भारत सरकार
रेल मंत्रालय

GOVERENMENT OF INDIA
MINISTRY OF RAILWAYS

TECHNICAL SPECIFICATION OF MAGNET VALVE TO PROVIDE 'RELEASE AND RUN' POSITION ON DIESEL AND ELECTRIC LOCOMOTIVES

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TECHNICAL SPECIFICTION OF MAGNET VALVE TO PROVIDE 'RELEASE AND RUN' POSITION ON DIESEL AND ELECTRIC LOCOMOTIVES

1. INTRODUCTION:

At present on the brake circuit of diesel and electric locomotives of Indians Railways, there is no provision of 'Release and Run' position i.e. charging of brake pipe is single stage. To introduce two stage charging, a magnet valve with a choke has been introduced. This specification gives technical requirement of the magnet valve with choke.

2. SCOPE:

This description covers general and technical requirement of magnet valve with choke to provide 'Release and Run' position on brake circuit of diesel and electric locomotives.

3. CLIMATIC AND ENVIRONMENTAL CONDITIONS OF OPERATION

3.1 Altitude

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

3.2 Temperature

0^{o} C to 55^{o} C The air temperature around equipment may reach as high as 70^{o} C.

3.3 Relative Humidity = Up to 100%.

3.4 Vibrations And Shocks

The magnet valve 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)

3.5 Other Conditions

Equipment shall be capable of operating efficiently inspite 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.

4. TECHNICAL REQUIRMENT:

4.1 The magnet valve should be normally closed type and should have built in 5.5 mm choke.

4.2 The magnet valve should be suitable for both pipe mounted conventional brake system and panel mounted brake system.

4.3 The magnet valve should be suitable for a working pressure of 0 to 15 kg / cm^2.

4.4 In de-energised condition of magnet valve (Run position), air flow should be through only 5.5 mm choke (hole). In energised position of magnet valve (Release position), air flow should be through full opening of magnet valve and 5.5 mm choke.

4.5 Flow factor (see para 4 of annexure 1) of magnet valve for water should be as under:

I) For 'Run' position of magnet valve: - 13 to 16 litre/minute (lpm)

II) For 'Release' position of magnet valve: - more than 160 lpm

4.6 The size of inlet and outlet port of magnet valve should be ¾" BSP. Envelop dimensions and mounting dimension required for mounting of magnet valve should be as per RDSO Drg. No. SKDP-3641 for panel mounted type and SKDP -3642 for pipe mounted type magnet valve.

4.7 The magnet valve should be suitable for rated voltage 72 $\pm$ 2 VDC & at a nominal operating voltage of 48-90 VDC for diesel locomotives and 110 VDC and at a nominal operating voltage of 85 to 130 VDC.

4.8 Operating voltage, power rating of coil, arrow indicating direction of flow, port no. with 'in' and 'out' indication should be clearly indicated on the magnet valve.

4.9 The weight of magnet valve should not be more then 2 kg.

4.10 The magnet valve should be capable to operate at 70% and 120% of the rated voltage.

4.11 Magnet valve should have manual over riding facility to take care of any exigency like power failure.

4.12 Magnet valve should be free from chattering during operation.

5. LITREATURE AND DRAWING:

5.1 The supplier has to fill up MP Guide 12 for registration in the vendor list of RDSO. MP Guide 12 is a priced document and can be obtained from MP Directorate.

5.2 The supplier will submit sectional diagram and outline diagram with mounting dimension in orthographic view for panel as well as pipe mounted valve alongwith the technical description.

5.3 The supplier shall submit testing procedure, specification covering detailed operating instruction, precautions in use, list of components etc. for magnet valve. The supplier shall also indicate the maintenance facilities and maintenance schedule required for proper upkeep of the equipment.

6. INSPECTION, TESTING AND APPROVAL:

6.1 The supplier will submit it's offer alongwith all the documents mentioned above. The offer will be evaluated and if found suitable prototype manufacturing will be started by the manufacturer. Manufacturer will be in touch with RDSO for design review and prototype development. After manufacturing of the prototype, it will be taken up for inspection.

6.2 There should be proper test set up at manufacturer's premises to conduct such test. The supplier will provide, without extra charges, tools and any other assistance, which the purchaser may consider necessary for any test.

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

6.4 During prototype inspection, a certificate from manufacturer of components/ valves/equipments/raw material, which have been purchased from out side, shall be produced as a proof of quality assurance.

6.5 <u>Prototype Inspection (Type Test):</u>

6.5.1 The prototype inspection including stage inspection will be carried out by RDSO at manufacturer's premises. The type test of the magnet valve will be conducted by RDSO every two years. The test procedures are given in annexure I. The test will be conducted atleast on five magnet valves. The valves should fulfill the following tests.

S.NO.	NAME OF TEST	STANDARD VALUE
1.	Visual check	As per annexure-1
2.	Dimensional check	As per RDSO Drg. No. SK.DP- 3641 for panel mounted type and SK.DP- 3642 for pipe mounted type magnet valve.
3.	Air leakage test	There should not be any leakage from joints, casting and body.
4.	Actuation test	Valve should operate at 70% and 120% of the rated voltage
5.	Flow test a) Flow factor for 'Run' position b) Flow factor for 'Release' position	 13 to 16 lpm More than 160 lpm
6.	Pick up and drop out voltage test a) Pick up voltage b) Drop down voltage	 Less then 70% of rated voltage More then 10% of rated voltage
7.	Temperature rise test	The temperature of the coil shall not rise to such a value above specified ambient temperature that might cause damage to the insulation. The final temperature in any case should not be more than 70ºC.
8.	Insulation resistance test	Not less then 100 mega ohms at 500 +/- 50 VDC
9.	High voltage test	No flashover or breakdown/damage should occur.
10.	Holding voltage test	Magnet valve should not de-energise till 70% of the rated voltage is reached.
11.	Coil resistance measurement	Should be with in ± 5% of the rated coil resistance
12.	Response time measurement	6 to 20 mili seconds
13.	Burn in test	The resistance should not differ by more then 2% of the value before commencement of test
14.	Surge test	The trace of wave of coil of magnet valve under test should match with the wave form of standard coil at peaks. Also there should not be any sign of discharge on the CRT trace at peak voltage.
15.	Vibration test	No damage of any of the part and loosening of fasteners should occur. After vibration test, the resistance of the solenoid should be with in the specified range and valve should operate between 70 % and 120 % of the rated voltage.
16.	Endurance test	Valve should withstand 100,000 operations and should pass tests mentioned in para 6.5.2 after completion of endurance test.

6.5.2 Following tests, as per the procedures given in annexure I, should be repeated on the magnet valve after endurance test and the valve should meet the conditions given in para 6.5.1 for these tests :-

1. Air leakage test
2. Actuation test
3. Flow test
4. Pick up and drop out voltage test
5. Temperature rise test
6. Insulation resistance test
7. High voltage test
8. Holding voltage test
9. Coil resistance measurement
10. Response time measurement

6.5.3. Type Test Of Magnet Valve On Loco

After successful type test testing of prototype magnet valve, five magnet valves will be tested on diesel / electric locomotive for their fitment and performance on loco. Following tests will be conducted on loco.

6.5.3.1 Charge the loco brake system fully and note the following:

i)	Brake pipe pressure	5 ± 0.1 kg/cm^2
ii)	Feed pipe pressure	6 ± 0.1 kg/cm^2
iii)	Brake cylinder pressure	0
iv)	Main reservoir pressure between	8 ± 0.1 to 10 ± 0.1 kg/cm^2

6.5.3.2 Run diesel locomotive at idle rpm/ electric locomotive at 2000 litres/minute. Maintain MR pressure between 8 to 10 kg/cm^2 and carry out the following tests.

i) Keep magnet valve in 'Release' position (energised state) and conduct test with 7.5 mm dia leak hole (RDSO drawing no. SKDP 2691) .
- Brake pipe pressure should not fall below 4.4 kg/cm^2 .

ii) Keep magnet valve in 'Run' position (de-energise state) and conduct test with 7.5 mm dia leak hole.
-Brake pipe pressure should fall below 3.5 kg/cm^2 but should be more than 2.5 kg./cm^2 .

If during the above tests MR pressure drops below 8kg/cm^2 then diesel engine speed should be raised or additional compressor should be started on electric locomotives to increase the compressor capacity.

If the performance of magnet valve is found satisfactory during type testing on loco as mentioned above, developmental order for limited quantity will be placed on the firm to supply magnet valves.

6.6 Field Trial

Performance of magnet valve on loco will be monitored in the field for atleast one year. If performance of magnet valve is found satisfactory in field trials, general clearance will be given for fitment of the magnet valve on locomotives.

6.7 Routine Inspection By Inspecting Authority Of Purchaser: -
(As Per Is: 2500 (Part I) –1978)

LOT SIZE	SAMPLE SIZE	
	COLUMN 'A'	COLUMN 'B'
2-8	2(0)	2(0)
9-15	3(0)	2(0)
16-25	5(0)	3(0)
26-50	8(0)	3(0)
51-100	13(0)	5(0)
101-150	20(0)	5(0)
151-300	32(0)	8(0)
301-500	50(1)	8(0)

Values in bracket are the acceptance numbers.

Column 'A' is for the following checks: -

1. Air leakage test
2. Actuation test
3. Pick up and drop out voltage test
4. Temperature rise test
5. Insulation resistance test
6. High voltage test
7. Holding voltage test
8. Coil resistance measurement
9. Visual inspection
10. Dimensional check

Column 'B' is for the following tests: -

1. Flow test
2. Response time measurement

7. QUALITY ASSURANCE PLAN (QAP)

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 sublet vendors-

- The name of components for which it is approved.
- Sublet vendor approving agency.
- Inspection criteria at sublet vendor's premises.

.6 Quality assurance system- Inspection & Testing Plan. This shall cover the following:

- incoming material.
- Process control
- Product control
- System control

.7 <u>Routine Inspection By The Firm</u>

The routine test should be done as per the following table.

S.NO.	NAME OF TEST	QUANTEM OF CHECK
1.	Visual check	100%
2.	Dimensional check	25%
3.	Air leakage test	100%
4.	Actuation test	100 %
5.	Flow test	10% of the lot size
6.	Pick up and drop out voltage test	100 %
7.	Temperature rise test	25 % of the lot size
8.	Insulation resistance test	100 %
9.	High voltage test	100 %
10.	Holding voltage test	100%
11.	Burn in test	100 % of the lot size
12.	Surge test	100 % of the lot size
13.	Response time measurement	10% of the lot size
14.	Coil resistance measurement	100 %

Annexure-I

TESTING METHOD AND ACCEPTANCE CRETRIA FOR TESTING OF MAGNET VALVE

1. Visual inspection: -

Following points are required to be checked during visual inspection:

- Serial number of the magnet valve
- Name plate of the magnet valve
- Port marking
- Paint quality and finish of the valve
- Arrow indicating direction of air flow
- Threads of the mounting holes
- Name plate showing operating voltage and power rating of coil

2. Air leakage test: -

Plug the valve outlet and apply 10 kg/cm2 air pressure to inlet. Connect the valve to rated voltage source with a switch. Check leakage by submerging the valve in water in energised and de-energised condition of magnet valve.

There should not be any leakage from joints, casting and body.

3. Actuation test: -

Magnet valve shall be tested by supplying air at inlet port of magnet valve. Apply 10 kg/cm2 air pressure at inlet and operate the valve by applying 70% of the rated voltage. Repeat the same by applying 120% of the rated voltage.

The magnet valve should function satisfactorily.

4. Flow test: -

4.1 Type testing to measure flow factor of magnet valve will be conducted on five prototype magnet valves. Following procedure will be adopted to calculate flow factor of each valve.

Each of the five magnet valves will be subjected to a water pressure of 2 kg/cm^2 at inlet. Water flow in liters per min at outlet in a reservoir will be

measured. Flow factor at unit pressure differential (Kv) will be computed by following formula:

$$Kv = Q / \sqrt{\delta P}$$

Where Q = flow in liters per min. through the valve
Kv = Flow factor lpm.
δP = Pressure differential across the valve in kg/cm2.

Five readings on each magnet valve will be taken both in energised and de-energised condition. Based on these readings average flow factor of each valve will be calculated separately. Average flow factor of all five magnet valve should meet the values given in para 4.5 of this specification.

4.2 Since it is impracticable to conduct above test to measure flow factor of the magnet valves during routine inspections, during type tests itself following tests will be conducted on five prototype magnet valves which meet the flow factor requirement given in para 4.1 of annexure- I to decide a standard for flow measurement during routine inspections.

a) Connect air supply of 10 kg/cm2 to the inlet port of the valve.
b) Connect the outlet port of magnet valve to reservoir of 50 liters capacity.
c) In de-energized condition of magnet valve, measure the time taken for air pressure build up from 1 kg/cm2 to 3 kg/cm2 in the reservoir. Take three readings of this test. Average of these three readings will be flow factor time of that magnet valve in 'Run' position.
d) Release the pressure to atmosphere.
e) Repeat the test in para 4.2.(c) in energized condition of magnet valve. Take three readings of the test. Average of these three readings will be flow factor time of that magnet valve in 'Released ' position.

Measurement of flow factor time in run and released position as per test in para 4.2 (c) and 4.2.(e) on five prototype magnet valves will give a range of flow factor time. This range of flow factor time will be used as standard for that firm for routine inspections .

4.3 The standard time range decided in the tests conducted as per para 4.2 during type testing will be used to compare performance of Release run magnet valves against regular purchase orders as per para 6.7 of this specification.

5 Pick-up and drop-out voltage test: -

Apply 10 kg/cm2 air pressure to the inlet of the magnet valve. Connect the solenoid to variable voltage source. First raise the voltage from 0 volt till the valve is energised. Note this as pick – up voltage. Keep raising the

voltage till the rated voltage is reached. Now reduce the voltage from the rated voltage till the valve is de-energised. Note this as drop-out voltage.

Pick-up voltage should be less then 70% of the rated voltage and drop-out voltage should be more then 10% of the rated voltage.

Example: For a rated voltage of 72 V DC

i)	*Pick-up voltage*	*< 48 V*
ii)	*Drop-out voltage*	*> 7 V*

6 Temperature rise test: -

The temperature rise of the coil shall be measured by the self resistance method, using a resistance measuring bridge. The coil should be kept energized to its rated voltage for a period of time sufficient for the temperature to rise to a constant value. Normally this condition is reached when the variation does not exceed 1ºC per hour.

Calculate the final temperature using the following formula:

$$R_T = R_0 [1 + \alpha (t_2 - t_1)]$$

Where

R_T	=	final resistance of the coil
R_0	=	resistance of the coil at room temperature
α	=	temperature coefficient of resistance of the material of the wire
t_2	=	final temperature
t_1	=	initial temperature

The t*emperature of the coil shall not rise to such a value above specified ambient temperature that might cause damage to the insulation. The final temperature (*t_2) in any case should not be more than *70ºC.*

7 Insulation resistance test: -

Apply 500 V DC between the coil terminals and the enclosure and measure value of resistance.

The insulation resistance between the coil winding and the enclosure should not be less then 100 mega ohms at 500 V DC

8 High voltage test: -

Short the terminals and apply 2000 V DC between the terminals of the coil and body for one minute. The test voltage should be of sinusoidal form (i.e. root mean square value) and its frequency should be 50 Hz.

No flashover or breakdown/damage should occur.

9 Holding voltage test: -

First ensure that the magnet valve is actuating correctly at all values of supply voltage between 70 % and 120 % of its rated voltage. The solenoid should be energized to its rated voltage so that it operates the piston of the magnet valve. Than reduce the voltage gradually.

The piston of the magnet valve should not be de-actuated till 70 percent of the rated voltage is reached.

10. Response time measurement: -

The time delay between the energisation or de-energisation of the solenoid and actual operation of the valve (closing and opening of the ports) should be measured as under:

Connect inlet port of the solenoid valve to air supply of 10 kg/cm2 and measure response time in mili seconds.

Response 'ON' time t_1 = time duration between supply of voltage to the coil and completion of plunger travel.
Response 'OFF' time t_2= time duration between switching off of power supply to the coil and plunger dropping.

Response time should be within the range of 6 to 20 mili seconds.

11. Burn in test: -

Measure the resistance of the solenoid at room temperature and equate it to 20 ºC using the following formula:

$$R_T = R_0 [1 + \alpha (t_2 - t_1)]$$

Where

R_T	=	final resistance of the coil
R_0	=	resistance of the coil at room temperature
α	=	temperature coefficient of resistance of the material of the wire
t_2	=	final temperature
t_1	=	initial temperature

Mount the coil on non magnetic core and connect the solenoid to an alternating voltage of 50 Hz of such magnitude as to cause a current which is 10% higher then the rated current at nominal DC voltage (i.e. 1.1 × Nominal voltage/ Coil resistance at 20 ºC.

Maintain the current for 168 hours. After every 5 min. switch off the power supply for 3 sec. At the end of 168 hours, allow cooling for 24 hours. Measure the resistance of the coil and equate it to 20 ºC using the above. This test will be conducted atleast on five nos. of magnet valves.

The resistance corrected to 20 ºC should not differ by more then 2% compare to value before commencement of the test.

12. Surge test :-

Surge test is conducted to check whether the magnet valve can withstand electrical surges or not. It is conducted after burn-in test. The solenoid which has minimum resistance variation with respect to its original resistance before starting of the burn-in test is taken as standard coil for surge test.

The surge test on coil of magnet valve under test is conducted by connecting it to 5 KV surge tester. The surge test is also conducted on standard coil selected above.

The trace of wave of coil of magnet valve under test should match with the wave form of standard coil at peaks. Also there should not be any sign of discharge on the CRT trace at peak voltage.

13. Vibration test: -

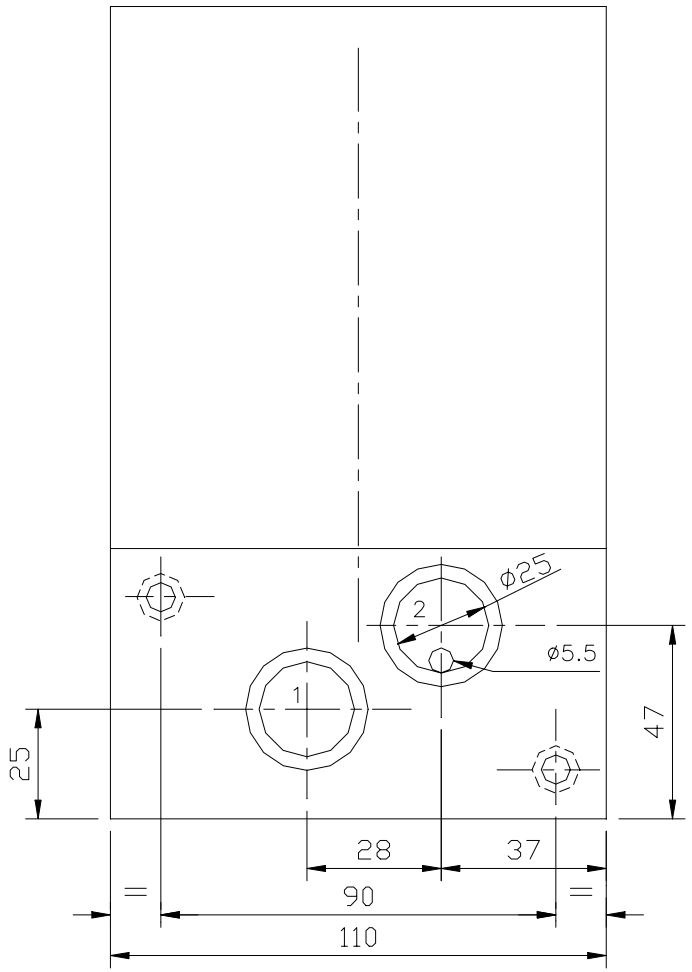
Attach the magnet valve to the platform of a vibration machine. Connect the inlet port of the valve with flexible tube and outlet port should be plugged. Supply the air pressure of 10 kg/cm2 to the inlet of the valve. Vibrate the valve at about 1440 cycles per min. at amplitude of 3.12 mm for 4 hours. Operate the valve between the voltage variations of 70 to 120% of the rated voltage. Test should be repeated in all three planes.

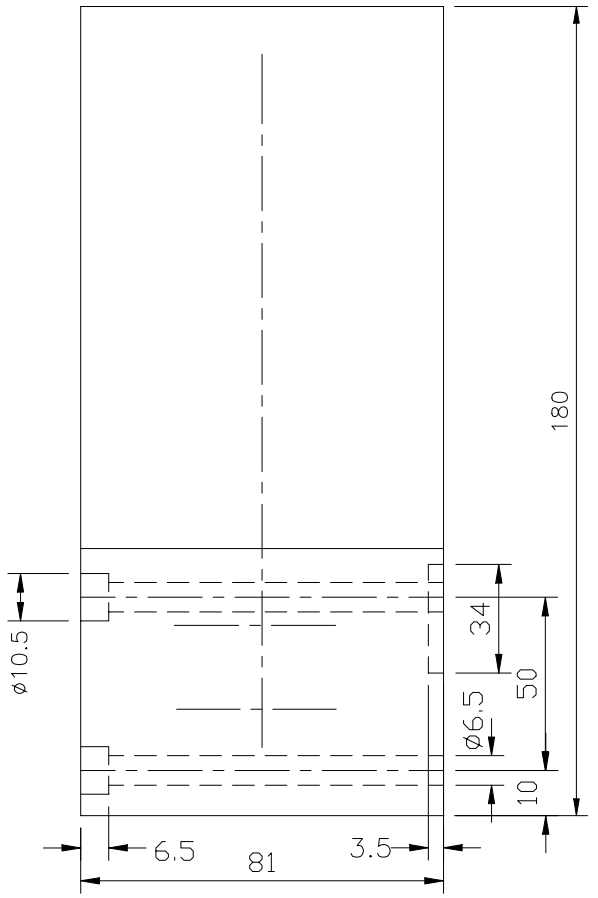
No damage of any part and no loosening of fasteners should occur. The resistance of the solenoid should be within the specified range after the vibration test. The valve should operate satisfactorily between 70 to 120% of the rated voltage.

14. Endurance test: -

Connect 10 kg/cm2 to inlet. Connect power supply of rated voltage through ON/OFF timer switch. Operate the valve for 100,000 operations.

Valve should withstand 100,000 operations and should pass tests mentioned in para 6.6.2 after completion of endurance test.





PORT CONNECTIONS:–

PORT NO. 1 – INLET

PORT NO. 2 – OUTLET

NOTE:–

1– ALL DIMENSIONS ARE IN MM.

D	S.K.SAXENA
C	S.P.GOVIL
APPD.	DIR/MP/BK
Dt	12-2001

ALT	NO.OF PLACES	REF. NO.	DESCRIPTION	ALT.NOTE NO.	SIGN	DATE

APPL. FOR DSL./ELEC. LOCO. | REF.

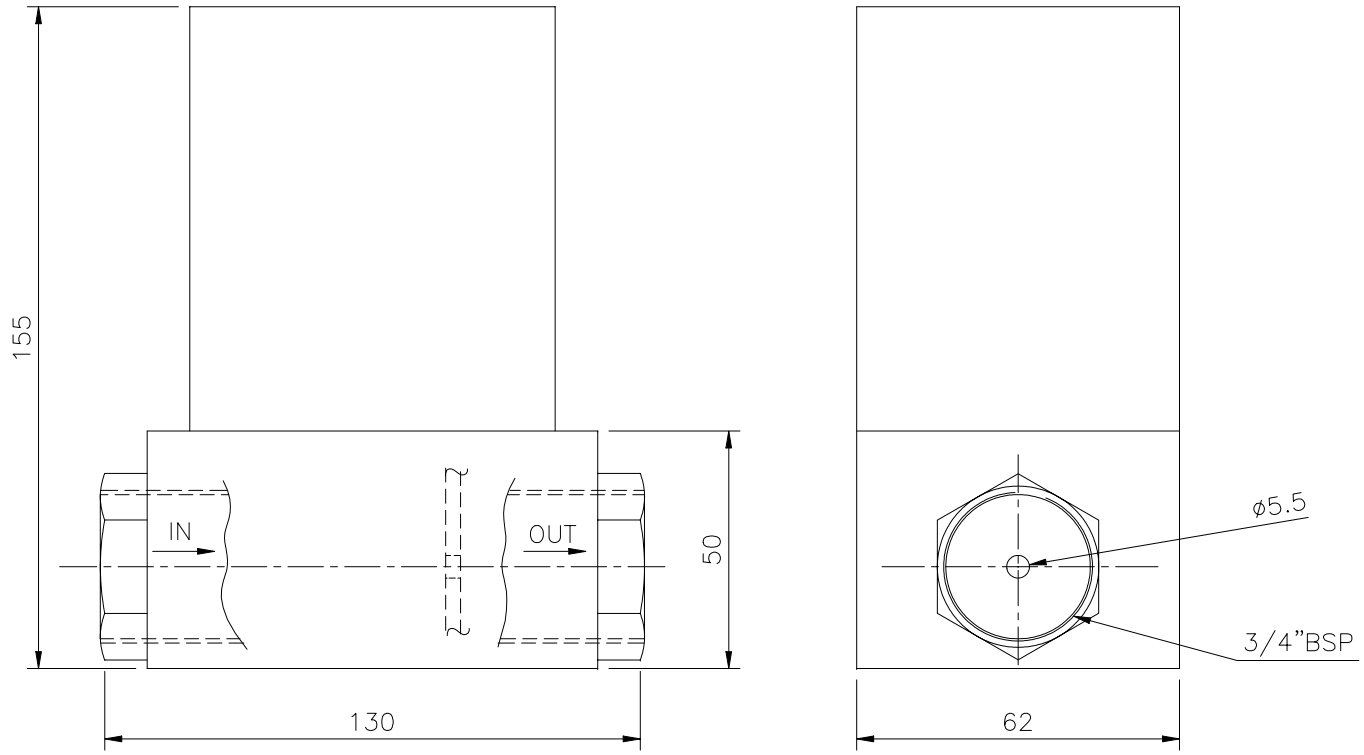
SCALE NTS.

MAGNET VALVE FOR 'RELEASE'–'RUN' POSITION (PANEL MOUNTED)

INDIAN RLYS R.D.S.O. (MP)

DRG. NO. SKDP–3641

MV2



NOTE:–

1– ALL DIMENSIONS ARE IN MM.

D	S.K.SAXENA
C	S.P.GOVIL
APPD. DIR/MP/BK	
Dt	08–2001

ALT	NO.OF PLACES	REF. NO.	DESCRIPTION	ALT.NOTE NO.	SIGN.	DATE

APPL. FOR DSL./ELEC. LOCO.	REF.
SCALE NTS.	MAGNET VALVE FOR 'RELEASE'–'RUN' POSITION (PIPE MOUNTED)
INDIAN RLYS R.D.S.O. (MP)	DRG. NO. SKDP–3642

MV1