

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 Characteristics
- b. Leakage Measurement
- 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 862 kPa (125 psi) nominal air brake systems. These tests are based upon long standing 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 D 117—Guide to Test Methods and Specifications for Electrical Insulating Oils of Petroleum Origin

3. General Notes

3.1 **Temperature**—Unless otherwise specified all testing shall be conducted at a temperature of 5.5 to 32 °C (60 to 90 °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.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

TO PLACE A DOCUMENT ORDER; (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS <http://www.sae.org>

- 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 Characteristics**—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 Measurement**
- 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 \pm 34 kPa (15 psi \pm 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 827 kPa \pm 34 kPa (120 psi \pm 5 psi) air pressure at the supply port(s).
- 5.1.3 **FULL SUPPLY PRESSURE TEST (APPLIED CONDITION)**
- 5.1.3.1 With 827 kPa \pm 34 kPa (120 psi \pm 5 psi) air pressure at the supply port and all unused ports plugged, actuate the valve to an ascending delivery pressure of 103 kPa \pm 34 kPa (15 psi \pm 5 psi). Measure and record leakage.
- 5.1.3.2 Repeat 5.1.3.1 with an ascending delivery pressure of 414 kPa \pm 34 kPa (60 psi \pm 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 \pm 34 kPa (15 psi \pm 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 827 kPa \pm 34 kPa (120 psi \pm 5 psi) air pressure at the supply port(s).

5.2.3 FULL SUPPLY PRESSURE TEST (APPLIED CONDITION)—With 827 kPa \pm 34 kPa (120 psi \pm 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 \pm 34 kPa (15 psi \pm 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 \pm 34 kPa (60 psi \pm 5 psi) air pressure at the inlet port.

5.3.3 FULL PRESSURE TEST—Repeat 5.3.2 with 827 kPa \pm 34 kPa (120 psi \pm 5 psi) air pressure at the inlet port.

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 \pm 34 kPa (15 psi \pm 5 psi) (ascending and descending) prior to the automatic actuation point. Measure and record leakage.

5.4.2 Apply 827 kPa \pm 34 kPa (120 psi \pm 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 \pm 34 kPa (165 psi \pm 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 \pm 34 kPa (165 psi \pm 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 $1138 \text{ kPa} \pm 34 \text{ kPa}$ ($165 \text{ psi} \pm 5 \text{ psi}$) air pressure for 10 s at the inlet port.

6.1.2.2 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.

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.

6.3 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 $-40 \text{ }^\circ\text{C} \pm 1 \text{ }^\circ\text{C}$ ($-40 \text{ }^\circ\text{F} \pm 2 \text{ }^\circ\text{F}$) for $24 \text{ h} \pm 4 \text{ h}$ with 0 kPa (0 psi) pressure applied. Maintain the surrounding atmosphere temperature and supply air at $-40 \text{ }^\circ\text{C} \pm 1 \text{ }^\circ\text{C}$ ($-40 \text{ }^\circ\text{F} \pm 2 \text{ }^\circ\text{F}$) 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 93 °C ± 3 °C (200 °F ± 5 °F) for 24 h ± 4 h with 0 kPa (0 psi) pressure applied. Maintain the surrounding temperature and supply air at 93 °C ± 3 °C (200 °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—Modulating Valve—With the surrounding temperature and supply air maintained at 88 °C ± 8.5 °C (190 °F ± 15 °F) and a pressure of 827 kPa ± 34 kPa (120 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 88 °C ± 8.5 °C (190 °F ± 15 °F) and a pressure of 827 kPa ± 34 kPa (120 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 88 °C ± 8.5 °C (190 °F ± 15 °F), an air pressure of 827 kPa ± 34 kPa (120 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 10.3 in the following sequence: Test #1, 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

9.1 Disassemble valve and place component parts in the salt spray chamber per ASTM B 117 (latest revision). Visually inspect parts and note extent of any corrosion after each 24 h increment of exposure until test is completed.

10. Endurance Testing

10.1 Endurance—Modulating Valve—With an air pressure of 827 kPa ± 34 kPa (120 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		% of Total Cycles
kPa	psi	
138	20	25
276	40	25
414	60	25
Full		25