



**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS**

TENTATIVE

**TECHNICAL SPECIFICATION OF MICROPROCESSOR
COMPATIBLE AIR FLOW SENSOR FOR DIESEL LOCOMOTIVES**

Specification No.MP – MP.0.01.00.22
(Rev.00)
September-2009

**RESEARCH DESIGNS & STANDARDS ORGANISATION
LUCKNOW - 226 011**

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TENTATIVE TECHNICAL SPECIFICATION OF MICROPROCESSOR COMPATIBLE AIR FLOW SENSOR FOR DIESEL LOCOMOTIVES

1. INTRODUCTION:

Railway Board vide their letter no.94/M(L)/466/32 dt 23.02.2001 issued instructions to all Zonal Railways to adopt the modification of switching 'ON' of flasher light in different phases on diesel and electric locomotives in the event of train parting/ACP. Subsequently, orifice of passenger alarm system of coaches has been modified from the existing 4mm to 8mm. With these modifications, Zonal Railways have reported that in the event of ACP, loco is not coming to idle, thus causing higher coupler forces.

In order to address the above problem, RDSO has investigated the matter in detail and tried to evolve a device, which can bring loco to idle in the event of ACP, from last coach of a 26-coach train, within a reasonable time. For this purpose, a specification no. MP.0.01.00.18 (Rev 00) was issued in July 2006, which was basically for stand alone type of air flow sensor. Subsequently it was felt that the output of air flow sensor can be combined with loco microprocessor based control system to get many desired functions executed through loco microprocessor. A study was again conducted on this, and based upon study a tentative specification no. MP.0.01.00.22 Rev 00 is prepared which gives technical requirements of a Microprocessor Compatible Air Flow Sensor for fitment on diesel electric locomotives fitted with Microprocessor control and IRAB-1 brake system.

- 1.1 The Microprocessor Compatible Air Flow Sensor covered in this specification shall replace the following existing equipments on diesel and electric locomotives:

S.no.	Equipment	Quantity/ Loco
1.	Air flow measuring valve	1 no.
2.	Air flow indicating gauge	2 nos.
3.	R-6 Relay valve	1 no.
4.	Pneumatic piping connecting all above equipments	--
5.	Pressure Switch (P2)	1 no.

Schematic diagram of existing and modified arrangement are shown in RDSO drawing no. SK.DP 3854 Rev-01.

- 1.2 Expected advantages of providing Microprocessor Compatible Air Flow Sensor in locomotive brake system in place of existing airflow indicating device are as under:
- i. It can enable crew a better appreciation of train condition, besides giving more accurate value of air leakage.
 - ii. Better reliability of the equipment because of reduction in number of equipments from loco brake circuit.
 - iii. Reduction in connecting pipe network.
 - iv. Reduction in complexity of brake system.
 - v. Comparatively lesser brake equipments are required to be maintained and thus provide ease in maintenance.
 - vi. Improvement in sensitivity and accuracy.

vii. It shall also operate auto flasher light operation by replacing P2 pressure switch.

2. SCOPE:

This specification covers purchase, inspection, testing and acceptance requirements of Microprocessor compatible Air Flow Sensor for diesel locomotives fitted with microprocessor control brake system of Indian Railways. Microprocessor compatible Air Flow Sensor may be developed as per RDSO drawing no. SKDP-4059. This shall consist of Air Flow Sensor (1 no.) and display in microprocessor control system.

3. DEFINITIONS, ABBREVIATIONS AND CLARIFICATIONS:

3.1 Tenderer -means firm/company from whom the offer for the supply of air brake equipment is invited.

3.2 Supplier- means the present firm/company on whom the order for the supply of the air brake equipment is placed/will be placed.

3.3 Purchaser- means the Indian Railways on behalf of the president of the Republic of India who are purchasing the air brake equipment.

3.4 Inspecting Authority- means the organisation or its representative nominated by the purchaser to inspect the Air Flow Sensor on his behalf.

3.5 The Research Designs and Standards Organization, Manak Nagar, Lucknow-2226011 is hereafter referred to as RDSO.

3.6 Indian Railways is hereafter referred to as IR.

3.7 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 for clarification.

4. CLIMATIC AND ENVIRONMENTAL CONDITIONS OF OPERATION:

4.1 Altitude:

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

4.2 Temperature:

0° C to 55° C. The air temperature around equipment may reach as high as 70° C.

4.3 Relative Humidity = Up to 100%.

4.4 Vibrations And Shocks :

The Air Air Flow Sensor should be capable to withstand, without damage, the vibrations and shocks normally encountered during service. The conditions are indicated below:

- .1 Maximum vertical acceleration = 1.0 g
 - .2 Maximum longitudinal acceleration = 3.0 g
 - .3 Maximum transverse acceleration = 0.5 g
- ('g' being acceleration due to gravity)

4.4.1 Details of Vibration, shock and bump tests

The assembly is secured in a suitable position to a machine producing vibrations of sinusoidal form with adjustable amplitude and frequency and is then subjected to the tests given below.

The assembly under test shall be able to withstand successfully the electrical tests and, in particular, the dielectric tests applicable to the equipment concerned.

4.4.2 Determination of resonant frequencies

In order to determine the possible existence of critical producing resonance, the frequency shall be varied progressively over the range 1 Hz-100 Hz within a time of not less than four minutes and the amplitude of oscillations (A) expressed in millimetres should be varied as a function of frequency (f) according to the relation

$$A = 25/f \quad \text{for values of } f \text{ from } 1 \text{ Hz to } 10 \text{ Hz}$$

$$A = 250/f^2 \quad \text{for values of } f \text{ exceeding } 10 \text{ Hz \& upto } 100 \text{ Hz.}$$

If resonance is produced, the corresponding frequency shall be maintained for ten minutes in each case with the apparatus alive. A check shall be made that no ill effects result on the operation of the apparatus (abnormal tripping of a relay, sparking at contacts, temperature rise at contacts, etc.).

4.4.3 Tests with sustained vibrations:

The assembly is next subjected to a test with sustained vibration for a period of two hours,

- either at the critical frequency, if any such well defined frequency has been detected in the course of the test of sub-clause 4.4.2
- Otherwise, at a frequency of 10 Hz;

In both cases, the amplitude of the vibrating table is to be adjusted to the value corresponding to the frequency concerned.

The test is considered to be satisfactory if there is no resulting damage or abnormality in operation.

If considered by Engineer or Inspecting Officer, the assembly may be subjected to sustained vibration for a longer period (25 h to 50 h), as an investigation test.

4.4.4 Tests for simulating the effect of shunting shocks:

In the direction corresponding to the longitudinal movement of the vehicle on which it is to be mounted, the assembly is subjected for 2 min. to 50 Hz vibrations of such a nature that the maximum acceleration is equal to 30 m/s² (amplitude a= 0.3 mm) the equivalent in operation.

4.5 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 vapours and radiant heat etc. to

which the rolling stock is normally exposed in service.

5. WARRANTY:

The equipment shall work satisfactorily for a period of 30 months from the time of supply or 24 months from time of fitment on locomotive, whichever is earlier. Any equipment which fails during the warranty period shall be replaced or modified free of cost by the supplier. In case it becomes necessary to modify the design, all the units will have to be modified by the supplier free of cost.

6. AFTER SALES:

6.1 Supplier shall arrange to supply along with the equipment, maintenance manuals of the equipment one with every 5 sets. Manual shall contain information pertaining to detailed dimensional drawings indicating mounting arrangement layout, sub assemblies, principle of operation, maintenance schedules, trouble shooting, and details of special tools if required, parts catalogue and testing procedure of the equipment being supplied. Updated position of modifications will also be incorporated.

6.2 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.

6.3 The supplier will impart training of working, operation and maintenance of the system free of charge to selected personal of Indian Railway, if Purchaser/ RDSO desire so.

6.4 The supplier shall supply necessary spares for maintenance for a period of at least 8 years after expiry of warranty.

7. QUALITY AUDIT:

Periodical Quality audit will be carried out by RDSO to ascertain that procedure of manufacturing, inspection and testing of the equipment is being done by the firm as per the approved QAP.

8. APPROVAL OF DRAWING AND TEST PROCEDURE:

At the time of prototype development the supplier will get the provisional approval of designs & drawing and testing procedure of equipment from Motive Power Directorate of RDSO. Test procedure of the equipment shall cover general performance requirement of the equipment, which are essential for satisfactory working of equipment for which it is designed and its reliability in service. This test procedure shall be apart from the tests mentioned in para 11.2.1 to 11.2.2 After prototype development, testing and fitment on locomotive, the drawing(s) will be approved by RDSO. The firm will modify the drawings/test procedure in consultation with RDSO, if required, based on field performance on locomotives in Railways.

9. TECHNICAL REQUIRMENTS:

- 9.1 The Air Flow Sensor shall be suitable for IRAB-1 brake system with micro-processor controlled locomotive. It shall include a device to sense air flow through the air brake system as a consequence of air leakage in the train, alarm chain pulling, train parting, Gd's brake application etc. It shall display the air flow rate in digital form either in a separate display unit to be supplied along with the sensor, or in the existing display unit of loco micro-processor. Air flow display unit, if supplied separately, shall have RS 485 serial port interface to interface with loco control micro processor for Air flow rate, ACP trigger and Train Parting trigger data log in specified format defined by loco micro processor.
- 9.2 The Air Flow Sensor shall have to be integrated with the loco control micro-processor to carry out the desired functions based upon air flow and logics mentioned in this specification.
- 9.3 The Air Flow Sensor should be preferably of venturi-type for better accuracy, and it can be fitted at MR-2 outlet pipe $\frac{3}{4}$ " diameter.
- 9.4 The basic function of Air Flow Sensor in locomotive is to indicate to the Crew any excess air flow because of train pipe leakage, train-parting or passenger alarm chain pulling. It should also alert the Driver about "suspected Train parting/Gd van valve operation and "suspected alarm chain pulling".
- 9.5 After a train formation, initial air flow value in l.p.m. will be fixed and locked as "Datum flow". Generally the initial air flow rate in a train formation corresponding to the permissible brake pipe pressure leakage rate of 0.25 Kg/sq. cm /min remains near the range 90 to 100 litre per minute at the prevailing pressure in the pipe line of the Air Flow Sensor. The datum flow value, once set does not change until and unless the same is again reset by the crew or maintenance personnel, and a record for the time of reset of datum shall be logged, and can be viewed.
- 9.6 The Air Flow Sensor should have a facility to display current flow rate value in four digit numerical display and datum flow in terms of l.p.m. to indicate leakage in total train formation. This datum bar will act as a reference flow of train formation to the driver to know about the initial condition of the train. There will be another bar by the side of datum bar to display current actual air flow to the driver reference.
- 9.5 The 'Current Air Flow' bar (showing air flow at any current moment) should nearly coincide with the 'Datum Air Flow' bar (showing the set initial flow rate), whenever the brake is fully released and charged during the journey so long as the train formation is not changed. During brake release after brake application, current air flow bar falls back steadily towards the datum flow bar and the difference between the two values at any time indicates the state of release of brake. When the system is fully recharged, the two values should approximately coincide again within tolerance of $\pm 10\%$ of datum flow. If

they do not coincide it is evident that the brake pipe leakage has changed and the amount of difference between the two readings gives the driver some idea of the magnitude of the change.

- 9.6 Whenever the formation of the train is changed, the datum reading of flow is to be reset through switch to give a new datum corresponding to new train formation. A reset switch should be provided for resetting the datum.
- 9.7 The Air Flow Sensor shall fulfill the following functions:
- (i) Show the air flow in litre per minute in digital form (in 4 digits).
 - (ii) Facilitate setting of datum air flow (in 4 digits) by driver to indicate initial flow after a train formation.
 - (iii) Shall display current air flow and datum flow terms side by side for easy comparison by Loco Pilot.
 - (iv) Shall give audio-visual alarm to the crew in case of the following
 - (a) Operation of Guard's brake valve in the rearmost vehicle / brake van.
 - (b) Train parting i.e. uncoupling of brake pipe between two coaches or wagons
 - (c) Alarm chain pulling in any coach of the train. ACP is done by venting air of the brake pipe through 8 mm choke.
- The Air Flow Sensor shall indicate to the crew about "Suspected Train parting/Alarm Chain Pulling/Gd Van operation" along with audio-visual alarm.
- (v) It shall be possible for the Loco Pilot to reset the buzzer by acknowledging through push button. After acknowledgement, the buzzer will stop, but the visual indication should continue till it is automatically reset at flow rate equal to or less than 125% of the datum flow value.
 - (vi) The Air Flow Sensor shall also give an output signal in situations of train parting and ACP which can operate Flasher light and bring engine to idle.
 - (vii) It shall also be able to eliminate the P2 Pressure switch for auto flasher light operation with the fitment of this air flow sensor.
- 9.8 The Air Flow Sensor shall be so designed that when driver releases the brake after brake application, the air flow arising out of this should not cause unnecessary alarm to crew, and should not bring engine to idle or operate flasher light. The auto flasher system and the audio- visual alarm shall be inoperational in case of intentional application of brake by the driver.

- 9.9 The Air Flow Sensor and airflow display units shall operate at 72 VDC or 110VDC depending on the type of locomotive. The Air Flow Sensor should be capable to operate between 70% and 120% of the rated voltage.
- 9.10 The Air Flow Sensor must be suitable for a working pressure of 5 to 10 kg / cm².
- 9.11 The port size shall suit 3/4" pipe ID with BSP threads for Microprocessor Compatible Flow Sensor.
- 9.12 The Air Flow Sensor should be free from chattering during operation.
- 9.13 Accuracy of the Air Flow Sensor should be such as to detect difference of flow at least to the extent of 10 lpm.
- 9.14 The Air Flow Sensor should be suitable for both pipe mounted conventional brake system and panel mounted brake system.
- 9.15 General arrangement of Air Flow Sensor is shown in RDSO drawing no. SK.DP 4059. The Schematic diagram is shown in Drg no. SK.DP 3854 Alt-01.

10. VENDOR REGISTRATION:

The vendor has to fill up MP vendor registration form no. MPF 0002 (Rev 02) January 2009 for registration in the vendor list of RDSO. MP vendor registration form can be obtained from MP Directorate on payment OR down load from website "www.rdsogov.in/vendor registration/Motive power/Application form for fresh registration of vendor no MPF 0002 (Rev 02) January 2009" but the same demand draft as mentioned above is to be paid at the stage of submission of form to this office.

11. INSPECTION, TESTING AND APPROVAL:

- 11.1 Vendor approval will be done as per procedure laid down in vendor registration guidelines no. MPG 0002 Rev 03 January2009, which shall be supplied along with vendor registration form.
- 11.2 Prototype Inspection (Type Test):
 - 11.2.1 Prototype inspection including stage inspection will be carried out at vendor's manufacturing premises or NABL accredited testing laboratory. The test will be conducted at least on five Air Air Flow Sensors. The Air Flow Sensor should fulfill the following tests:

S.NO.	NAME OF TEST	STANDARD VALUE
1.	Visual check	As per IEC 60571 : 1998
2.	Dimensional check	As per approved drawing, if any.
3.	Performance test	As per IEC 60571 : 1998 and equipment specific test as laid down by OEM
4.	Cooling test	As per IEC 60571 : 1998

5.	Dry heat test	As per IEC 60571 : 1998
6.	Damp heat test	As per IEC 60571 : 1998
7.	Supply over voltages, surges and electrostatic discharge tests	As per IEC 60571 : 1998
8.	Transient burst susceptibility test	As per IEC 60571 : 1998
9.	Radio interference test	As per IEC 60571 : 1998
10.	Insulation test	As per IEC 60571 : 1998
11.	Salt mist test	As per IEC 60571 : 1998
12.	Vibration, shock and bump test	As per IEC 60571 : 1998
13.	Water tightness test	As per IEC 60571 : 1998
14.	Equipment stress screening	As per IEC 60571 : 1998
15.	Low temperature storage test	As per IEC 60571 : 1998
16.	Endurance test	Functional operation of the device for 1,25,000 nos. of cut-in and cut-out cycle.

11.2.2 Pneumatic test procedure:

The pneumatic test will be conducted on test bench as given in Annexure-I.

11.2.3 Field Trial of Air Flow Sensor on Locomotives

Development order for at least ten numbers Microprocessor compatible Air Flow Sensor will be placed on the firm and fitted on the locomotive for field trial. The performance of the Microprocessor Compatible Air Flow Sensor in field will be monitored for at least one year. Prototype should give satisfactory results in field.

11.2.4 Regular Inspection

11.2.4.1 Regular inspection of the Air Flow Sensor 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.

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

11.2.4.3 Sample Size

Sample size for various tests is given below:

Lot size	For tests as per QAP
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	Sample size	Number of rejection acceptable
Upto 25	3	0
25-50	5	0
50-75	8	0
75-100	10	0
More than 100	10% of the lot	0

Samples should be picked up at random from the lot. If rejection number is more than the acceptable limit, inspection will be stopped and entire lot will be tested again by the firm. After checking the firm will re offer the lot for reinspection. Again sample checking will be done by the inspecting authority. If second time also rejection is more than the acceptable limit , entire lot will be rejected.

12. INSTALLATION:

- 12.1 Installation, commissioning and integration of the Air flow sensor with loco microprocessor control system on the first prototype shall be done by the supplier. Assistance with regard to labour and other facilities which are available in the workshop/ shed would, however, be provided by the purchaser to the supplier. Additional equipment/fittings, not covered in the specification, if required, for installation of the equipment, shall be supplied by the supplier. Integration of the other Air Flow Sensor also with loco microprocessor shall be the responsibility of the supplier.
- 12.2 The supplier shall submit tentative installation drawings along with the offer based on the availability of space in the locomotive. These drawings would, however, be finalised after fitment of the first prototype.

13. QUALITY ASSURANCE PLAN (QAP):

- 13.1 The firm will give a quality assurance programme (QAP) for approval to RDSO. QAP will consist of following aspects-
- .1 Organisation chart emphasising quality control set-up.
 - .2 Qualification of key personals and the officials deployed in quality control cell.
 - .3 Process flow chart indicating process of manufacture for an individual product or for a family of products if the process is same.
 - .4 Stage inspection detailing inspection procedure, inspection parameters, method of testing/ test procedure including sample sizes for destructive and non-destructive testing etc.
 - .5 Details of sub suppliers-
 - The name of components for which it is approved.
 - Sub supplier approving agency.
 - Inspection criteria at sublet supplier's premises.

- .6 Quality assurance system- Inspection & Testing Plan. This shall cover the following:
- Incoming material.
 - Process control
 - Product control
 - System control

13.2 Revision of QAP

QAP is required to be revised in case of any of the following to be -

- Change in Quality Control Organisation Set-up.
- Change of official working in Quality Control Organisation.
- Change in machines, which may affect the process/method/mode of production.
- Change of conventional machines by CNC machines.
- Change in control over incoming material such as,
Sub supplier
Inspection Criteria
- Change in control over process.
- Change in control over product.
- Change in control over system.
- Addition of any corrective action taken to improve the system by the supplier.
- Alterations suggested by RDSO in the intervening period since last approval.

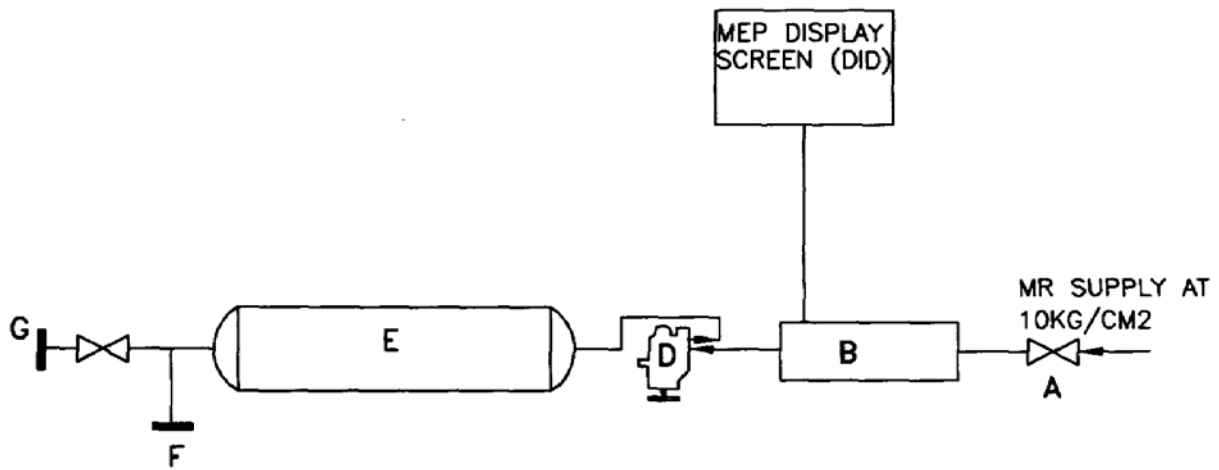
14. **DEVIATIONS:**

The supplier shall submit list of deviations, if any, with reasons thereof.

Test Scheme

The pneumatic test will be conducted on test bench as given in sketch (enclosed). The following parameters to be observed.

Sl. No.	Description of test	Standard value	Observed value
1.	Provision for supply of compressed air @ 3400 lpm (FAD) at 10 kg /cm ² .	-----	
2.	Create the leakage through palm end 'F'('X'mm choke) @ 0.25 kg /cm ² /minute.	85-105 lpm(at existing air pressure)	
3.	Exhaust the air through palm end 'G' ('8'mm choke).	Audio and visual signal along with indication for Suspected ACP /Gd van operation should come	
4.	Close the isolating cock before palm end 'G'. When flow comes down less than 125 lpm (at system air pressure)	Audio and visual signal along with indication for Suspected ACP /Gd van operation should go.	
5.	Exhaust the air without palm end 'G' (through 1" opening).	Audio and visual (Suspected TP) signal should come.	
6.	Close the isolating cock before palm end 'G'. When flow comes down less than 125 lpm	Audio and visual (Suspected TP) signal should go.	



SL. NO.	ITEM NO.	DESCRIPTION	QTY/test rack
1	A	ISOLATING COCK	3
2	B	AIR FLOW SENSOR	1
3	C	MEP DISPLAY SCREEN (DID)	1
4	D	LIMITING VALVE SET AT 5.0 ± 0.1 KG/CM ²	1
5	E	RESERVOIR 350 LITRE	1
6	F	PALM ENDS WITH CHOKE SIZE 'X' MM	1
7	G	PALM ENDS WITH CHOKE SIZE '8' MM	1

NOTE:-

1. CHOKE SIZE 'X' MM WILL BE DECIDE AT THE RATE 0.25 KG/CM²/MINUTE.

SKETCHMETIC LAY OUT OF TEST BENCH.

