GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

Specification for Computer/ Microprocessor Controlled
Air Brake System with Advanced Features
For 3-Phase Electric Locomotives

Specification No. RDSO/EL/SPEC/2016/XXXX Rev. ‘0’

MAY 2016

Approved By
EDSE/Co-ord.

Signature

RESEARCH DESIGNS & STANDARDS ORGANISATION
MANAK NAGAR LUCKNOW 226011

Prepared by
Checked by
Issued by
### Status of Revision

<table>
<thead>
<tr>
<th>S.N.</th>
<th>Date of Revision</th>
<th>Page no.</th>
<th>Revision</th>
<th>Reasons for Revision</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>-</td>
<td>All</td>
<td>0</td>
<td>First Issue</td>
</tr>
</tbody>
</table>
## CONTENTS

<table>
<thead>
<tr>
<th>S.No.</th>
<th>CONTENTS</th>
<th>PAGE No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Acronyms &amp; Definitions:</td>
<td>4</td>
</tr>
<tr>
<td>2.0</td>
<td>Scope</td>
<td>5</td>
</tr>
<tr>
<td>3.0</td>
<td>Basic Relevant Data of Locomotives</td>
<td>5</td>
</tr>
<tr>
<td>4.0</td>
<td>General Conditions</td>
<td>7</td>
</tr>
<tr>
<td>5.0</td>
<td>Service Condition</td>
<td>8</td>
</tr>
<tr>
<td>6.0</td>
<td>Technical Requirements of Brake System</td>
<td>8</td>
</tr>
<tr>
<td>7.0</td>
<td>System Requirement</td>
<td>11</td>
</tr>
<tr>
<td>8.0</td>
<td>Additional Requirements of Brake System</td>
<td>20</td>
</tr>
<tr>
<td>9.0</td>
<td>Literature &amp; Drawings</td>
<td>21</td>
</tr>
<tr>
<td>10.0</td>
<td>Inspection, Testing and Approval</td>
<td>22</td>
</tr>
<tr>
<td>11.0</td>
<td>Performance Guarantee.</td>
<td>23</td>
</tr>
<tr>
<td>12.0</td>
<td>After Sale Service</td>
<td>24</td>
</tr>
<tr>
<td>13.0</td>
<td>Indigenization</td>
<td>25</td>
</tr>
<tr>
<td>14.0</td>
<td>Deviations</td>
<td>25</td>
</tr>
<tr>
<td>15.0</td>
<td>Training</td>
<td>25</td>
</tr>
<tr>
<td>16.0</td>
<td>Quality Assurance Plan (QAP)</td>
<td>25</td>
</tr>
</tbody>
</table>
### Acronyms & Definitions:

<table>
<thead>
<tr>
<th>Acronyms</th>
<th>Definitions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>BP</td>
<td>Brake Pipe</td>
</tr>
<tr>
<td>MR</td>
<td>Main Reservoir</td>
</tr>
<tr>
<td>FP</td>
<td>Feed Pipe</td>
</tr>
<tr>
<td>AFI</td>
<td>Air Flow Indication</td>
</tr>
<tr>
<td>MREQ</td>
<td>Main Reservoir Equalising</td>
</tr>
<tr>
<td>BC</td>
<td>Brake Cylinder</td>
</tr>
<tr>
<td>BH</td>
<td>Brake Handle</td>
</tr>
<tr>
<td>PB</td>
<td>Parking Brake</td>
</tr>
<tr>
<td>FAD</td>
<td>Free Air Delivery</td>
</tr>
<tr>
<td>BCEQ</td>
<td>Brake Cylinder EQ</td>
</tr>
<tr>
<td>MU</td>
<td>Multiple Unit</td>
</tr>
<tr>
<td>VCD</td>
<td>Vigilance Control Device</td>
</tr>
<tr>
<td>TPWS</td>
<td>Train Protection Warning System</td>
</tr>
<tr>
<td>TCAS</td>
<td>Train Collision Avoidance System</td>
</tr>
<tr>
<td>VCU</td>
<td>Vehicle Control Unit</td>
</tr>
</tbody>
</table>
Specification for Computer/ Micro-processor Controlled Air Brake System with Advanced Features for 3-Phase Electric Locomotives.

1. **SCOPE**

This specification covers the functional requirement of Computer/Microprocessor Controlled air brake system for WAG9, WAP7 and WAP5 3-Phase electric locomotives and this specification would assist in purchase, inspection, testing and acceptance requirements. This Computer Controlled air brake system will be fitted on WAG9, WAP7 and WAP5 class of electric locomotives and new locomotives for future development. This specification takes reference of CLW tender specification no.CLW/MS/3/001 Alt. 13. and CLW/MS/10/031 Alt. 6

The locomotive shall be provided with braking system of proven design for operation of twin pipe graduated release air /conventional or disc braked train. The loco shall have independent air brakes as well as parking brakes. In case of tripping of circuit breaker during regenerative braking due to any fault in the system, rise in line voltage for any other reason, equivalent locomotive/ train brake/ shall apply automatically. Service speed of the Passenger locomotive 160 kmph- upgradable to 200 kmph and test speed is 180 kmph- upgradeable 225 kmph.

2. **BASIC RELEVANT DATA OF LOCOMOTIVE**

Basic data of WAG9, WAP7 and WAP5 class of electric locomotive relevant to brake system is as under:

2.1 Capacity of compressor:

Compressor capacity (FAD) at 10 kg/cm² pressure:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>WAG9 &amp; WAP7</th>
<th>WAP5</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>1750±10% LPM at 10.0 kg/cm² 02 compressors</td>
<td>1750±10% LPM at 10.0 kg/cm² 02 compressors</td>
</tr>
</tbody>
</table>

2.2 Nominal bore diameters of four major pneumatic pipes used on air brake locomotive are as under:-

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of pipe</th>
<th>WAG9, WAP7</th>
<th>WAP 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Brake pipe</td>
<td>32 mm</td>
<td>32 mm</td>
</tr>
<tr>
<td>ii)</td>
<td>Feed pipe</td>
<td>32 mm</td>
<td>32 mm</td>
</tr>
<tr>
<td>iii)</td>
<td>Brake cylinder equalizing pipe</td>
<td>19 mm</td>
<td>15 mm</td>
</tr>
<tr>
<td>iv)</td>
<td>Main reservoir E.Q. pipe</td>
<td>25 mm</td>
<td>25 mm</td>
</tr>
</tbody>
</table>

2.3 Basic data related to locomotives is as under:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Parameters</th>
<th>WAG9,WAP7</th>
<th>WAP5</th>
</tr>
</thead>
<tbody>
<tr>
<td>i)</td>
<td>Max. Weight of locomotive</td>
<td>123t± 1%</td>
<td>78t± 1%</td>
</tr>
<tr>
<td>ii)</td>
<td>No. of brake cylinders on loco</td>
<td>12</td>
<td>08</td>
</tr>
<tr>
<td>iii)</td>
<td>Bore diameter of brake cylinder</td>
<td>7&quot; TBU, 8&quot;UAH type</td>
<td>8&quot;</td>
</tr>
</tbody>
</table>
2.4 Length of the train is as under:
0.1 Air brake passenger train = 26 coaches
0.2 Air brake freight train = 58 BOXN
0.3 Locomotive used = Up to 3 nos. in multiple.

2.5 Relevant data of coaches and wagons are as under:

<table>
<thead>
<tr>
<th>S.No</th>
<th>Type of Rolling stock</th>
<th>Length of stock (in mm)</th>
<th>Brake pipe diameter (in mm)</th>
<th>Feed pipe diameter (in mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Air brake coach</td>
<td>22297</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>BOXN wagon</td>
<td>10713</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td>3</td>
<td>3-Phase Locomotive</td>
<td>WAG9 20562</td>
<td>32</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WAP7 20562</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>WAP5 18162</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.6 Maximum permissible speed of train:

<table>
<thead>
<tr>
<th>Type of stock</th>
<th>Air brake stock</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger</td>
<td>160 kmph</td>
</tr>
<tr>
<td>Freight</td>
<td>100 kmph</td>
</tr>
</tbody>
</table>

2.7 MP Service Range Pressure = 8.0 Kg/cm² to 10 Kg/cm²

<table>
<thead>
<tr>
<th>Loco Type</th>
<th>Minimum Reduction</th>
<th>Full Service</th>
<th>UIC 541-03 OR (BP volume:251)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BP</td>
<td>BC</td>
<td>BP</td>
</tr>
<tr>
<td>WAG-9</td>
<td>4.6±0.1</td>
<td>0.3–0.7</td>
<td>3.35±0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAP-7</td>
<td>4.6±0.1</td>
<td>0.3–0.7</td>
<td>3.35±0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAP-5</td>
<td>4.6±0.1</td>
<td>0.6–1.2</td>
<td>3.35±0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.8 CLW Specifications for Pneumatic Section

<table>
<thead>
<tr>
<th>S.No</th>
<th>Name of Item</th>
<th>CLW Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Specification of SS tubes (Seamless Annealed), Grade-304, Conforming to ASTM-A269</td>
<td>CLW/MS/3/029 Alt.7</td>
</tr>
<tr>
<td>02</td>
<td>Specification of Copper tubes</td>
<td>CLW/MS/3/030 Alt.7</td>
</tr>
<tr>
<td>03</td>
<td>Specification for Nylon tubes</td>
<td>CLW/MS/3/079 Alt.4</td>
</tr>
<tr>
<td>04</td>
<td>Specification of Clamps</td>
<td>CLW/MS/3/059 Alt.5</td>
</tr>
<tr>
<td>05</td>
<td>Specification of Hoses (End Fittings, A108)</td>
<td>CLW/MS/3/033 Alt.4</td>
</tr>
<tr>
<td>06</td>
<td>Specification of fittings (End Fittings, A 108, Ferrule SS(Gr.316)</td>
<td>CLW/MS/3/053 Alt.9</td>
</tr>
<tr>
<td>07</td>
<td>Specification of Polypropylene strut</td>
<td>CLW/MS/3/52 Alt.1</td>
</tr>
</tbody>
</table>
2.9 Maximum down gradient - 1 in 30

2.10 Electric Characteristics
   Operating Voltage 77 to 143 V dc according to EN 50155

   Power Consumption:
   BAT-1 line protection switch
   Max. Continuous Power consumption 175W (50-90 V, max. cont. rating 3.9A
   In Rush current: 300A (pk) 200µs ,@87 V

   BAT-2 line protection switch
   Max. Continuous Power consumption 215W (50-90 V, max. cont. rating 3.9A
   In Rush current: 400A (pk) 200µs ,@87 V

The electro-pneumatic or electrical devices shall be suitable for 110 volts DC on electric locomotive. The voltage variation on locomotive may be between 78 and 136 Volts.

3.0 General Conditions

3.1 Application for approval

The vendor seeking approval for manufacturing and supply of Computer/microprocessor Controlled air brake system can obtain a copy of form No. EL/F/0012, Ver."3" or (latest version) of Electrical Directorate. RDSO, Lucknow on payment.

3.2 Credentials and facilities of the vendor applying for approval

The vendor or its foreign collaborator (if any), who intends to supply Computer/microprocessor Controlled air brake system to Indian Railways, should have proven technology of Computer/microprocessor Controlled air brake system used in locomotive application (successfully working on at least—50 locomotives anywhere in the world). The vendor should have qualified and competent design personnel acquainted with the design and manufacturing technology required for brake system manufacturing.

3.3 The vendor or its collaborator should conform to RDSO’s Schedule of Technical Requirements No. RDSO/ 2011/EL/STR/0076 Rev. ’0’. 2011

4.0 Service Conditions

The equipment shall be capable of working satisfactorily under the service conditions indicated below:

4.1 Altitude

Mean sea level to an altitude of 1000 meters above mean sea level.
4.2 Temperature

Maxm Atmospheric Temp. – Under sun 75° C
   - Under shade 55° C

4.3 Relative Humidity = Up to 100% Saturation during rainy season.

4.3.1 Reference site conditions.

   (i) Ambient Temp. Maxm= 47°C, Minm = 0° C
   (ii) Humidity : 60%
   (iii) Altitude: 160m above sea level.

4.5 Rain Fall: Very heavy in certain areas. The locomotives will be designed to permit its running at 10 KMPH in flood water level of 102 mm above rail level.

4.6 Atmosphere during hot weather: Extremely dusty and desert terrain in certain areas.

4.7 Coastal Area: Locomotive and equipment will be designed to work in coastal areas in humid and salt laden atmosphere.

4.8 Vibrations and Shocks Tests.

   Vibration testing shall be done in accordance with clause ‘A’ category 1 of IEC-61373.

4.9 Ultra sonic ‘C’ scanning of the panel to establish consistency of the bonding of plates before and after shock & vibration testing

4.10 Other Conditions

Equipment shall be capable of operating efficiently in spite of dirt, dust, mist, torrential rain, heavy sand or stone storms and presence of oil vapors and radiant heat etc. to which the rolling stock is normally exposed in service.

5.0 TECHNICAL REQUIREMENTS OF BRAKE SYSTEM

5.1 The brake system offered should be Computer/Microprocessor Controlled air brake system of proven design. It should be compatible with graduated release twin pipe air brake system in accordance with RDSO’s specification 02-ABR-02

5.2 The compact modular Computer/microprocessor control brake system shall comprise of distributed electronics with Electro pneumatic modules linked together through gateway or local network. Its electro-pneumatic control unit shall consist of modularised electro-pneumatic modular Line Replaceable Units (LRU), which shall work as intelligent units, communicate with each other through the network or gateway and control the development of all pneumatic control pressures. It should also have redundancy features with availability of back-up for having Brake pipe control for applying and release of train brakes and Locomotive brakes. The details regarding availability of this feature should be submitted along with the offer.
5.3 There shall be no separate Electronic unit, as the pneumatic and electronic units shall be integrated together with Line Replaceable modular Units (LRUs). The interfaces shall be provided only among these modular units.

5.4 The Electro-Pneumatic Control Unit shall be resistant to water intrusion, however it may not be water tight, and can be mounted in an enclosed area.

5.5 There should be a provision of Brake Controller selector switch (mounted on brake controller) with four positions (Lead, Trail, Helper and Test) on each control stand. Alternatively selector switch with three positions (NORM, BANK, TEST) can be offered as separate unit to mount on each control stand.

5.6 The envelop size of the panel mounted with the equipment) should be as compact as possible, and shall preferably fall within the limits of 1100 mm (L) X 700 mm (W) X 1650 mm (H). The shape and size of the panel fits well in the locomotive with ample space for maintenance. All the LRU’s/Components should be preferably mounted on one side of the brake panel. The weight of the panel with equipment shall not be more than 600 Kg.

5.7 Even in case of failure of Computer/microprocessor controlled brake system, it should be possible to work the loco with self-power up to certain restricted speed.

5.8 The brake system should be capable of giving graduated application and release of brake on locomotive as well as on train for air brake system.

5.9 There are two control units/ cabs on locomotive. At one time one control cab will be used to control loco/train and brake system. Driver’s brake valves are to be provided on both the control units/cabs. Arrangement should be there to make brake valves inoperative on control unit which is not being used to control loco/train and brake system. However, it should be possible to apply emergency brakes from the control unit, which is not being used.

5.10 The locomotive brake system should be provided with self-lapping type independently operated brake valve on each control unit. The brake valve should have two positions namely ‘Release’ and ‘Application’ position as per UIC code. In between Release and Application position, the brake cylinder pressure built up should be in proportion to the handle movement. Corresponding to this pressure, the total braking effort shall work out to about 20% of the adhesive weight of the locomotive.

5.11 Provision of isolating position in the driver’s brake valve would be preferred.

5.12 The direction of rotation of driver’s automatic and independent valves shall be anti-clockwise or push to apply for the application of brakes, when placed in horizontal plane. The valve is placed on the left side of the pilot.

5.13 It shall be possible to apply the brakes from one cab and release it from another cab in case the pilot has to change the cab.

5.14 It should be possible to release locomotive brakes when the brakes of trailing stock are partially or fully applied with suitable bail off.
5.15 Locomotive should be provided with digital air flow indicating device to provide indication to the pilot about the train pipe condition and also of the train parting while hauling air braked stock.

5.16 An emergency brake valve operational system shall be provided. During emergency application, automatic shut off of locomotive power should take place, through Vehicle Control Unit (VCU) system.

5.17 It should be possible to use locomotive in multiple unit operation up to 3 locomotives in one group.

5.18 The locomotive shall be provided with electrical brake (regenerative) capable of providing optimum braking effort over a wide range of speed. Arrangement for automatic reduction of brake power in case of wheel skidding shall be provided.

5.19 It should be possible to use the locomotive as banking locomotive. In case of rolling stock equipped with air brakes, the brake pipe of the rolling stock shall not be changed by the banking locomotive. It shall be possible for the banking locomotive driver to apply train brakes from banking locomotive in case of emergency.

5.20 Rubber components such as pistons, ‘O’ rings etc. wherever employed in the brake system and their controls shall be entirely suitable for humid and hot environmental conditions prevailing in India.

5.21 Pneumatic Sanding shall be provided for all the front wheels and it shall be effective in either direction of travel. Automatic Sanding arrangement during wheel slipping by means of wheel slip detection relays shall be provided. Sand pipe nozzles shall be located at the height of 30 mm from rail level and the height shall be made adjustable to cater for the wheel wear.

5.22 It will be preferable if the sizes of pipes are limited to minimum. Sharp bends shall be avoided and where necessary standard connections shall be used. However, pneumatic piping and pipe fittings are outside the scope of this specification.

5.23 The various stop-cocks and isolating valves except drain cocks shall be oriented in the open position to the fluid flow direction. It shall be necessary to ensure that due to weight of the handle, when operated in a vertical plane, it shall not open or close on its own under vibrations encountered in service.

5.24 The connecting parts necessary for piping e.g. couplings, nuts, unions, bends etc. shall be assembled by means of tapper threads.

5.25 Adequate drainage arrangement to drain the moisture in the compressed air system shall be provided. The drainage is to be so adjusted with the air flow in the pneumatic control and brake system beyond the automatic drain valves is practically free from moisture.
6.0 SYSTEM REQUIREMENTS:

6.1 Panel (Brake Rack)

6.1.1 There should be a provision of Brake Controller selector switch (mounted on brake controller) with four positions (Helper, Trail, Lead, and Test in sequence from left to right) on each control stand. Alternatively selector switch with three positions (NORM, BANK, TEST) can be offered as separate unit to mount on each control stand.

6.1.2 The brake system should be capable of giving graduated application and release of brake on locomotive as well as on train for air brake system.

6.1.3 There are two control stands/cabs on locomotive. At a time one control stand will be used to control loco/train and brake system. Driver’s brake valves are to be provided on both the control stands/cabs. Arrangement should be there to make brake valves inoperative on control stand which is not being used to control loco/train and brake system. However, it should be possible to apply emergency brakes from the control stand which is not being used.

6.2 Driver’s Brake Valve

The Driver’s Brake valve (Controller) shall be electronic based, and act as interface between the Brake system and the Loco Pilot (Man-Machine Interface). The communication between the driver’s brake valve (Controller) and micro-processor based air brake system should be through fibre optic cable or CAN/ LON network. The interface cable with VCU provided for power supply or network connection must be shielded. Driver’s brake valve (controller) shall have handles for operation of the Independent and Automatic brakes. Alternatively separate valves (Independent & Auto brake) shall be offered. The electronic brake valve or Display unit shall accommodate LCD display of limited advisory and diagnostic messages (in English) to the crew. Apart from electronics, the Electronic Brake valve should contain a cam-actuated pneumatic valve, which will create a pneumatic emergency when automatic handle is brought to ‘emergency’ position. Each of the two driver control units of the locomotive shall be provided with Electronic Brake Valve (Controller) or separate valves (Independent, Auto brake & Display units).

6.3 Independent Brake Valve

The locomotive brake system should be provided with self-lapping type independently operated brake valve on each control stand. The brake valve should have two positions namely ‘Release’ and Full Service. In between Release and Full Service, the brake cylinder pressure built up should be in proportion to the handle movement.

6.4 Automatic Brake Valve

6.4.1 Automatic brake valve shall be self-lapping type and shall have separate ‘Release’ and ‘Run’ position as per UIC code. The ‘Release’ position should be
spring loaded. Following detent positions except release should be provided on automatic brake valve:

- **0.1** Release position - spring loaded
- **0.2** Run position
- **0.3** Minimum reduction brake application
- **0.4** Full service applications
- **0.5** Emergency application positions

**6.4.2** In automatic brake control module an electrical signal corresponding to the pressure in the Brake Pipe is transmitted to the computer by pressure transducer. The required Brake Cylinder pressure corresponding to brake pipe pressure reduction in inverse proportion is given as follows.

<table>
<thead>
<tr>
<th>Auto Brake Lever Position</th>
<th>BP Pressure (Kg/cm²)</th>
<th>BC (WAG-9 &amp; WAP-7) (Kg/cm²)</th>
<th>BC (WAP-5) (Kg/cm²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Release / Run</td>
<td>5.0±0.1</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Minimum Reduction</td>
<td>4.6±0.1</td>
<td>0.40±0.1</td>
<td>0.75±0.15</td>
</tr>
<tr>
<td>Full Service</td>
<td>3.35±0.1</td>
<td>2.5±0.1</td>
<td>5.15±0.15</td>
</tr>
<tr>
<td>Emergency</td>
<td>Less than 0.3</td>
<td>2.5±0.1</td>
<td>5.15±0.15</td>
</tr>
</tbody>
</table>

**6.4.3.1** In ‘Release’ position of the brake handle, an increased flow of air between the MR (Main Reservoir) air feed and brake pipe charging valve should be available to facilitate quick charging of air brake pipe. However, in ‘Running position’ of the automatic brake valve, the passage between MR and brake pipe charging brake unit shall be restricted for maintaining leakage in the train system.

**6.4.3.2** In between minimum and full service position, the brake pipe pressure built up /exhaust should be in proportion to the handle movement.

**6.4.3.3** In emergency position of brake valve handle, the brake pipe shall be vented to atmosphere through a sufficiently large diameter opening in such a way that the BP pressure comes from 5 to 3.5 kg/cm² shall be less than 2.5 seconds when the locomotive is tested separately. The emergency position in driver’s brake valve should be independent of normal brake control system and be available for use at all times at both the control stands/cabs irrespective of the presence of locomotive power or battery power. Whenever emergency brake application occurs, engine should come to idle in co-ordination with Vehicle Control Unit (VCU).

**6.4.3.4** Position of Driver’s Brake Valves (DBVs): Independent and automatic brake valves combined into one module shall be fitted on control stands such that movement of handle is in vertical plane with ‘push to apply’. Alternatively separate valves (Independent, Auto brake & Display units) shall be offered. Loco Brake Cylinder (BC) Pressure in Kg/cm² is given as follows:
<table>
<thead>
<tr>
<th>LOCO TYPE</th>
<th>Emergency Full Service A-9</th>
<th>Independent Brake SA-9</th>
<th>A-9 Application Time (sec)</th>
<th>Auto Brake Release Time (Sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WAG-9</td>
<td>2.5±0.1 2.55±0.1 kg/cm²</td>
<td>3.5±0.1 3.55±0.1 kg/cm²</td>
<td>18~24</td>
<td>45~60</td>
</tr>
<tr>
<td>WAP-7</td>
<td>2.5±0.1 2.55±0.1 kg/cm²</td>
<td>3.5±0.1 3.55±0.1 kg/cm²</td>
<td>3~5</td>
<td>15~20</td>
</tr>
<tr>
<td>WAP-5</td>
<td>5.05±0.1 5.15±0.1 kg/cm²</td>
<td>5.05±0.1 5.15±0.1 kg/cm²</td>
<td>3~5</td>
<td>15~20</td>
</tr>
</tbody>
</table>

BCEQ/DBP Pressure = 3.5 Kg/cm²

6.4.3.5 Loco Brake WAG-9, WAP-7 & WAP-5

The different pressure and timing within the loco will be managed by the software. In particularly one software version is able to manage 2 different parameter settings one for Passenger set up and one for Freight set up.

6.4.3.6 ER & BC Timings.

<table>
<thead>
<tr>
<th>Description</th>
<th>From Kg/cm²</th>
<th>To Kg/cm²</th>
<th>Time (Sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ER Volume</td>
<td>5</td>
<td>3.5</td>
<td>6 to 8</td>
</tr>
<tr>
<td>Emergency Brake (BC side on BC Res.)</td>
<td>0</td>
<td>95% of Max. BC Pr.</td>
<td>3 to 5 ‘P’ 18 to 24 ‘G’</td>
</tr>
<tr>
<td>Automatic Brake (BC Side)</td>
<td>0</td>
<td>95% of Max. BC Pr.</td>
<td>3 to 5 ‘P’ 18 to 24 ‘G’</td>
</tr>
<tr>
<td>Automatic or Emergency Brake release (BC Side)</td>
<td>Max. BC</td>
<td>0.4</td>
<td>15 to 20 ‘P’ 45 to 60 ‘G’</td>
</tr>
<tr>
<td>Independent Brake (BC Side)</td>
<td>0</td>
<td>95% of Max. BC Pr.</td>
<td>3 to 5</td>
</tr>
<tr>
<td>Independent Brake Release (BC Side)</td>
<td>Max. BC</td>
<td>0.4</td>
<td>&lt;7</td>
</tr>
<tr>
<td>BP Overcharge</td>
<td>5.0</td>
<td>5.4</td>
<td>3 to 5 in Loco Alone</td>
</tr>
<tr>
<td>BP Assimilation</td>
<td>5.4</td>
<td>5.0</td>
<td>160 to 200</td>
</tr>
<tr>
<td>Dynamic Brake Interlock</td>
<td>3.8</td>
<td>0.4</td>
<td>&lt;7</td>
</tr>
</tbody>
</table>

6.4.3.7 It should be possible to release the locomotive auto brakes by the driver even when the partial or full service application brakes on trailing stock are made.

6.5 Assistant Loco Pilot’s Emergency Brake Valve

In addition to the emergency brake application position on automatic brake valve, two Assistant Loco Pilot’s emergency brake valves (one on or near each control stand) shall be provided for direct venting of brake pipe pressure during emergency by the
driver /driver’s assistant. Venting shall be through a sufficiently large diameter opening in such a way that the Brake pipe pressure comes to atmosphere level in 1 to 3 seconds when the loco is tested separately. During emergency brake application by emergency brake valve or through driver’s automatic brake valve, system should go on penalty and engine comes to idle. However this valve is not within the scope of supply of the vendor of Microprocessor Controlled Air brake system.

Microprocessor Controlled Brake System shall have sufficient safety provisions for acknowledgment of system penalty brakes, by the driver to prevent un-intended automatic release of brakes applied as a result of various penalties as above.

6.6 Distributor Valve

6.6.1 A pneumatic back up brake has to be provided, so that even in case of failure of the LRUs or because of power failure etc., brake will be applied in the locomotive. The backup protection is required also to ensure graduated application and release of brake in case the loco with micro-processor based air brake system is attached dead. If the Computer/Microprocessor Controlled Air brake system is with a distributor valve, it should be only of UIC approved type. However, if the offered system is without UIC type distributor valve, the application/release timings and other features of the system should be as per relevant UIC specification.

6.6.2 The distributor valve shall have fixed position, either goods or passenger mode to obtain brake application and release timings to match with the train requirements.

6.7 Multiple Operation

6.7.1 A maximum of 2+1 3 (Three) locomotives shall be used in multiple operation. In such cases, multiple operations with all functions of brake system should be possible for all locomotives provided with computer / micro-processor controlled air brake system.

6.7.2 In case of parting between coupled locomotives, the brakes on the locomotives shall come on automatically. UIC type break-in-two protection should also be provided to bring the engine to idle in all the locomotives through locomotive control microprocessor. There shall be complete isolation of brake cylinder equalizing pipe (BCEQ) when parting between locomotives occurs.

6.7.3 When Brake Controller selector switch (L/T- switch) is in ‘Lead’ position, it should be possible to apply & release brakes from Brake Valve Controller. When the switch is in ‘Trail’ position, brake valves should be inoperative. However, in trail position, it should be possible to apply emergency brakes. In Helper mode, it should be possible to operate the independent brake and also apply the emergency brake.

6.7.4 In case, in leading locomotive, both control stands are wrongly set in ‘Trail’ position or both control stands wrongly selected in ‘Lead’, it should not get powered. For this purpose a suitable interlock should be provided with locomotive communication control (LCC) microprocessor based control system.

6.7.5 Provision shall be made for utilizing the compressor capacity of trailing locomotive for releasing the train brakes or during initial charging.
6.8 Overcharge Feature

6.8.1 Microprocessor based air brake system shall have an automatic overcharge feature which gets activated, whenever the brake valve handle is held in Release position.

6.8.2 Operation of overcharge feature shall increase the brake pipe pressure by 0.5 kg/cm² over the normal level of 5.0 kg/cm² (in WAG9/WAP5 Loco). The overcharge so created by this feature, should automatically be maintained till handle is placed in Release position. The rate of drop in brake pipe pressure with the removal of such overcharge should be at uniform and slow rate so as not to cause brake application on any of the vehicles in the train. The dissipation time of BP pressure from 5.5 to 5.0 kg/cm² (in WAG9/WAP5 Loco) is as per UIC standards.

6.8.3 During assimilation or bleeding down of overcharge pressure it should be possible to apply normal brake. However, when the normal brakes are released remaining overcharge cycle should be completed from where it got interrupted.

6.9 Interfaces with Regenerative Brake

6.9.1 When regenerative brakes are applied, locomotive brakes should be cut off, if brakes are applied through automatic brake valve. However, in case of emergency brake application by driver's brake valve or by Assistant Driver's emergency brake valve, the regenerative brakes should 'cut-off' and locomotive brakes should apply.

6.9.2 In case train is being controlled by regenerative brake on locomotive and automatic brake on the trailing stock, if the regenerative brake fails, air brakes on locomotive should be automatically applied in proportion to the position of automatic brake handle.

6.9.3 The details of equipment along with description and principle of operation should be submitted.

6.9.4 Rubber components such as diaphragm and ‘O’ rings etc. whenever used on brake system and their controls shall be entirely suitable for humid and hot environmental conditions of India.

6.9.5 Overhauling of the pneumatic valves should not be required before 06/08 years.

6.9.6 In case of failure of Computer/Microprocessor Controlled based air brake system on the locomotive, there should be provision for automatic back up by pneumatic brake system. The vendor shall give necessary details.

6.10 Self-Test

As soon as the Computer/Microprocessor Controlled based air brake system should have self-diagnostic and display feature. There shall also be a facility for conducting self-test, as and when desired, in which the functioning of the brake system and its interface shall be checked thoroughly. In case the system does not pass the self-test, the nature of fault shall be displayed. In case of serious fault affecting safety, the locomotive should not be allowed to move unless the fault is rectified.
6.11 **Self-Diagnostic Feature**

Microprocessor Controlled air brake system should have self-diagnostic & display feature. The display of fault should be such that it can be easily viewed by the crew, and will not require any opening of cover etc. It should also include fault diagnosis and display (Transparent EMI protected window should be provided on Computer Controlled air brake system so that fault code is easily visible to the loco pilot). It should have real time diagnostics which can identify component failures, apply the train brake automatically if safety is compromised and provide trouble shooting information for facilitating repair/replacement. It should be possible to monitor as well as conduct on-board trouble shooting using computer/ laptop on fully charged and operational brake system on the locomotive. In case of proven system, an exception can be made with the approval of RDSO. The vendor will provide complete detail along with additional feature, if any.

6.12 There should be a provision of appropriate battery backup system or other arrangement so that time and date does not change in case of power failure or power off situation.

6.13 There should be an arrangement for electrical isolation of brake system, for carrying out any welding activity in the locomotive to safe guard against spike voltages.

6.14 **Brake System Pressure and Brake Application/Release Timings.**

The brake system should be capable to maintain following pressure and brake release / application timings. Where timings are not given UIC standard timings can be taken to design brake system.

6.15 **Pressure specification.**

<table>
<thead>
<tr>
<th>Pressure</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Reservoir pressure</td>
<td>8-10 kg/cm²</td>
</tr>
<tr>
<td>Brake Pipe pressure</td>
<td>For WAG9 &amp; WAP5 5.0+ 0.1 kg/cm²</td>
</tr>
<tr>
<td>Feed pipe pressure</td>
<td>6.0+ 0.1 kg/cm²</td>
</tr>
<tr>
<td>Full Service- reduction in BP</td>
<td>1.55 to 1.75 kg/cm²</td>
</tr>
<tr>
<td>Minimum Service- reduction in BP</td>
<td>0.3 to 0.5 kg/cm²</td>
</tr>
<tr>
<td>Maximum Independent BC pressure</td>
<td>For WAG9/WAP7 &amp; WAP5 2.50±0.1 &amp; 5.15+ 0.30 kg/cm² respectively</td>
</tr>
<tr>
<td>Maximum auto Brake Cylinder (BC) (Arrangement should be there to adjust BC pressure)</td>
<td>3.55 kg/cm²²</td>
</tr>
</tbody>
</table>

6.16 **Standard Timings**

Application and release timings with automatic brake valve, shall be as per UIC specification (UIC CODE 540,5th edition)
### 6.17 Pressure Gauges

The Gauges shall be supplied as per following CLW drawing as gauges are CLW controlled item:

The gauges should be self-illuminated with L.E.D with flush mounting. All the pneumatic gauges shall be calibrated in 0.1 Kg/cm² pressure and least count should be 0.1 Kg/cm². Following gauges are available in the driver cab to indicate air pressure level in various parts of the system.

- 0.1 Main Reservoir MR pressure gauge.
- 0.2 Feed Pipe FP pressure gauge.
- 0.3 Brake Pipe BP pressure gauge.
- 0.4 Airflow indicator gauge.
- 0.5 Brake Cylinder BC pressure gauge
- 0.6 Any other gauge which is required as per the system offered.

The above gauges are not within the scope of supply of the vendor of Computer Controlled air brake system. It is the responsibility of the vendor of Computer Controlled air brake system to provide suitable pneumatic signals for the above gauges as per existing locomotive air piping diagram. Digital display in Analogue form for all the above mentioned pressures may be offered as an optional item.

### 6.18 Air Flow Indicator/ Sensor

6.18.1 Locomotive is provided with air flow indicating device (indicator gauge) to show air flow to the brake pipe.
6.18.2 The equivalent air flow rate (unit of flow rate i.e. wagon or LPM) for these graduations shall be indicated by the vendor.

6.18.3 Vendor shall indicate the position marking of RED needle of AFI on loco (light engine) and Loco with 58 BOXN wagon and 26 coach train considering 0.25 Kg/cm²/minute air leakage of train.

6.18.4 It should indicate conditions of train-parting and Guard brake valve operation/Passenger Alarm chain pulling. The computer/ microprocessor controlled air brake system has to provide a pneumatic signal to the air flow sensor. It is the responsibility of the vendor of Computer/ microprocessor Controlled air brake system to provide suitable pneumatic signals for the above flow indicator as per existing locomotive air piping diagram.

6.19 **Banking Operation**

6.19.1 The brake system shall have necessary provision for using these locomotives as banking locomotives

6.19.2 When locomotive is used for banking operation it should not be possible to apply/release the brakes from banking locomotive. However, it should be possible to apply emergency brakes on the train, if required, by the banking driver.

6.19.3 It shall be possible to apply & release locomotive independent brakes of bankers.

6.20 **Dead Engine Feature**

While hauling a dead locomotive as a trailing locomotive (MU pipe connected), provision shall be made for application and release of brakes on this locomotive from the leading locomotive.

While hauling a dead locomotive as a piped vehicle (MU pipe not connected), provision shall be made for application and release of brakes with the help of distributor valve on this locomotive.

6.21 **Loss of Power Feature & OHE Failure**

With no voltage supply feed to Computer/Microprocessor Controlled air brake system getting disrupted and in case of OHE power failure, there should be facility to apply brakes on train and locomotive through distributor valve.

6.22 **Bail off Feature (Quick Release)**

Release of an Automatic locomotive brake while retaining the train brake cylinder pressure can be accomplished by lifting the bail off ring on the independent valve handle. Alternately bail off shall be possible through foot pedal operation. Locomotive brake will remain released unless the automatic handle is in emergency.
6.23 **Compatibility with Distributed Power System**

Purchaser has an option to install distributed power system on the locomotive in future. The computer/microprocessor controlled air brake system shall be compatible with Distributed Power System.

WAG9/WAP7/WAP5 locomotives which are fitted with computer/micro-processor controlled brake system shall have possibility to add EP assist in future for brake pipe control. In pneumatic brake systems using the Brake Pipe (BP) the brake signal is transmitted pneumatically. The maximum speed of the signal is thereby limited to the speed of sound. In real applications 280 m/s are reached while the requirement is 250 m/s according to UIC 540. Requirements for the EP assist brake are to be incorporated as per UIC541-5 OR in the existing computer/micro-processor controlled brake system.

6.24 **Interface with Locomotive Microprocessor and other warning systems**

WAG9/WAP7/WAP5 Locomotives are fitted with computer/microprocessor controlled brake systems conforming to RDSO specification no. RDSO/EL/SPEC/2016/XXXX (Latest revision) shall be interfaced with warning systems meant to provide protection by preventing trains to pass signal at Danger (RED), excessive speed over turnouts/speed restrictions and to avoid situation in which more than one trains are on the same track to cause collision, in case operation are not able to control so. It also provides assistance to Loco Pilots by means of real-time display of signal aspects in Loco Pilots cab. It is the responsibility of the successful tenderer of Computer / Microprocessor controlled brake system to interface with TCAS/TPWS/ACD and other warning systems locomotive microprocessor control system. The general interface requirements between the TCAS and other warnings systems will be as given below:

- Normal Braking (NB) application/release,
- Emergency Braking (EB) application,
- Full Service (FS) application/release
- Light Locomotive (LL) indication

Based on the real pressure feedback through pressure switched already in place and feedback can be extended to TICAS/TPWS/ACD from computer /microprocessor control brake system to VCU for BP, BC/DBP etc. in case of power breakdown. The control of locomotive brake application/release interfacing with any warning system shall be through Vehicle Control Unit (VCU) only.

6.25 **Interfacing with Piping and Wiring**

Interfacing with Piping and Wiring of the locomotive shall be responsibility of the vendor of Microprocessor Controlled air brake system.

Major overhauling of locomotives would be done in six/eight years. However, Computer/Microprocessor Controlled air brake system should be capable of working for six years without major overhauling.
6.26 Data/Fault Logging, Diagnostics and Display

The system shall have built in data logging, diagnostics and trouble shooting, including indication of fault status, analysis of the fault data and provision of necessary information to drivers/maintenance crew. For analysis of fault, the data (essential information for fault analysis) corresponding to the time of occurrence of faults as well as a few seconds before and after the fault should be logged along with real times and date. The fault, with resolution of 1 second data pack of 8 snap shots (five prior to faults and 3 post faults) with 1 second mapping may be recorded in fault archive. This function may be executed by the air brake system either by itself or through Loco micro-processor control system by necessary exchange of fault data. This snap shot shall remain active as long as fault log is active. It should be possible to retrieve all such data. All the logged faults must be chronologically recorded with real date and time of the occurrence of fault should be immediately displayed. The fault messaging text shall include the displayed message, fault code, description, real time and date and troubleshooting advice (wherever applicable). It should be possible to recall all details of active fault log. Till the fault(s) details are downloaded, the same shall be considered active fault log.

6.27 Download of Data

Suitable provision for downloading the data from the locomotive to a computer should be provided. The system should have arrangement for downloading of fault data pack and information pack through common USB port or a serial port so that data can be downloaded in a pen drives also either directly or through a Portable test Unit or laptop.

6.28 Software Change and Up gradation

Any software change as necessitated or felt during use must be proposed, mooted, tested and validated within 180/120 days. If this software change necessitates hardware change, it should be possible to do the same in situ. There should be provision for up gradation of software at different Brake cylinder pressures settings for freight/ goods locomotives with the assistance of Manufacturers. For this purpose a suitable simulator should be available by tenderer or its collaborator.

7.0 Additional Requirements of Brake System

In addition to the basic technical requirements given in Para 4, 5 & sub-paras, following additional features should also be incorporated in the Computer Controlled air brake system being offered:

7.1 Multi-Resetting Vigilance Control Device

The Vigilance Control Device (VCD) feature is provided to enhance the safety of locomotive operation by ensuring alertness of the crew all the time. The system shall be of multi-resetting type i.e. acknowledgement of the system is not only by means of pressing reset push button but by the other normal driving activities (i.e. throttle handling, dynamic brake application, operation of sanders or application of brakes),
of the driver during the train operation. This reduces the strain on the driver, as he is not required to press the reset push button always when operating other controls of the locomotive.

7.2 Automatic Switching ‘ON’ of Flasher Light

7.2.1 Flasher lights have been provided with on both the sides of electric locomotives to give indication of abnormal condition to driver of the train coming from other direction.

7.2.2 The flasher light will glow automatically in the direction of train movement in the following emergency / abnormal situations on the train.

0.1 Parting of a train
0.2 Emergency brake application by D1 ALP Emergency Valve
0.3 If Emergency stop push button is pressed

7.2.3 The flasher light would not glow automatically in the following condition

0.1 Brake application and release by driver
0.2 Alarm Chain Pulling

7.2.4 In above conditions, the flasher should glow automatically and should not switch OFF due to brake application by the driver. Flasher light should continue to glow till such time above conditions remain on train or the driver switches it OFF manually by a separate reset switch to be provided by vendor of brake system. However the system should be such if power ON/OFF switch is in OFF position, even then flasher light should again glow automatically if above conditions reappear on train.

8.0 LITERATURE AND DRAWINGS

8.1 The tenderer shall submit brake schematic diagram along with description of the complete system with the offer. Pamphlets covering schematic diagram, installation drawing of complete system shall be submitted along with the offer for proper appreciation of the system offered by the vendor.

8.2 The tenderer shall submit testing procedure, specification etc. brake system as a whole. The tenderer shall also indicate the maintenance facilities required for proper upkeep of the equipment. Offer should also include requirements of spares along with cost of each item for a period of 6 years. The cost of spares will also be given in the offer.

8.3 After the system is finalized, the tenderer shall submit copies of the instructional, maintenance and test specifications at the rate of one copy per two locomotive covering the following:

0.1 Manuals 03 copies incorporating in detail the general description of the Brake System complete and individual valves/equipment along with operating features.
0.2 Assembly and disassembly instructions.
0.3 Trouble shooting instructions
0.4 Testing procedure / specification of whole brake system.
0.5 Overhauling kits of Valves
0.6 Overall dimensions and mounting details of individual items.
0.7 Particulars of cable entry points, if any.
0.8 Weight of various assemblies.
0.9 Lubrication chart, if any(equivalent indigenous lubricant may be indicated).

9.0 Inspection, Testing and Approval

During the developmental stage, for proper control & monitoring, RDSO will be the Controlling Agency. The supplier shall submit its offer of equipment to RDSO along with all the details of equipment as per clause 8. The firm will be inspected to check capacity and capability as per information given in form No. EL/F/0012, Ver.’3’ or (latest version), of Electrical Directorate, RDSO, Lucknow of specification no. ------------ - Of RDSO. Manufacturer will be in constant touch with RDSO for design review and prototype development. If found suitable product will be taken up further for prototype inspection.

9.1 Prototype Inspection:

9.1.1 The prototype inspection including stage inspection will be carried out by representative of Electrical Directorate of RDSO, Manak Nagar, Lucknow 226011 at the manufacturer's premises. In general the inspection will be carried out according to UIC/RDSO specifications. Detailed type tests inspection scheme will be submitted by the vendor along with their offer. The test scheme should include testing of complete system as well as testing of individual brake valve/equipment. The test scheme should indicate stage inspection and final inspection on test bench as well as on locomotive. Vendor should get prior approval of test scheme from RDSO before actually conducting prototype inspection.

9.1.2 There should be proper test equipment/test racks at manufacturer work’s premises to conduct such tests. The vendor shall provide, without extra charges material, tools and any other assistance which the purchaser may consider necessary for any test, examination and dimensional checking.

9.1.3 The vendor shall, on demand make available manufacturing related drawings and specifications to the inspecting authority at the time of inspection. Vendor will also submit the test results of the test conducted by them.

9.1.4 During prototype inspection manufacturer certificates of components/valves/equipment which have been purchased from outside shall be produced as a proof of quality assurance.

9.1.5 Electronic equipment used in the system shall be tested in accordance with IEC-60571 or equivalent international standard. These tests as per relevant clause of IEC-60571 shall be carried out for prototype only. A certificate (original) from NABL accredited testing laboratory shall be considered satisfactory for this purpose, if tested in India.

9.2 Inspection of fitment of the brake system on locomotive.

9.2.1 The installation of first system on electric locomotive shall be the responsibility of the vendor. Assistance with regard to labor and other facility which are available in the production unit/work shop/diesel shed of Indian Railways would however, be
provided to the vendor during prototype installation. Vendor will provide all necessary guidance and technology including any special tooling or wiring etc. required for satisfactory installation of the system on the locomotive.

9.2.2 The fitment aspect of the system will be checked on the locomotive by the representative of Electrical Directorate, RDSO, Manak Nagar, Lucknow and purchaser in presence of the vendor. It is the responsibility of the vendor of Computer Controlled air brake system to interface with locomotive microprocessor control system. The inspection on locomotive will be carried out generally in accordance with vendor's test plan which shall be approved by RDSO prior to testing.

9.2.3 After successful prototype development and testing, development order will be placed. The performance of the brake system in field will be monitored for at least two years. On satisfactory performance in field, the vendor will be placed in category-II of RDSO Vendor Directory.

9.3 Up gradation from part-II to part-I, the firm should meet qualifying criteria as laid down in ‘Guidelines for Development of Vendor Approval No. EL-WI-7.1 Ver. 5.0 date effective 07.05.15 or (latest version) available on RDSO website.

9.4 Routine Inspection

Routine inspection as per RDSO approved Plan of the equipment shall be carried out by the purchaser or his nominee. The supplier shall provide, without extra charges, for material, equipment, tools and any other assistance, which the purchaser or his nominee may consider necessary for any test and examination. The supplier shall make available manufacturing drawings and material specifications of the components to the inspecting authority at the time of inspection.

Supplier will offer brake system for inspection after complete checking by them. The test results of every brake system will be submitted to the inspecting authority. Inspecting authority shall carry out all tests necessary to prove that the equipment fulfils the technical requirements, covered in this specification.

10.0 Performance Guarantee.

10.1 The equipment supplied by the vendor shall guarantee the equipment against design and manufacturing defects for a period of 02 (two) years from the date of commissioning. Notwithstanding anything that may be specified in this specification, the final responsibility for suitability of the design shall lie with the vendor who shall undertake to carry out all modifications and alterations to the equipment supplied by them for satisfactory functioning in accordance with this specification as may be necessary during guarantee period. Such modification shall be carried out on all units by the vendor free of cost. The component/material which fails during guarantee period must be replaced by the manufacturer/supplier free of cost. The replaced components shall be further be under guarantee for a period of 02 (two) years from the date of their fitment.

10.2 All the equipment shall be guaranteed for satisfactory performance for a period of 07 (Seven) years from the date of delivery or 06 (Six) years from the date of commissioning of the locomotive whichever is earlier. All aspects of workmanship and
material will be covered by the guarantee.

10.3 The equipment supplied by the vendor shall guarantee the equipment against design and manufacturing defects for a period of two years from the date of commissioning or 30 months from date of supply whichever is earlier. Notwithstanding anything that may be specified in this specification, the final responsibility for suitability of the design shall lie with the vendor who shall undertake to carry out all modifications and alterations to equipment supplied by them for satisfactory functioning in accordance with this specification as may be necessary during guarantee period. Such modification shall be carried out on all units by the vendor free of cost.

Any damage or unsatisfactory performance of any equipment noticed during the guarantee period shall be rectified or replaced free of cost. If replaced component gives unsatisfactory performance in service, it shall be replaced by modified and improved component by the vendor free of cost.

10.4 Marking

Each Assembly/subassembly/Individual component shall have clear readable marking on its body. The marking shall be as following

0.1 Manufacturer's name or trademark if any.
0.2 Month and year of manufacture.
0.3 Part No./Drg. No./Type No.
0.4 Batch No. if any.
0.5 Important technical data, such as rating, if any.

10.5 Packing & Delivery

All the equipment will be properly packed to avoid any damage during transit and storage.

11.0 After Sale Service

The vendor shall post one of their engineers in the base shed where such equipment is installed for a period of one year after installation and it shall be the responsibility of the vendor for satisfactory operation of the equipment for this period. Indian Railways maintenance staff shall be associated with the vendor's engineer throughout this period. The engineer would impart necessary training to the maintenance and operation staff free of cost.

12.0 Indigenization

In case the offered system is being manufactured in country other than India, vendor shall arrange for manufacture of equipment in India by transferring the technology to a suitable organization in India. The vendor will give stage wise details of indigenization program including:

0.1 Design calculations, material specifications.
0.2 Detailed manufacturing drawing, with tolerances, surface finish, jigs and
fixtures and special tools and machines required for manufacturing equipment.

0.3 Manufacturing process sheets including detailed instructions on special
techniques wherever applicable.

0.4 Detailed specifications for inspection & testing.

0.5 Other technical clarifications and supplementary instructions, if any, which
may be required for manufacture of the equipment.

13.0 Deviations

13.1 The vendor shall submit clause wise comments from the specification and shall
indicate the deviations, if any with the reasons thereof.

13.2 Any deviation from the standards laid down in this specification, with a view to
improve the performance of the equipment shall be given with details. Supporting
documents for such suggestion shall also be given with the offer.

14.0 Training

14.1 Sufficient number of technicians / engineers /officers shall be trained in
consultations with the purchaser / RDSO so that adequate staff is available in the
field for maintenance. This training shall be at the vendor works and electric sheds
for a suitable period and shall cover maintenance and testing, brake system and
design, quality control and trouble shooting.

14.2 Adequate numbers of maintenance manual covering schedule maintenance,
maintenance practices, testing, maintenance tools, spare etc and wall charts showing
pictorial view of components along with part numbers will be given. These
maintenance manuals and wall charts are meant for wider circulation for Railways
and fresh copies will be given with each order even if there are no changes in the
design.

15.0 Quality Assurance Plan (QAP)

15.1 The firm will give a quality assurance program (QAP) for approval to RDSO. The QAP
will be as per “Guidelines for Work Instructions for development vendors as per Doc.
EL-WI-7.1 Ver. 5.0 effective from date 07.05.15_or (latest version) available on RDSO
website.

15.2 Revision of QAP

QAP is required to be revised with approval of RDSO as per Guidelines for preparing
QAP as per Work Instructions for development vendors as per Doc. EL-WI-7.1 Ver. 5.0
effective from date 07.05.15_or (latest version) available on RDSO website _in case of
any change

Note:

1. All Standard fasteners (screws, bolts, nuts etc.) shall be of M/s. TVS, M/s. L.P.
2. In case exact equivalent is not offered, functional equivalent must be offered. The total
no. of items comprising the microprocessor controlled air brake system may be more
or less than the existing system provided that the existing locations for mounting of one no. Brake rack and two nos brake controllers are followed.

3. Dimension of the offered items should not exceed the dimensions of the corresponding items of existing system. In case any dimensions of offered items exceed the corresponding dimension of existing item, vendor must ensure the sufficient space is available on the locomotive and submit details along with the offer.

4. Mounting arrangements, piping and wiring connection etc. should be interchangeable with existing system as far as possible.