



हाई हर्स पावर डीजल लोको में प्रयुक्त हेतु मापन समष्टि व एयर फलो इंडिकेटर की विशिष्टि ।

Technical Specification of Gauge complex with Air flow indicator for HHP locomotives

Specification Number	MP.0.01.00.32		
Version Number	01	Date of Issue	March' 2021

Brief Description

Technical Specification of Gauge complex with Air flow indicator for HHP locomotives

FOREWORD

1. This specification covers the description of equipment, general, functional, technical, testing, maintenance, and environmental requirements for the Gauge complex with Air flow indicator for Microprocessor controlled brake system to be used in HHP locomotives on Indian Railways.
2. Gauge complex with Air flow indicator is used in HHP locomotives control stands for monitoring the air pressure level at different locations of brake system as well as to indicate the status of brake pipe charging/abnormal air leakage to loco crew.
3. In the event of a conflict between this specification and any other standards or specification quoted herein, the requirement of this specification shall prevail.
4. The operation of Gauge complex with Air flow indicator, in no way infringes/overrules the rules of normal train operation.

DISCLAIMER

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LIST OF AMENDMENTS

S. No.	Amendment Date	Version	Details
1	March' 2021	01	<ul style="list-style-type: none"> • Addition of Clause no. 15 (Preference to Make in India) in compliance of directives issued by GOI for promotion of Make in India policy. • Addition of Clause no. 16 (Vendor Changes in Approved Status) in compliance to Vigilance cell note no. 13/Vig/Policy dated 08.09.2016. • Revision of clause 12 to incorporate Equivalent Indian Standards, field trial performance feedback format & acceptance criteria in compliance of MOM of the VC meeting on Specification/ STRs held on 29.08.2020

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1. INTRODUCTION

Gauge complex with air flow indicator, used in HHP locomotives, is a unit consisting of pressure gauges and an air flow indicator. Pressure gauges in the unit are used for monitoring the air pressure level at different locations of brake system viz MR, BP, BC and ER while air flow indicator provides driver (Loco pilot) a visual indication of the brake pipe conditions in air brake trains. The brake pipe conditions is interpreted in to information consisting of variation in brake pipe leakage, state of release of bake following an application, operation of guard van valve, pulling of alarm chain in passenger train, breakage of brake pipe coupling or train parting. The unit is located on both the drivers control consoles.

2. OBJECTIVES AND SCOPE OF THE SPECIFICATION

The specification covers description of Gauge complex with air flow indicator and its general, functional, technical, testing, maintenance, and environmental requirements for use with Microprocessor controlled air brake system.

3. TERMINOLOGY / ABBREVIATIONS

Abbreviations	Full form/Description
IEC	International Electro Technical Commission
RDSO	Research Designs & Standards Organization
AFI	Air Flow Indicator
DC	Direct Current
LED	Light Emitting Diode
BP	Brake Pipe
EMD	Electro-motive Division
DLW	Diesel locomotive works
HHP	High horse power
MR-ER	Main reservoir - Equalizing Reservoir
BC-BP	Brake Cylinder- Brake pipe
HP	High pressure
LP	Low pressure

4. DEFINITIONS

4.1 Throughout this specification and in any other specification here to annexed, the terms:

4.1.1 "Purchaser" means the President of the Republic of India;

4.1.2 "Tenderer" means Firm's/companies participating in the tender;

4.1.3 "Contractor" means any person, firm or company with whom the order for the supply of the stores to be placed;

4.1.4 "Sub-contractor" means any person, firm or company from whom the contractor may obtain any material or fittings to be used in the supply of or manufacture of stores;

4.1.5 "Supplier" means a party that supplies goods or services. A supplier may be distinguished from a contractor or subcontractor, who commonly adds specialized input to deliverables. Also called vendor;

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4.1.6 “Manufacturer” means entity that makes a goods through a process involving raw materials, components, or assemblies, usually on a large scale with different operations divided among different workers. Commonly used interchangeably with producer.

4.1.7 “Inspecting Officer” means the person(s), firms(s) or department(s) and his deputies nominated by the purchaser to inspect the stores on his behalf;

4.1.8 “Engineers” means the Research Designs & Standards Organisation, Ministry of Railways, Manak Nagar, Lucknow – 226011.

4.2 In case of tenderer needs any clarification in respect of any clause of this specification or regarding the drawings the tenderer shall obtain it from Motive Power Directorate, RDSO.

5. BRIEF DESCRIPTION OF THE EQUIPMENT/COMPONENTS & SYSTEM REQUIREMENT

Gauge complex with air flow indicator to EMD Part No. 10631881, DLW Part No. 17452508 shall be used on HHP locomotives fitted with Microprocessor controlled brake system. It consists of two Duplex air pressure gauges, one Air flow indicator (AFI) gauge and Assembly clamp (bracket).

5.1 Duplex air pressure gauges:

5.1.1 Each duplex pressure gauge shall have Red pointer (Bottom) & White pointer (Top). Red hand (RH) and White hand (WH) shall be stamped on its port connections as shown in EMD part no. mentioned above.

5.1.2 The dial face of duplex pressure gauge shall have marking in kg/cm² (0-14) as well as in lb/in² (0-200).

5.2 Air flow indicator Gauge:

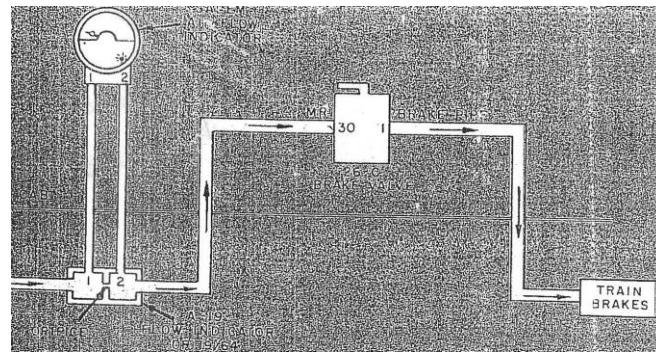
5.2.1 It is like a differential air pressure gauge with two pointers (Top pointer- red & Bottom pointer-white) and two connection ports (i.e ‘1’ & ‘2’ marked).

5.2.2 Red pointer is called reference pointer, which is attached to a knurled knob and protrudes through the dial glass, so that it can be set manually in any desired position.

5.2.3 Pressure difference on its connection ports are sensed by the responsive mechanism within gauge assembly and transmitted to its indicating pointer (White) which moves on the scale.

5.2.4 The numerals appearing on the face of the dial shows the pressure level because of the air flowing through an orifice that has been placed within the locomotive brake system. The heavier the air flow the greater the pressure drop on the downstream side of the orifice resulting in a higher reading on the dial.

5.2.5 A small removable Red LED shall be placed in the Air Flow indicator to indicate the crew whenever the rate of air flow exceeds a predetermined numeral on the dial face.



Schematic of Interface of Air Flow Indicator to Microprocessor control Brake System

5.2.6 'RED' indicator LED resistance shall be 2400 OHMS. Resistance wire leads from the 'LED' are connection to 74 Volts DC. Current range of LED shall be 30-40mA.

5.2.7 LED output lead shall be of 760 ± 10 mm length with colours White & White/Black strip for positive & negative respectively.

5.3 Assembly clamp:

5.3.1 Assembly clamp facilitates ease mounting of gauges and making connection with brake system air connecting piping.

5.3.2 Gauge base with pressure controlling knobs & CAM (locking assembly) are mounted on a Clamp for each individual gauges.

6. GENERAL REQUIREMENTS

- 6.1 The sub-assemblies and components of the device shall be properly housed and shall be easily accessible for maintenance and inspection.
- 6.2 All electrical components shall be protected, enclosed and provided with mechanical dust proofing covers to avoid dust ingress and then mounted in a robust housing so that entire assembly is capable of withstanding shocks, vibration, electromagnetic induction & electrical surge etc as applicable.
- 6.3 The electrical wires shall be suitably numbered and properly tagged in order to facilitate identification. The electrical connections of positive and negative terminal shall be of different colours in order to distinguish between them. The wires shall be laid properly in a conduit. Loose and dangling wires will not be acceptable.
- 6.4 When the device is connected to the electric circuit in the locomotive, it shall be connected to the general wiring of the locomotive by plugs or any other suitable connections not requiring soldering.
- 6.5 It shall have provision to secure the 'LED' leading to prevent stressing their connection at the, 'LED'.
- 6.6 The LED shall work on DC supply source normally consisting of accumulator battery and/or an auxiliary generator. LEDs used shall be capable of working for their desired functioning from 48V DC to 90V DC power supply with nominal voltage 72 V.

- 6.7 The visual indication light shall be prominent enough to be detected immediately on flashing.
- 6.8 If any pneumatic valves are used in the device, functioning of the valves shall not be affected by moisture, dirt, temperature, fluctuation of pressure etc.
- 6.9 The system shall have proper filters at all the sensing ports to prevent any malfunctioning.
- 6.10 The equipment shall work satisfactory for the MR pressure up to 11 kg/cm².
- 6.11 Gauge complex with air flow indicator complex as an assembly and individual gauge wise shall be interchangeable between different makes as per EMD Part No. 10631881, DLW part no 17452508.

7. FUNCTIONAL REQUIREMENTS

7.1 Duplex air pressure gauges:

- 7.1.1 The air pressure shall be read as the indicating needle moves from the center Zero (0) point towards the right of the gauges scale.
- 7.1.2 These gauges shall provide information for the locomotive brake system in term of air pressure level on different points as mentioned in table below.

Duplex gauge	Pointer	Pressure
Left duplex gauge	Red pointer	Main reservoir
	White pointer	Equalizing reservoir
Middle duplex gauge	Red pointer	Brake cylinder
	White pointer	Brake pipe

- 7.1.3 Duplex gauges have been made of similar design to enable universal use at above locations. Hence, special marking i.e MR-ER & BC-BP shall not be done in duplex gauge.
- 7.1.4 These gauges shall work satisfactory for the entire range of marking. The error in pressure indication, with either increasing or decreasing pressure, at any point shall not exceed 02 percent of the maximum scale value.

7.2 Air Flow indicator:

- 7.2.1 The Air flow indicator shall show immediately the rate of air flow to the brake system as follows:
- It shall indicate the flow of air in brake pipe on dial of the air flow indicator.
 - The flow indicating pointer (white) shall indicate more than approximately '2' mark on the dial on releasing of Auto brake after Full service application. When Brake pipe is full recharged this pointer shall return to initial position.
 - It shall expose the 'RED' light emitted diode (LED) whenever the rate of air flow exceeds the '5' numeral on the dial face to alert the crew of an abnormal flow rate.

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7.2.2 The flow indicator shall read within 3 % of full scale i.e approx $\pm \frac{1}{2}$ mark. It shall be taken with UP & DN direction, normally at 5 & 10 marks of scale.

7.3 Assembly Clamp:

7.3.1 The 'Knobs' fitted in gauge base shall have free movement. Clockwise rotation shall allow air to pass in gauge sensing mechanism and anti-clock wise rotation shall stop the air flow to gauge sensing mechanism.

7.3.2 CAM (locking assembly) shall have clockwise rotation to tighten the gauge on gauge base and anti-clock wise rotation shall allow dismantling the gauge from gauge base.

8. TECHNICAL REQUIREMENTS

8.1 All three gauges dial shall have Black background with white letters and graduations.

8.2 Each gauge shall have ports of bottom face entry.

8.3 The pins (air passes) shall be located under gauge housings that interface with the gauge base. Center to center distance of pins in gauges shall be 30 mm. Outer diameter of pins shall be 3.2mm to ensure interchangeability.

8.4 A Gauge plate of 1.6mm thickness shall be used between gauge and gauge base.

9. ENVIRONMENTAL/CLIMATIC REQUIREMENTS

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

9.1 Altitude: - Mean sea level to an altitude of 1200 meters.

9.2 Relative Humidity:- Up to 100 %

9.3 Temperature (Ambient air):-

a) Maximum temperature

Stabled Locomotive under sun : 70 deg. C

On board Working loco under sun : 55 deg. C

b) Minimum temperature : - 5 deg. C

c) Average temperature : 47 deg. C

9.4 Ambient conditions: The equipment shall be capable of operating efficiently in spite of dust, dirt, mist, torrential rain, heavy sand or snow storms, presence of oil vapors and radiant heat, coastal area etc. to which rolling stock is normally exposed in service

9.5 The part of the Gauge complex with air flow indicator, if exposed to solar radiation during normal usage, shall remain unaffected by it.

10. MAINTENANCE AND DIAGNOSTIC AID

- 10.1 Supplier shall arrange to supply along with the equipment, maintenance manuals of the equipment, one with each 5(or less) Gauge complex/sub units. Manual shall contain information pertaining to dimensional drawings of assembly/ subassembly indicating mounting arrangement, principle of operation, maintenance schedules, trouble shooting, details of special tools if required, parts catalogue and testing procedure of the equipment being supplied. Updated position of modifications shall also be incorporated.
- 10.2 Adequate number of coloured wall charts showing pictorial view of components along with part nos. will be given. The copies of Maintenance Manual and wall charts are meant for wider circulation for Railways and fresh copies shall be furnished as stipulated even if there are no changes in the manual and wall charts furnished against earlier contract.
- 10.3 Training of purchaser's personnel for operation and maintenance shall be given by the contractor free-of-charge. Demonstration of the working of the device on locomotive shall be given by the contractor free-of-charge.

11. GUARANTEE/WARRANTY

- 11.1 The supplier shall be responsible for any failure or damage to equipment provided in the locomotive due to defective design, materials, and workmanship up to a period of 24 months after commissioning on the locomotive or 36 months from the date of supply, whichever is earlier. The supplier shall replace/ repair within reasonable time, such equipment during the warranty period at his cost. The period of warranty shall be extendable in case of recurring problems attributable to defective design, material or manufacturing. The supplier's liability in this respect of any complaints, defects and /or claim shall be limited to the furnishing and installation of replacement parts free of any charge.
- 11.2 The supplier shall be responsible for carrying out all the modifications at his cost on any part of the equipment during the period of warranty required for satisfactory operation of the equipment as per this technical specification. For any technical decision the final authority from the purchaser's side shall be with RDSO.

12. TESTS & VERIFICATION

12.1 Type Test

Type test shall be carried out on 2 units of Gauge complex with air flow indicator (one loco set). If RDSO feels necessary to conduct type test on some more units, the samples will be picked up at random for further validations of design and drawings. This option shall be exercised by RDSO based on the performance of the unit till design is validated. Once design is validated the final approval shall be given by the RDSO. Following shall comprise type tests:

S.N	Test	Details
1	Visual & Dim. checks	As per Annexure-I
2	Performance Test	As per Annexure II
3.	Effect of voltage variation	As per IEC 60571 or Equivalent Indian Standards, In addition to this firm to submit their suppliers

		(maker's) test certificate for LEDs.
4.	Shock tests (complete assembly)	As per Annexure III
5.	Endurance test	As per Annexure III
6.	Any other test specified in the approved QAP as well as desired by purchaser.	As per QAP or as specified by the purchaser

12.2 Routine test

Following shall comprise the routine tests and shall be conducted by the manufacturer on each equipment and the test results will be submitted to the inspection authority before acceptance tests.

- a) Visual & dim. checks - As per Annexure-I
- b) Performance test - As per Annexure-II
- c) Effect of voltage variation - As per IEC 60571 or Equivalent Indian Standards, In addition to this firm to submit their suppliers (maker's) test certificate for LEDs.
- d) Any other test specified in the approved QAP or desired by manufacturer - As per QAP or as specified by the purchaser

12.3 Acceptance test

Acceptance test (Regular inspection) 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 Gauge complex with flow indicator as unit or part, as per the requirement of the purchase order, for inspection after complete checking by them. The test results of every unit will be submitted to the inspecting authority. Inspecting authority shall carry out all tests necessary to prove that the equipment fulfills the Functional/Technical requirements, covered in this specification. However, following tests shall be mandatory.

- a) Visual & dim. checks- As per Annexure-I
- b) Performance test - As per Annexure-II
- c) Effect of voltage variation - As per IEC 60571 or Equivalent Indian Standards, In addition to this firm to submit their suppliers (maker's) test certificate for LEDs.
- d) Any other test specified in the approved QAP or desired by manufacturer - As per QAP or as specified by the purchaser

12.4 Field trial:

After successful prototype development and testing, field performance of equipment shall be monitored as specified by RDSO. Supplier shall arrange commissioning, testing & field trials of the prototype equipment in service jointly with Railways/RDSO and shall depute team of engineers to Railway field units for this purpose. Assistance with regard to labour and other facilities which are available in

the sheds/production units would, however, be provided to the supplier during prototype installation.

Field performance feedback format is as under:

S. No.	Shed/Rly.	Loco No.	Date of fitment	Date of failure, if any	Reason of failure	Remarks

The acceptance criteria of field trial shall be the satisfactory field performance of equipment.

13. PAINTING, LABELING AND MARKING

The equipment shall be appropriately painted for aesthetics and protection. The parts, connection ports, mounting points etc shall be clearly marked in a manner that these are easily readable and remain legible over the lifetime of the equipment. ID plate having Name of Component, Make, Sl. No, Date of Manufacture, Ratings shall be provided on assembly and sub-assemblies (like Duplex gauge, Air flow indicator, assembly clamp).

14. PACKAGING AND DELIVERY/SHIPMENT IF DIFFERENT FROM IRS

The equipment consists of sensitive and fragile components. These should be packed with precautions required to prevent damage in transit. All requirements of IRS conditions for packaging and delivery shall be applicable.

15. PREFERENCE TO MAKE IN INDIA

The Government of India policy on 'Make in India' shall apply.

16. VENDOR CHANGES IN APPROVED STATUS

All the provisions contained RDSO's ISO procedures laid down in Document No. QO-D-8.1-11, dated 22.01.2021 (Titled "Vendor-changes in approved status") and subsequent version/amendment thereof, shall be binding and applicable on the successful vendor/vendors in the contract floated by Railways to maintain of products supplied to Railways.

17. DATE OF ENFORCEMENT

The date of enforcement of the specification is with effect from 1st April'2021.

Annexure-I

A. Visual Check

Sr. No.	Parameters		Standards	Observed			Remarks	
				Assembly Clamp (bracket)	Duplex Pressure Gauge			AFI
					1	2		
a)	Name of Manufacturer		Yes					
b)	Month & Year of Manufacturer		Yes					
c)	Painting Quality & Finish of Gauge.		Yes					
d)	Colour of sub parts as per drg.	Indicator light	RED	----	----	----		
		Cables	White: +ve,	----	----	----		
			White/Black strip: -ve	----	----	----		
		Printing	White	----				
		Dial	Black	----				
		Pointers	Duplex: Top-White, Bottom-Red, AFI: Top-Red, Bottom-White	----				
e)	Scale marking		0-14 kg/cm ² & 0-200 Lb/In ² for Duplex gauge and 0-14 for AFI	----				
f)	Male connector on each leads of LED for loco connection		Yes	----	----	----		
g)	Removable 'LED'		Yes	----	----	----		
h)	Port connection of bottom orientation.		Yes	----				
i)	Port marked		RH/WH on duplex gauge & 1/2 on AFI	----				
j)	It should be free from corrosion, Dust particles & Sharp Edge.		Yes					
k)	Check for tightness of fasteners & the visual damages		Yes					

B. Dimension Check (Tolerance as per standard mentioned in the EMD Part no.)

Sr. No.	Parameters	Standards (Dim. are in inches if not specified)	Observed				Remarks
			Assembly Clamp (bracket)	Duplex Pressure Gauge		AFI	
				1	2		
a)	Length of Base Bracket (i.e clamp)	15.38		----	----	----	
b)	Height of Base Bracket	1.0		----	----	----	
c)	Width of Base Bracket	1.5		----	----	----	
d)	Distance between Base Bracket mounting holes (from left)	0.38, 4.69, 4.69, 5.25		----	----	----	
e)	Height of mounting holes from Base Bracket free end	0.69		----	----	----	
f)	Dia. of mounting holes	0.41x 4 holes		----	----	----	
g)	Distance of connection enabling holes from Base Bracket front face	1.0		----	----	----	
h)	Bezel/font ring Dia.	5.12	----				
i)	Case with Bezel Height	2.22	----				
j)	Distance between knobs	1.38	----				
k)	Width of gauge at knob w.r.t case	2.34	----				
l)	Air pipe connection ports in mounting block	1/8" NPT, female x 2nos per gauge block	----				
m)	Center to center distance air passage holes in gauges	30mm	----				
n)	OD of air passage hole	3.2mm	----				
o)	LED resistance	2400 Ohms	----	----	----		
p)	Resistance wire length	30	----	----	----		
q)	Total height of assembly	7.19	----				
r)	Height of gauge center	4.62	----				
s)	Height of knob center	1.38	----				
t)	Height of connection port in mounting block	0.75	----				
u)	Distance of Gauges (from left of Base Bracket)	2.44, 5.25, 5.25		----	----	----	
v)	Gauge plate thickness	1.6mm	----				

Annexure-II

Performance Test

(a) Duplex pressure gauges:

Test description	Standards	Observation
(i) Leak test: Apply 14Kg/cm ² to ports RH (Red Hand) and WH (White Hand). Check leakage at connection port, bracket surface and body surface using soap water solution.	No leakage	
(ii) Accuracy Test (Calibration): The gauge shall be subjected to pressure equal to the maximum scale value and shall be maintained at that pressure for not less than 1 hour. After that the pressure is released and without recalibration or adjustment, the gauge shall be tested over its entire scale with readings taken both up and down the scale.	The error in pressure indication, with either increasing or decreasing pressure, at any point shall not exceed 2% percent of the maximum scale value,	As per table given below

Observations of Accuracy test:

S. no.	Reading in Master Gauge (Kg/cm ²)	Gauge sl.no.				Gauge sl.no.				Remarks if any
		UP		DN		UP		DN		
		RH	WH	RH	WH	RH	WH	RH	WH	
1	0									
2	2									
3	4									
4	6									
5	8									
6	10									
7	12									
8	14									

(b) Air flow indicator:

Test description	Standards	Observation
<p>(i) Leak test:</p> <ul style="list-style-type: none"> • Keeping the port 2 open and apply pressure of 10 PSI to port-1 and pointer reading should be $10 \pm \frac{1}{2}$ mark. Check the air leakage at port 2, bracket surface and body surface using soap water solution. • Apply 140 PSI to port 1 and port 2 and check leakage at bracket surface and body surface using soap water solution. 	<p>No leakage</p> <p>No leakage</p>	
<p>(ii) Pneumatic test:</p> <p>The Air Flow indication pointer exposes the 'RED Indicator LED' whenever flow Exceeds '5' numeral on dial face. (Red LED shall work with 74 V DC/ 30-40mA).</p>	Should expose Red indicator LED	
<p>(iii) Accuracy Test (Calibration):</p> <p>The AFI shall be subjected to pressure equal to the maximum scale value and shall be maintained at that pressure for not less than 1 hour. After that the pressure is released and without recalibration or adjustment, the gauge shall be tested for accuracy with readings taken both up and down the scale.</p>	<p>The error in indication, with either UP & DN, at 5 & 10 marks shall not exceed $\pm \frac{1}{2}$ marks.</p>	As per table given below

Observation of Air flow indicator:

S. no.	Conduct test maintaining HP line pressure in the range 120-140 PSI Readings to be seen in master gauges (in PSI) on HP & LP Line	HP line pressure	LP line pressure	Reading on AFI Gauge	Remarks (OK/ Not OK)
Up direction					
1.	Keep HP & LP line pressure equal				
2.	Keep LP line pressure 5 PSI lower than HP line pressure				
3.	Keep LP line pressure 10 PSI lower than HP line pressure				
Down direction (Raise flow to indicate 14 marks on scale and then record reading on return at 10 and 5 marks)					
4.	Keep LP line pressure 10 PSI lower than HP line pressure				
5.	Keep LP line pressure 5 PSI lower than HP line pressure				
6.	Keep HP & LP line pressure equal				

(c) Assembly Clamp:

S. no	Test description	Standards	Observation
1	Insert & remove the knobs from the gauge base holes.	Free movement. Clock wise for allowing air to gauge and anti-clock wise rotation for closing the air flow to gauge.	
2	Rotation of CAM (locking assembly)	Free rotation. Clockwise & anti-clock wise for tightening and dismantling the gauges.	
3	Leak test: Mount gauge(s) on assembly clamp and apply 14Kg/cm ² to connection ports. Check leakage above and below gauge plate across contact surface using soap water solution.	No leakage.	

Annexure-III

Shock & Endurance Test

Gauge complex with air flow indicator:

Shock Test	Endurance Test
The Gauge complex with air flow indicator shall be subjected to a shock test, shaking with an acceleration of 30 m/s ² at a frequency of 80 to 120 shocks per minute for a period of not less than 2 hours. After this test the gauge error should not change by more than ±2% of maximum scale value (Duplex pressure gauges) and ± ½ mark (Air flow indicator).	The gauges will be subjected to a pressure fluctuation of 25% to 75% of maximum scale value. The frequency of fluctuation will be 60 cycles per minute for a minimum 15000 cycles. After testing the difference at any point of the range between gauge error before and after the endurance test should not exceed more than ±2% of maximum scale value (Duplex pressure gauges) and ± ½ mark (Air flow indicator). The frequency of fluctuation in case of Air low indicator will be kept subject to system need/per minute.

Observation of duplex pressure gauges:

Reading in Master Gauge (Kg/cm ²)	Gauge SI.No.								Gauge SI.No.								Remarks (if any)		
	Before test				After test				Before test				After test						
	UP		DN		UP		DN		UP		DN		UP		DN				
	RH	WH	RH	WH	RH	WH	RH	WH	RH	WH	RH	WH	RH	WH	RH	WH			
0																			
2																			
4																			
8																			
10																			
12																			
14																			

Observation on Air flow indicator:

S.no.	Conduct test maintaining HP line pressure in the range 120-140 PSI Readings to be seen in master gauges (in PSI) on HP & LP Line	HP line pressure		LP line pressure		Reading on AFI Gauge		Remarks (OK/ Not OK)
		Before test	After test	Before test	After test	Before test	After test	
Up direction								
1.	Keep HP & LP line pressure equal							
2.	Keep LP line pressure 5 PSI lower than HP line pressure							
3.	Keep LP line pressure 10 PSI lower than HP line pressure							
Down direction (Raise flow to indicate 14 marks on scale and then record reading on return at 10 and 5 marks)								
4.	Keep LP line pressure 10 PSI lower than HP line pressure							
5.	Keep LP line pressure 5 PSI lower than HP line pressure							
6.	Keep HP & LP line pressure equal							