performed by the supplier and during the test, the criteria shall be observed and results shall be recorded. Routine test reports shall be furnished along with the supplies.

The supplier shall perform, as a minimum, the following tests

Sl. No.	Description	Test Method	Type test	Routine test
1)	Visual inspection	-	•	•
2)	Dimensional inspection	-	•	•
3)	Hardness	ASTM D2240	•	•
4)	Tensile Strength	ASTM D412	•	
5)	% Elongation	ASTM D412	•	
6)	Tensile Set	ASTM D412	•	
7)	Compression Set	ASTM D395	•	
8)	Tear Strength	ASTM D624	•	
9)	Density	ASTM D1817	•	
10)	Accelerated ageing	ASTM D573	•	
11)	Outdoor exposure resistance	ASTM D1171	•	

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12)	Low temperature resistance	ASTM D2137	•	
13)	Staining test	ASTM D925	•	
14)	Ozone resistance	ASTM 1149	•	
15)	Peel Adhesion (wherever applicable)	EN 1939	•	
16)	Fire Safety	EN 45545 HL3	•	

7.4. First Article Inspection (FAI)

Before mass production, each type of EPDM/ Nitrile/ Silicon/ Neoprene rubber profiles and sheets shall be subjected to First Article Inspection by BEML and/or Customer's Representative. After clearance from BEML only, mass production shall be taken up. After formal approval has been given, no change in the compound or processing conditions shall be made without the consent of BEML.

8. Submittals with Technical Offer

The Supplier shall provide as a minimum, the following along with the technical offer:

1. Complete technical offer for rubber packing and rubber profiles.
2. Technical data sheet of EPDM, Silicone, Neoprene & Nitrile rubbers and the self adhesive.
3. Copy of Type test reports of earlier similar projects.
4. Clause-wise comments against the PTS Doc No. GR/TD/1766.
5. Fire safety test report copies of earlier similar projects.
6. Supporting documents for Qualification Criteria compliance.
7. Duly filled Vendor credential form along with supporting documents including QAP & ITP, company profile with infrastructure facilities, product range etc.,

Date:

Proforma No: RS15/BEML/V.NNO/CAT-__ / ____ /M/ ____

<u>CHECKSHEET FOR</u>			
<u>SUBMISSION OF DOCUMENTS FOR</u>			
<u>NOTICE OF NO OBJECTION FOR SUB-CONTRACTOR/VENDOR FROM DMRC</u>			
ITEMS:			
Category	A	Items manufactured outside India and proposed to be used in all RS15 trains.	<input type="checkbox"/>
	B	Items manufactured outside India and proposed to be used in all RS15 trains but likely to be localised after some part quantity from OEM (shall be declared by BEML).	<input type="checkbox"/> Equivalent Localisation Quantity : __ Trainsets
	C	Locally manufactured items proposed to be used in all RS15 trains.	<input type="checkbox"/>
1	Proforma for Submission of documents		<input type="checkbox"/> YES <input type="checkbox"/> NO
2	Vendor Details	Annexure-I	<input type="checkbox"/> YES <input type="checkbox"/> NO
3	Sub-Vendor Detail	Annexure-I	<input type="checkbox"/> YES <input type="checkbox"/> NO
4	Certificate from BEML	Annexure-II	<input type="checkbox"/> YES <input type="checkbox"/> NO
5	Copy of technical purchase specification of BEML		<input type="checkbox"/> YES <input type="checkbox"/> NO
6	Inspection and Test Plan		<input type="checkbox"/> YES <input type="checkbox"/> NO
Note:	1	Incomplete documents will not be reviewed by DMRC.	
	2	Items used in DMRC's existing rolling stock do not automatically qualify for use unless specifically approved by DMRC for this project.	
(BEML Limited)		_____ (Proposed Vendor)	

PROFORMA FOR SUBMISSION OF DOCUMENTS FOR NOTICE OF NO OBJECTION FOR SUB-CONTRACTOR/VENDOR FROM DMRC					
1	Item description				
2	Vendor particulars along with proposed manufacturing unit submitted in Annexure-I	<input type="checkbox"/> YES		<input type="checkbox"/> NO	
3	Technical Specification & Inspection Plan	—			
3.1	Enclosed copy of Technical Purchase Specification of BEML	<input type="checkbox"/> YES		<input type="checkbox"/> NO	
4	Details of experience/ satisfactory performance to establish compliance with ERTS 3.2.2.				
The Information shall be submitted in following format:					
S.No.	Mass Rapid Transit System where proposed sub-system/equipment/component has been used	Country	Quantity Used	Period in satisfactory Revenue Service [from/to] (Min 2 yrs in each MRTS)	Manufacturing Unit
	1	2	3	4	5
1	1				
	2				
	3				
2	1				
	2				
	3				
3	1				
	2				
	3				
4	1				
	2				
	3				
4.1	Based on above, is the proposed item compliant with ERTS 3.2.2				<input type="checkbox"/> YES <input type="checkbox"/> NO
4.2	Is the proposed manufacturing unit compliant with ERTS 3.2.2				<input type="checkbox"/> YES <input type="checkbox"/> NO
4.3	Confirmation that the subsystems used in RS15, as proposed herein, shall have NO CHANGE in source, manufacturing unit, components, specification, material etc. from those approved unless got specifically approved from DMRC.				<input type="checkbox"/> CONFIRMED <input type="checkbox"/> NOT CONFIRMED
4.4	Information submitted herein as above is certified as correct, strictly in accordance with the RS13 contract conditions and has been verified by BEML. In case any information is found to be factually incorrect or at variance with contract conditions at any stage, BEML commits to replace the concerned 'sub-system' in complete fleet as per the instructions of engineer, which shall be final and binding. In such case, BEML shall not be eligible either for seeking any claim whatsoever or for seeking extension of contract delivery period.				<input type="checkbox"/> CONFIRMED <input type="checkbox"/> NOT CONFIRMED
4.5	Confirmation that DMRC may depute a team of Engineers (around six) at Sub-contractor/vendor's office for requisite duration with a view to expedite finalization of designs in accordance with contract 'RS15' conditions ERGS 5.11.3.				<input type="checkbox"/> CONFIRMED <input type="checkbox"/> NOT CONFIRMED
5	Notwithstanding the vendor approval communicated by DMRC on the proposal of BEML, responsibility for manufacture, testing, supply, commissioning and quality control shall continue to rest solely with BEML and BEML will be solely responsible for meeting all contractual requirements.				<input type="checkbox"/> CONFIRMED <input type="checkbox"/> NOT CONFIRMED
<p>(BEML Limited) _____ (Proposed Vendor)</p>					

Date:

Proforma No: RS15/BEML/V.NNO/CAT- ___ / ___ /P2/ ___

6	Category B - Sourcing from facilities in India after supply of agreed quantity from approved manufacturing unit.	
6.1	In case OEM wants to use manufacturing facilities in India (other than his own) for items for which the OEM has been approved, it shall enter into an agreement with such selected Indian equipment manufacturer and obtain prior approval from DMRC. No change in composition, rating, type, model no., manufacturing process, quality standards, design, etc. and make of the components used in assemblies/sub-assemblies of such equipment as manufactured by the approved parent vendor shall be made without specific prior approval of the Engineer.	
6.2	In case the vendor uses his own facilities for indigenization after part supply of equipment from the approved manufacturing unit, no change in design, component type/make, quality standards, manufacture procedure, sourcing of materials etc. shall be made without specific prior approval of the Engineer.	
6.3	In case OEM wishes to change/make/type specifications, etc. of any sub-components for supplies to be sourced from Indian facility, specific prior approval of the Engineer shall be obtained for changes made, model, specification, etc. Responsibility for obtaining such prior approval shall rest solely with the contractor.	
6.4	In case of local manufacturing of carbody or any other item(s) manufactured by BEML/OEM and used in initial trains, BEML shall be exclusively responsible for all quality assurance and inspection and their implementation and also ensure provision of physical partition as per the ERGS 1.1.7	
7	Category C- Locally Manufactured Items	
7.1	Does the manufacturing unit satisfy ERTS 3.2.2	<input type="checkbox"/> YES <input type="checkbox"/> NO
7.2	If not, basis/justification for proposal to be submitted for DMRC review	<input type="checkbox"/> YES <input type="checkbox"/> NO
8	BEML confirms that in terms of ERTS 3.2.2, they would seek Notice of No Objection for Sub-Contractor/Vendor from DMRC notwithstanding the item(s) being used in DMRC's existing rolling stock.	<input type="checkbox"/> YES <input type="checkbox"/> NO
9	BEML shall submit Certificate as per enclosed Annexure-II confirming:	
9.1	Compliance with Clause 6.6 of ERGS and GCC Clause 5.8 regarding supply of software tools/documents/materials etc.	
9.2	Compliance with Clause 8.12 of ERGS regarding supply of all drawings, specifications, patterns etc. in case the manufacture of these items is discontinued by the proposed vendor.	
10	Commitment from the vendor that in case of any future procurement action by DMRC, he shall quote directly to DMRC.	
12	BEML commits that the vendor shall be complying with all relevant contract clauses.	
(BEML Limited)		_____ (Proposed Vendor)

Date:

Proforma No: RS15/BEML/V.NNO/CAT- ___ / ___ /A1/ ___

Annexure-I					
SUB-Contractor/VENDOR/SUB-SUPPLIER DETAILS					
1	Vendor/Sub-supplier OEM Name				
2	Details of item proposed to be sourced				
3	Sourcing by: <table style="width: 100%; border: none;"> <tr> <td style="width: 80%; border: none;">(a) BEML</td> <td style="width: 20%; border: none; text-align: center;"><input type="checkbox"/></td> </tr> <tr> <td style="border: none;">(b) Proposed Main vendor</td> <td style="border: none; text-align: center;"><input type="checkbox"/></td> </tr> </table>	(a) BEML	<input type="checkbox"/>	(b) Proposed Main vendor	<input type="checkbox"/>
(a) BEML	<input type="checkbox"/>				
(b) Proposed Main vendor	<input type="checkbox"/>				
4	Marketing Office/Head Office				
4.1	Complete address (including website)				
4.2	Contact person details in Head Office				
	<ul style="list-style-type: none"> ● Name ● Designation ● Telephone ● Fax ● Mobile ● Email 				
5	Details of proposed compliant plant/manufacturing unit from where item is proposed to be sourced				
5.1	Complete address (including website)				
5.2	Contact person details				
	<ul style="list-style-type: none"> ● Name ● Designation ● Telephone ● Fax ● Mobile ● Email 				
5.3	Supply details of the manufacturing unit for the proposed item or item with similar design.				
5.4	It is confirmed that the proposed manufacturing unit and the vendor are fully compliant with ERTS 3.2.2				
5.5	We commit that in case of any future procurement action by DMRC, the proposed vendor shall quote directly to DMRC without any involvement of BEML.				
5.6	We have carefully gone through all relevant clauses of the RS15 Contract and shall fully abide by the contract conditions and decisions communicated by DMRC during contract execution without exception.				
<table style="width: 100%; border: none;"> <tr> <td style="width: 60%; border: none;">(BEML Limited)</td> <td style="width: 40%; border: none; text-align: right;">_____ (Proposed Vendor)</td> </tr> </table>		(BEML Limited)	_____ (Proposed Vendor)		
(BEML Limited)	_____ (Proposed Vendor)				

Date:

Proforma No: RS15/BEML/V.NNO/CAT- ___/___/A2/___

Annexure-II

**Certificate for compliance with Contract conditions regarding
Software requirements.**

This is certified that in the contract between BEML and _____ (proposed vendor) for supply of _____, specific conditions for confirming total compliance with the following contract condition/clauses have been included and agreed to between BEML and _____(proposed vendor):

(a) Clause 6.6 of ERGS and GCC 5.8

It is certified that we shall provide full access of application software(s) and any other software /hardware tools to DMRC which they may specifically require for the intended purpose specified in this specification. For all commercial software BEML shall provide all available documentation for the application and maintenance of that software.

Complete documentation along with the software to be supplied by BEML and its Vendor(s) shall comprise of Signal flow diagram, flow charts, functional blocks, details of signals, interpretations so as to enable engineer to debug and implement vehicle/train level modifications based on DMRC's experience, operational & maintenance requirements. Full access to the application software to DMRC shall be provided for this purpose.

It shall be possible for DMRC to modify/change various parameters/logics used in the software and implement the changes on trains. Full facilities including any software/hardware tools, simulation/test bench which are essential for this purpose shall be supplied.

It is committed to supply the software/hardware etc. within the scope specified in respective clauses of ERTS relevant for the proposed item/vendor and we would be fully complying with GCC 5.8

(b) Clause 8.12 of ERGS:

It is certified that _____ (proposed vendor) will supply all drawings, specifications, patterns and any other information required by DMRC for arranging such items in case the manufacture of these items is discontinued within 10 years by the proposed vendor.

(BEML Limited)

_____ (Proposed Vendor)