

SPEC. NO.: GA/TECH-SPEC/1084

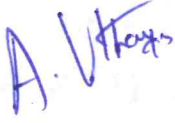


Revision – 1; Dated 25.06.2020

**TECHNICAL SPECIFICATION
OF
AIR SUSPENSION SYSTEM FOR BEML
HEAVY DUTY VEHICLE 4x4 / 6x6 (Front Axle)**

**513 SU 02075
(SUSPENSION KIT FOR 4x4)**

**BEML LIMITED
R&D DEFENCE
KOLAR GOLD FIELDS
KARNATAKA INDIA**



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1. INTRODUCTION

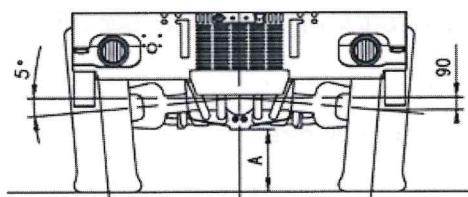
BEML vehicles designed as heavy-duty vehicles designated for hard terrain, difficult climatic and environmental conditions. The all-wheel drive chassis employs independent suspension and backbone tube frame, the unique feature of the chassis that allow each wheel to move independently with improved steering and maximum tyre to ground contact.

The unique chassis and suspension design gives the vehicle exceptional resistance to shocks and vibrations, protects superstructures from torsion, stresses, and allows driving fast on rough roads.

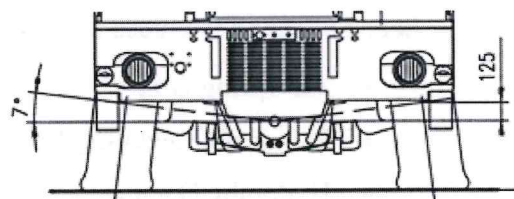
BEML 4x4, suspension majorly comprises of air springs, hydraulic dampers, stabilizer bars and automatic height control mechanism. This suspension system can be adopted to all variants viz., 4x4, 6x6, 8x8, 10x10 and 12x12, i.e., with minimum modification.

2. VEHICLE INFORMATION (FOR REFERNECE)

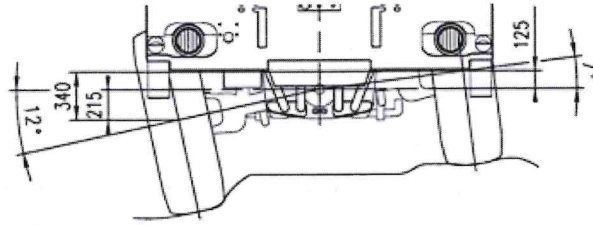
| | |
|-------------------------|---|
| Vehicle Model | 4x4 Armoured Cab |
| Overall length | 6 500 mm |
| Overall width | 2 750 mm |
| Overall height | 3 300 mm |
| Maximum Speed..... | 100 km/h |
| Axle Capacity | 9 000 kg per axle |
| Overload Capacity | Min. 10% additional margin i.e., approx. 10 000 kg per axle |
| Wheel Track | 2032 mm |
| Wheel Bump | 7° (125 mm) |
| Wheel Rebound | 12° (215 mm) |
| Total Wheel Travel..... | 340 mm |



Raised Position



Lowered Position



(Representation pictures only)

3. OPERATING CONDITIONS

| | |
|-----------------------------|--------------------------------|
| Operating Temperature | -20 to +55 °C |
| Storage Temperature | -30 to + 70 °C |
| Relative Humidity | up to 50 % @ 30 °C |
| Altitude | up to 4 000 m above sea level |
| Salt Condition..... | As found in sea coast |
| Dusty Condition | As found in Rajasthan & Punjab |

4. SCOPE OF SUPPLY

1. Development, Testing and Supply of Air Suspension System for BEML Heavy Duty Vehicle 4x4 for both front & rear axles meeting the BEML Specification.

- Brief Specification & dimension information is provided in this document. 3d model available with BEML could be shared during development stage for Vendor reference.
- Any deviation or equivalent offered should be notified to BEML and approval to be obtained before proceeding with the prototype development.

| S. No. | Description | Part Number | Qty |
|--------|---|--------------|--------|
| 1. | Air Suspension System for BEML 4x4 (For both front axle & rear axle) | 513 SU 02075 | 1 Set. |

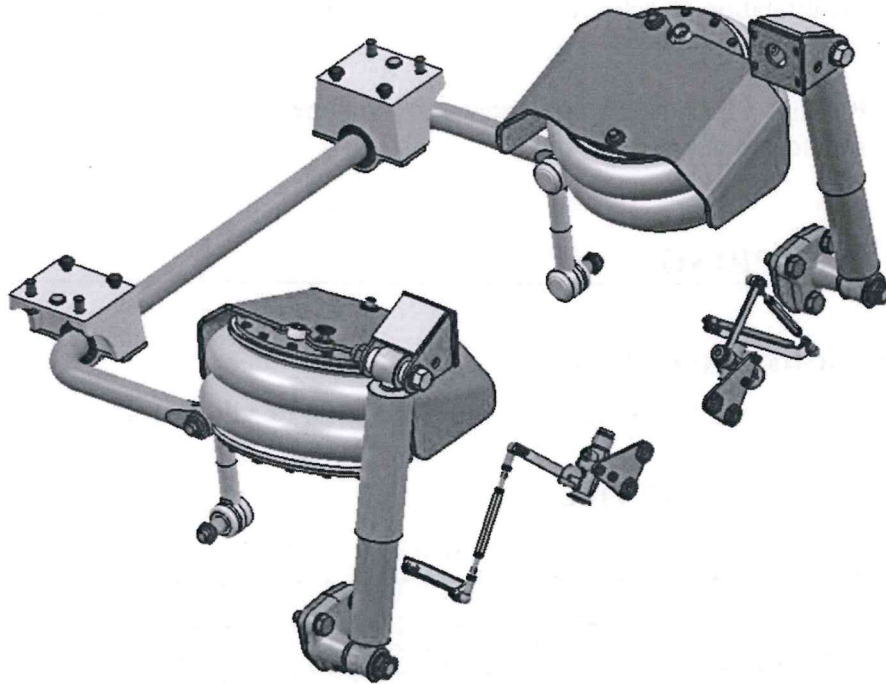
Scope of supply includes but not limited to following aggregates per axle:

- Air Spring Unit
- Pneumatic Levelling Valve with adjustable rod.
- Hydraulic Damper
- Anti-Roll Bar
- Mounting Brackets, Accessories, etc.,

2. Integration Support of Air Suspension System on Proto-Vehicle at BEML Plant

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3. Support during development trials of vehicles at designated locations, anywhere in the country within the warranty period. Schedule and plan will be intimated well in advance before commencement of trials.



(3d representation image of entire scope of supply/axle)

5. TESTING / INSPECTION REQUIREMENT

1. BEML team will carry out stage inspections during execution of the contract as per the development plan. The inspection of individual items will be as per the drawings and technical requirements & conditions at SUPPLIER's premises before start of the sub-assemblies & assembly.
2. Metallurgy test certificate (chemistry & mechanical properties) for Raw materials to be tested from NABL accredited labs & test reports to be provided to BEML.
3. Parts / Assembly to confirm all aspects mentioned in Drawings, Standards & specification.
4. Visual Examination – Each part / assembly shall be examined visually for workmanship & finish and should be free from manufacturing defects such as dents, soldering defects, cracks, etc.
5. Dimension & Weights – 100% to be verified for prototype & inspection records to be provided with supply. Dry weight of major assembly / sub-assembly to be provided.
6. Process inspection – Quality of surface treatment and heat treatment to confirm specification. Surface protective coating & Heat Treatment shall be checked against specifications

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indicated in the special notes of the respective part drawings. The heat treated parts shall be checked for surface hardness, micro-structure and for any surface cracks.

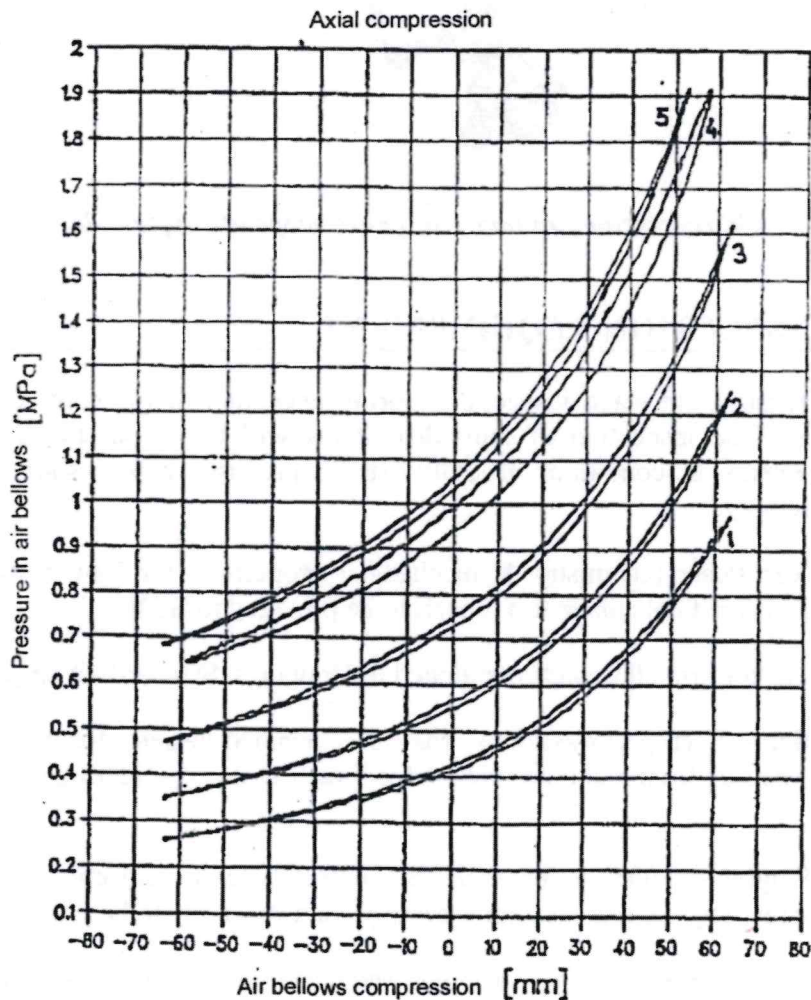
7. Preservation Check – Ensure that all the components such as hoses, rubber parts, gaskets, lubricants and glue has sufficient life period & surface treatment given to parts & assembly.
8. Identification Check – Ensure proper identifications are made with metal labels reverted on to the major assemblies.
9. Packing Check – Ensuring that no components should be damaged during transit and it should contain packing slip.

6. AIR SPRING

6.1 MODEL INFORMATON

380/2T (380mm, 2 waves) of Ms. Rubena (Czech Republic) or Better Equivalent

6.2 CHARACTERISTICS:

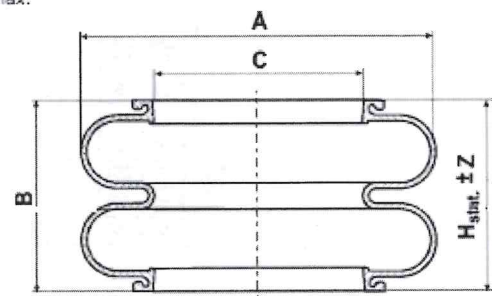


6.3 DIMENSIONS INFORMATION

| Air Spring A/Number of convolutions | A _{max.} [mm] | B [mm] | C [mm] | H _{stat.} [mm] | Z [mm] | V [cm ³] | S _{ef.} [cm ²] | P _{max.} [PMa] | m [kg] |
|---|---------------------------|-----------|-----------|----------------------------|-----------|-------------------------|--|----------------------------|-----------|
| 130/1 | 140 | 80 | 53,6 | 75 | + 30 | 638 | 74 | 0.5 | 0.3 |
| 130/2 | 140 | 145 | 53,6 | 130 | + 40 | 1 155 | 73 | 0.5 | 0.4 |
| 130/3 | 140 | 210 | 53,6 | 170 | + 60 | 1 515 | 77 | 0.5 | 0.5 |
| 170/1 | 180 | 92 | 90 | 80 | + 30 | 960 | 152 | 0.7 | 0.4 |
| 170/2 | 180 | 162 | 90 | 135 | + 60 | 1 945 | 154 | 0.7 | 0.6 |
| 170/3 | 180 | 232 | 90 | 180 | + 100 | 2 760 | 156 | 0.7 | 0.9 |
| 190/1 | 200 | 140 | 96 | 130 | + 30 | 2 410 | 154 | 0.5 | 0.5 |
| 190/2 | 200 | 210 | 96 | 200 | + 60 | 3 640 | 153 | 0.5 | 0.8 |
| 190/3 | 200 | 280 | 96 | 240 | + 100 | 4 935 | 155 | 0.7 | 1.1 |
| 280/1 | 295 | 108 | 150 | 100 | + 30 | 4 480 | 385 | 0.7 | 2.1 |
| 280/2 | 295 | 179 | 150 | 165 | + 60 | 6 720 | 387 | 0.7 | 2.6 |
| 280/3 | 295 | 250 | 150 | 230 | + 100 | 8 970 | 389 | 0.7 | 3.2 |
| 290/1 | 310 | 93 | 154 | 115 | + 60 | 4 300 | 342 | 0.7 | 2.2 |
| 290/2 | 310 | 162 | 154 | 175 | + 90 | 7 315 | 400 | 0.7 | 2.8 |
| 290/3 | 310 | 231 | 154 | 240 | + 100 | 10 150 | 438 | 0.7 | 3.4 |
| 340/2 | 345 | 162 | 192 | 170 | + 90 | 9 500 | 600 | 0.7 | 1.8 |
| 34/3 | 345 | 231 | 192 | 240 | + 100 | 14 900 | 600 | 0.7 | 2.4 |
| 380/1 | 395 | 106 | 234 | 110 | + 30 | 7 300 | 714 | 0.7 | 2.2 |
| 380/2 | 395 | 175 | 234 | 170 | + 75 | 12 900 | 739 | 0.7 | 3.0 |
| 380/2T | 400 | 200 | 213 | 230 | + 80 | - | 700 | 1.0 | 4.3 |
| 38/3 | 395 | 244 | 234 | 240 | + 100 | 19 650 | 756 | 0.7 | 3.7 |
| 410/1 | 410 | 130 | 270 | 130 | + 30 | 11 000 | 973 | 0.7 | 2.4 |
| 410/2 | 410 | 206 | 270 | 205 | + 75 | 18 000 | 975 | 0.7 | 3.4 |
| 410/3 | 410 | 280 | 270 | 280 | + 120 | 26 700 | 1 000 | 0.7 | 4.3 |

Legend:

- A** = outside diameter of the bellow in the mould (in mm)
A_{max.} = max outside diameter of the bellow at H_{stat.} and P_{max.}
B = bellow high in the mould
C = inside diameter at the bellow in the mould
H_{stat.} = static (assembling) height of the bellow
Z = stroke of the bellow from H_{stat.}
V = volume of the bellow at H_{stat.}
S_{ef.} = effective area of the bellow at H_{stat.}
P_{max.} = max operating overpressure at H_{stat.}
 - outside diameter of the bellow (in cm)
 - job-order manufacture



6.4 MATERIAL

The air bellows to be made of Rubber Rubena 31472 (PN 62 2000) or equivalent. The rayon cord of the minimum strength of 210 N/thread should be used for the air bellows.

The operating temperature range from -40°C to $+70^{\circ}\text{C}$

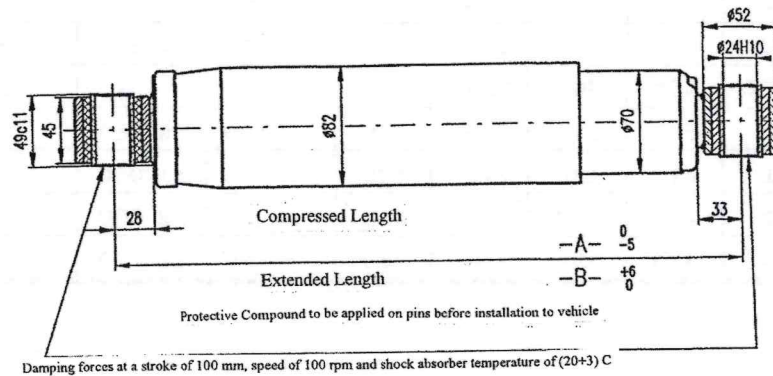
6.5 TEST REQUIREMENTS

1. The physical and mechanical properties of Rubber Rubena 31472 or equivalent.
2. Durability tests on the test stand simulating the weight and conditions as stated above, the air bellows must stand 2,00,000 cycles at the half-axle swing angle of $\pm 8^{\circ}$.
3. The minimum destructive pressure at the static height of 230mm of the air bellows which it must stand, is 4MPa (However, the air bellows to be designed for working pressure of maximum 1 MPa at the air bellows height of 230 mm)
4. The above both test should holds satisfactory up to the period of 18 months from the date of manufacture of air bellows.

7. HYDRUALIC DAMPER

7.1 PRODUCT INFORMATION

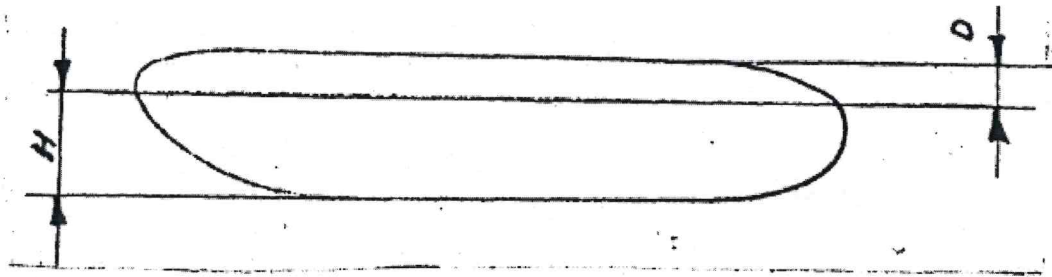
Size, weight & damping force requirement refer below table & diagram for model code – P 50 x 230 or better equivalent is acceptable.



| Type | Damping force (N) | | Dimensions | | Weight |
|------------|-------------------|-----------------|------------|-----|---------|
| | Extension | Compression | A | B | |
| P 50 x 175 | 4 500 \pm 450 | 1 000 \pm 150 | 387 | 562 | |
| P 50 x 250 | 8 800 \pm 800 | 1 200 \pm 200 | 462 | 712 | |
| P 50 x 250 | 8 800 \pm 800 | 1 200 \pm 200 | 437 | 687 | 6.2 kg |
| P 50 x 230 | 8 800 \pm 800 | 1 200 \pm 200 | 417 | 647 | 5.65 kg |
| P 50 x 165 | 8 800 \pm 800 | 1 200 \pm 200 | 352 | 517 | |
| P 50 x 230 | 11 000 \pm 1100 | 2 600 \pm 390 | 417 | 647 | 5.65 kg |

Untolerated dimensions for information only | Max Inclination 45°
Max.transverse inclination $\pm 3^{\circ}$
Max.swivelling angle $\pm 20^{\circ}$

7.2 DAMPING DIAGRAM



H - Top damping

D - Bottom damping

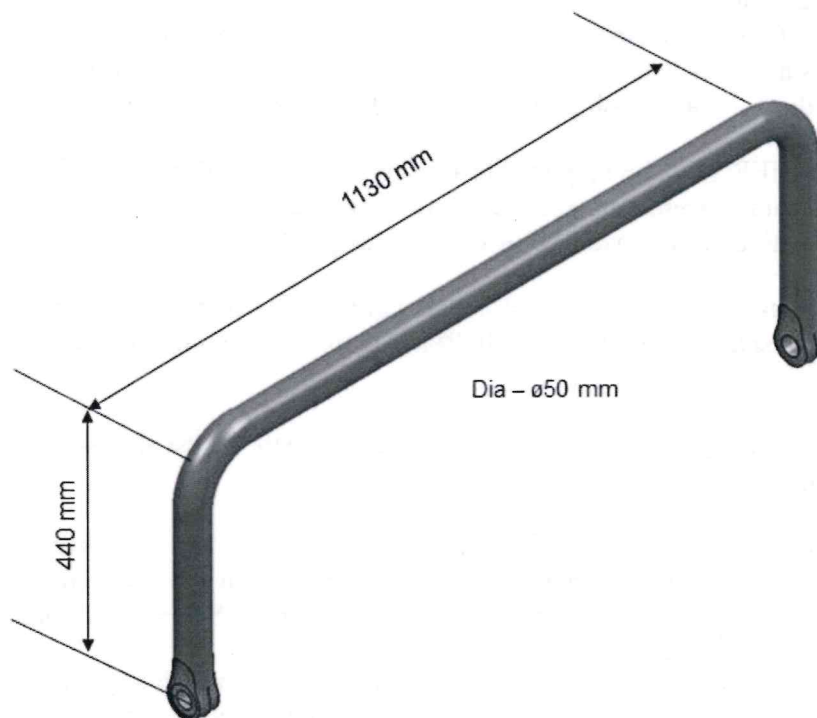
7.3 TEST REQUIREMENTS

Shock absorber to confirm to the general and test requirements as laid down in IS: 5423 which shall include Damping force test, Endurance test and effect of temperature on damping characteristics.

8. ANTI-ROLL BAR

8.1 BASIC DIMENSION DETAILS

Refer figure for indicative dimension.



(for reference only)

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8.2 MATERIAL SELECTION

Suitable material to be selected for anti-roll bar as per relevant automotive standard and practices & the same shall be notified to BEML and approval to be obtained before proceeding with proto development.

9. DELIVERY SCHEDULE

The complete deliverables as mentioned above in all aspects should reach to our BEML Plant within 3 months from date of placement of purchase order.

10. ACCEPTANCE TRIALS

Post successful integration of the above components in either 4x4 or 6x6 vehicle within the axle load rating specified above.

Vehicle will be subjected to 250 km cross-country trials in BEML test facilities or any other test facility / locations within India.

No mechanical failure or abnormal behaviour should be observed during this trial for successful completion of trials.

11. WARRANTY

1. Notwithstanding inspection & acceptance by BEML of the hardware under this contract or any clause concerning the conclusiveness thereof, SUPPLIER shall provide warranty for a period of 24 months from the date of integration of the Air Suspension system on vehicle or 36 months after hardware delivery, whichever comes first, that hardware is free from defects / failures due to workmanship, material or manufacturing non-conformance.
2. The SUPPLIER shall be responsible for any defect or failure of equipment provided in the Air Suspension system, test and diagnostic equipment, maintenance and unit exchange spares due to defective design, material or workmanship.
3. The repair and/or replacement of failed components and installation of repaired/replaced components shall be taken by the SUPPLIER on his own charge at the Site (BEML' works, India).
4. In case of failures & rectifications, SUPPLIER shall re-test the air suspension system for proper functionality
5. The SUPPLIER shall bear custom duty, freight charges and all other expenses involved in collection of defective components and equipment from the Site, and transportation to the manufacturer's works in India or abroad and its return to Site after repairs.
6. Further, the SUPPLIER shall carry out all replacement and repairs under the warranty promptly and satisfactorily on notification of the defect by BEML immediately.

12. WORKMANSHIP

1. The workmanship should be in accordance with the accepted engineering and production standards of the industry so as to ensure operation of cooling system under severe combat environment
2. Non-Standard/special process employed during fabrication shall have prior approval of BEML.
3. Sharp edges, burrs, corners likely to cause injuring during handling should be removed or suitably rounded off.
4. All hardware items like bolts used in the assembly will be of high tensile strength of the order of 10.9 or above. All bolts whether used will be provided with spring and lock washer of appropriate size. However structural fastening shall be as per IS 800.
5. All the purchased items must be of regular standard shape, size and make.
6. All welding & fabrication shall be complied by IS 813 or 823 / ASME Sec 8.
7. Only qualified welders as per relevant IS or equivalent standard should carry out welding operation.
8. Cutting, Bending, Machining, Selection of electrodes, edge preparation, tag welding, preheating and welding to be carried out as per 'Workshop Recommendations' or as defined by respective drawings/documents.
9. All the components used in the construction of this supply shall be from fresh and present stock and not from older stocks. SUPPLIER shall provide necessary material certificate to this effect
10. Stage inspection to be carried out. All threaded fasteners should turn freely without jamming and to be lubricated wherever called for.
11. Quality inspection facilities for manufacture and testing should have certificates with regard to calibration & accuracy.
12. The joints in core, inlet and outlet shall be properly soldered and shall be free from any manufacturing defects like discontinuities, cracks.

13. PRODUCT LIFE SUPPORT

The SUPPLIER shall be required to confirm that, he is in a position to provide product support in terms of maintenance, material and spares for a period of minimum 30 years. The SUPPLIER must provide at least 2 Years notice to BEML before closing the production line so as to enable "LIFE TIME BUY" of all the material & spares before closure of the production line. All upgrades & modifications carried out on the equipment during the life cycle must be intimated to buyer.

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14. PAINT SYSTEM

All main metal surface are to be painted in Abrasive Resistant Paint. Paint Colour will be intimated at later stage.

15. VENDOR QUALIFICATION CRITERIA

Should have prior experience in development of air suspension units or retro-fitments of air suspension unit on to commercial vehicles (Trucks/Buses, etc.). Kindly enclose the list of projects handled in support of this claim.

If any imported components / material being used in the system to be informed to BEML for prior approval. No imported components to be used from countries which are under restricted list from GoI.

Previous experience of providing suspension solution to any Defence application is of added advantage.

Note:

Para-Wise compliance/confirmation to this specification to be submitted by the vendor (compliance matrix format enclosed). Also, enclose relevant model code or specification of item considered against the above requirement.