SAE International

SURFACE VEHICLE RECOMMENDED PRACTICE

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(R) Air Brake Valves Test Procedure

1. Scope

This SAE Recommended Practice establishes uniform test procedures for air brake systems pneumatic valves with respect to:

a. Input-Output Performance
b. Leakage Characteristics
c. Low Temperature Evaluation
d. Elevated Temperature Evaluation
e. Corrosion Resistance Evaluation
f. Endurance Testing
g. Structural Integrity

1.1 Purpose

This document establishes uniform accelerated laboratory test procedures for evaluating comparative performance characteristics of pneumatic valves designed to operate in 931 kPa (135 psi) nominal air brake systems. These tests are based upon current industry practices.

2. References

2.1 Applicable Publication

The following publication forms a part of the specification to the extent specified herein. Unless otherwise indicated, the latest revision of SAE publications shall apply.

2.1.1 ASTM PUBLICATION

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 117— Method of Salt Spray (Fog) Testing

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this document.

2.2.1 SAE PUBLICATIONS

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001

SAE J1410 Air Brake Valve—Performance Requirements
SAE J1859 Test Procedures for Determining Air Brake Valve Input-Output Characteristics

3. General Notes

3.1 Temperature

Unless otherwise specified, all testing shall be conducted at a temperature of 15.5 to 38 °C (60 to 100 °F), inclusive.

3.2 Mounting

All testing shall be conducted with the unit mounted essentially as in service. The actual mounting position for each test shall be recorded.

3.3 Leakage Measurement

All leakage rates shall be expressed in standard cubic centimeters per minute of free (atmospheric) air. Leakage shall be indicative of total valve leakage. Various methods may be utilized, such as pressure drop in a specific volume or by flow meters.

3.4 Pressure Units

All pressure units are expressed as gage pressure (that is, above atmospheric pressure), unless otherwise specified.

3.5 Cycle Rate (Endurance Test)

All endurance testing shall be done at a rate of 15 to 25 cycles per minute. Faster rates are permitted if no abnormal effects are introduced.

3.6 Supply Air

Unless otherwise specified, the supply air shall be clean and dry.

3.7 Testing Sequence

Unless otherwise specified, it is not necessary to use the same valve for more than one test section.

3.8 Multiple Function Valves

Valves with multiple functions shall be tested per all applicable subsections of any test section as agreed upon by valve manufacturer and purchaser.

3.9 Delivery Volume (Endurance Test)

Delivery volumes for all endurance testing shall be agreed upon by the valve manufacturer and purchaser.

4. Input-Output Performance

The test and test procedure for the input-output characteristics shall be determined by the intended design and functions as agreed upon by the valve manufacturer and purchaser. A typical characteristic is the comparison of input pressure, force or actuator position versus output pressure (application and release).

5. Leakage Characteristics

5.1 Pilot Operated and Mechanically Actuated Modulating Type Valves

5.1.1 LOW SUPPLY PRESSURE TEST (NO DELIVERY PRESSURE CONDITION)

With the valve in the no delivery pressure position, the delivery port(s) open to atmosphere, and 103 kPa ± 34 kPa (15 psi ± 5 psi) air pressure at the supply port(s), measure and record leakage.

NOTE— When necessary, apply control signal to close inlet seat before performing this test, such as in the case of normally open or inverting type valves.

5.1.2 FULL SUPPLY PRESSURE TEST (NO DELIVERY PRESSURE CONDITION)

Repeat 5.1.1 with 931 kPa ± 34 kPa (135 psi ± 5 psi) air pressure at the supply port(s).

5.1.3 FULL SUPPLY PRESSURE TEST (APPLIED CONDITION)

5.1.3.1 With 931 kPa ± 34 kPa (135 psi ± 5 psi) air pressure at the supply port and all unused ports plugged, actuate the valve to an ascending delivery pressure of 103 kPa ± 34 kPa (15 psi ± 5 psi). Measure and record leakage.

5.1.3.2 Repeat 5.1.3.1 with an ascending delivery pressure of 414 kPa ± 34 kPa (60 psi ± 5 psi). Measure and record leakage.

5.1.3.3 Repeat 5.1.3.1 with the maximum attainable delivery pressure.

5.2 Pilot Operated and Mechanically Actuated Non-Modulating Type

5.2.1 LOW SUPPLY PRESSURE TEST (NO DELIVERY PRESSURE CONDITION)

With the valve in the no delivery pressure position, the delivery port(s) open to atmosphere, and 103 kPa ± 34 kPa (15 psi ± 5 psi) air pressure at the supply port(s), measure and record leakage.

NOTE—When necessary, apply control signal to close inlet seat before performing this test such as in the case of normally open or inverting type valves.

5.2.2 FULL SUPPLY PRESSURE TEST (NO DELIVERY PRESSURE CONDITION)

Repeat 5.2.1 with 931 kPa ± 34 kPa (135 psi ± 5 psi) air pressure at the supply port(s).

5.2.3 FULL SUPPLY PRESSURE TEST (APPLIED CONDITION)

With 931 kPa ± 34 kPa (135 psi ± 5 psi) air pressure at the supply port(s) and all unused ports plugged, actuate the valve so that air pressure occurs at the delivery port. Measure and record leakage.

5.3 Through Valves

NOTE—Valves with two independent inlet ports shall be tested with one inlet port pressurized and the second open to atmospheric pressure. These valves must then be retested with the second inlet port pressurized and the first port open to atmospheric pressure.

5.3.1 LOW PRESSURE TEST

With all applicable ports plugged and 103 kPa ± 34 kPa (15 psi ± 5 psi) air pressure at the inlet port, measure and record leakage.

5.3.2 INTERMEDIATE PRESSURE TEST

Repeat 5.3.1 with 414 kPa ± 34 kPa (60 psi ± 5 psi) air pressure at the inlet port.

5.3.3 FULL PRESSURE TEST

Repeat 5.3.2 with 931kPa ± 34 kPa (135 psi ± 5 psi) air pressure at the inlet port.

5.3.4 (THIS TEST ONLY APPLIES TO ONE WAY CHECK VALVES.) REPEAT 5.3.1, 5.3.2 AND 5.3.3 EXCEPT WITH THE OUTLET PORT PRESSURIZED AND THE INLET PORT VENTED.

5.4 Automatic Pressure Actuating Valves (Valves That React to Supply Pressure)

5.4.1 Apply an air pressure level to the valve supply port which is 103 kPa ± 34 kPa (15 psi ± 5 psi) (ascending and descending) prior to the automatic actuation point. Measure and record leakage.

5.4.2 Apply 931 kPa ± 34 kPa (135 psi ± 5 psi) air pressure at the supply port. Measure and record leakage.

6. Structural Integrity

6.1 Over Pressurization

6.1.1 PILOT OPERATED AND MECHANICALLY ACTUATED VALVES

6.1.1.1 Released Condition

With the valve in the released position and the delivery port(s) open to atmosphere (delivery port(s) plugged on normally open or inverting type valves), apply and maintain 1138 kPa ± 34 kPa (165 psi ± 5 psi) air pressure for 10 s at the supply port.

6.1.1.2 Fully Applied Condition

With the valve in the fully applied position and all unused ports plugged (delivery port(s) open to atmosphere on normally open or inverting type valves), apply and maintain 1138 kPa ± 34 kPa (165 psi ± 5 psi) air pressure for 10 s at the supply port and control port (if applicable).

6.1.1.3 Test the valve per Sections 4 and 5.

6.1.2 THROUGH VALVES

NOTE—Valves with two independent inlet ports shall be tested with one inlet port pressurized and the second open to atmospheric pressure. These valves must then be retested with the second inlet port pressurized and the first port open to atmospheric pressure.

6.1.2.1 With all applicable ports plugged, apply and maintain 1138 kPa ± 34 kPa (165 psi ± 5 psi) air pressure for 10 s at the inlet port. Test the valve per Sections 4 and 5.

6.1.2.2 (This test only applies to one way check valves.) Apply and maintain 1138 kPa ± 34 kPa (165 psi ± 5 psi) air pressure for 10 s at the outlet port with the inlet port vented. Test the valve per Sections 4 and 5.

6.1.3 AUTOMATIC PRESSURE ACTUATING VALVES

6.1.3.1 With all applicable ports plugged, apply and maintain 1138 kPa ± 34 kPa (165 psi ± 5 psi) air pressure for 10 s at the supply port. Test the valve per Sections 4 and 5.

6.2 Maximum Pressure Test

NOTE—This test is potentially dangerous and precaution should be taken to avoid operator injury in case of valve failure due to the high internal pressure.

6.2.1 PILOT OPERATED AND MECHANICALLY ACTUATED VALVES

6.2.1.1 Released Condition

With the valve in the released position and the delivery port(s) open to atmosphere (delivery ports plugged on normally open or inverting type valves), increase hydrostatic pressure at the supply port at a uniform rate not exceeding 6890 kPa (1000 psi) per minute to the maximum attainable pressure not to exceed 2070 kPa (300 psi). Maintain pressure for 10 s and visually inspect valve. Record leakage location or damage to the valve.

6.2.1.2 Fully Applied Condition

With the valve in the fully applied position and all unused ports plugged (delivery ports open to atmosphere on normally open or inverting type valves), increase hydrostatic pressure at the supply port and control port (if applicable) at a uniform rate not exceeding 6890 kPa (1000 psi) per minute to the maximum attainable pressure not to exceed 2070 kPa (300 psi). Maintain pressure for 10 s and visually inspect valve. Record leakage location or damage to the valve.

6.2.2 THROUGH VALVES

NOTE—Valves with two independent inlet ports shall be tested with one inlet port pressurized and the second open to atmospheric pressure. These valves must then be retested with the second inlet port pressurized and the first open to atmospheric pressure.

6.2.2.1 With all applicable ports plugged, increase hydrostatic pressure at the inlet port at a uniform rate not exceeding 6890 kPa (1000 psi) per minute to the maximum attainable pressure not to exceed 2070 kPa (300 psi). Maintain pressure for 10 s and visually inspect valve. Record leakage location or damage to the valve.

6.2.2.2 (This test only applies to one way check valves.) Increase hydrostatic pressure at the outlet port at a uniform rate not exceeding 6890 kPa (1000 psi) per minute to the maximum attainable pressure not to exceed 2070 kPa (300 psi) with the inlet port vented. Record leakage location or damage to the valve

6.2.3 AUTOMATIC PRESSURE ACTUATING VALVES

With all applicable ports plugged, increase hydrostatic pressure at the supply port at a uniform rate not exceeding 6890 kPa (1000 psi) per minute to the maximum attainable pressure not to exceed 2070 kPa (300 psi). Maintain pressure for 10 s and visually inspect valve. Record leakage location or damage to the valve.

6.3 Mounting

The procedure for this test shall be determined by the intended design and function as agreed upon by the valve manufacturer and the purchaser.

7. Low Temperature Evaluation

7.1 Low Temperature Leakage

Subject the valve to a temperature of -40 °C ± 1 °C (-40 °F ± 2 °F) for 24 h ± 4 h with 0 kPa (0 psi) pressure applied. Maintain the surrounding atmosphere temperature and supply air at –40 °C ± 1 °C (–40 °F ± 2 °F) and conduct leakage test per Section 5.

7.2 Low Temperature Function

The procedure for this test shall be determined by the intended design and function as agreed upon by valve manufacturer and purchaser.

7.3 Room Temperature Test

Allow the valve to return to room temperature and test per Sections 4 and 5.

8. Elevated Temperature Evaluation

8.1 Elevated Temperature Leakage

Subject the valve to a temperature of 105 °C ± 3 °C (221 °F ± 5 °F) for 24 h ± 4 h with 0 kPa (0 psi) pressure applied. Maintain the surrounding temperature and supply air at 105 °C ± 3 °C (221 °F ± 5 °F) and conduct leakage test per Section 5.

8.2 Elevated Temperature Function

The procedure for this test shall be determined by the intended design and function as agreed upon by the valve manufacturer and purchaser.

8.3 Elevated Temperature Endurance

8.3.1 Elevated Temperature Endurance

Higher temperatures may be appropriate for some applications, depending on the location of the valve.

Modulating Valve—With the surrounding temperature and supply air maintained at 93 °C ± 8.5 °C (200 °F ± 15 °F) and a pressure of 931 kPa ± 34 kPa (135 psi ± 5 psi) at the supply port(s), cycle the valve from 0 kPa (0 psi) to 552 kPa ± 23 kPa (80 psi ± 3 psi).

8.3.2 Elevated Temperature Endurance—Non-Modulating Valve

With the surrounding temperature and supply air maintained at 93 °C ± 8.5 °C (200 °F ± 15 °F) and a pressure of 931 kPa ± 34 kPa (135 psi ± 5 psi) at the supply port(s), cycle the valve from 0 kPa (0 psi) to full delivery pressure.

8.3.3 ELEVATED TEMPERATURE ENDURANCE—ANTILOCK (ABS) MODULATOR VALVE

With the surrounding temperature and supply air maintained at 93 °C ± 8.5 °C (200 °F ± 15 °F), an air pressure of 931 kPa ± 34 kPa (135 psi ± 5 psi) at the supply port(s) and the solenoids operated at nominal rated voltage ±0.5 V, cycle the valve assembly by performing tests from the table in 10. 4 in the following sequence: Test #1, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 4, 5, 4, 5, 4, 5. The total testing of this sequence is defined as one major cycle.

NOTE—This test is for modulators with two solenoids or equivalent function, i.e., one (1) normally open and one (1) normally closed. Other designs will require testing as agreed upon by the valve manufacturer and purchaser.

8.4 Room Temperature Test

Allow the test valve to return to room temperature and test per Sections 4 and 5.

9. Corrosion Resistance Evaluation

Place the valve in a salt spray chamber per ASTM B 117 (latest revision). Plug all ports that are normally connected to air lines. Ports or openings designed to be open to atmosphere should remain exposed. Upon completion of 240 hours, test per Sections 6.2.

10. Endurance Testing

10.1 Prior to Endurance Testing, soak the valve at 105°C ± 1°C (221 ± 2°F) for 60 ± 5 minutes with all ports open to atmosphere. Allow the part to return to room temperature.

10.2 Endurance—Modulating Valve

With an air pressure of 931 kPa ± 34 kPa (135 psi ± 5 psi) at the supply ports, if applicable, cycle the valve per the following schedule in Table 1:

TABLE 1—PRESSURE SCHEDULE

Delivery Pressure kPa	psi	% of Total Cycles
138	20	25
276	40	25
414	60	25
Full		25

10.3 Endurance—Non-Modulating Valves

With an air pressure of 931 kPa ± 34 kPa (135 psi ± 5 psi) at the supply port(s), cycle the valve to full delivery pressure.

10.4 Endurance—Antilock (ABS) Modulator Valves

With an air pressure of 931 kPa ± 34 kPa (135 psi ± 5 psi) at the supply port, if applicable, and the solenoids operated at nominal rated voltage ± 0.5 volts, cycle the valve assembly by performing tests from the table below in the following sequence: Test #1, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 2, 3, 4, 5, 4, 5, 4, 5. The total testing of this sequence is defined as one major cycle.