



<b>SURFACE VEHICLE RECOMMENDED PRACTICE</b>	<b>J1409™</b>	<b>DEC2020</b>
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Superseding J1409 JUL2016		
Air Brake Valves Test Procedure		

## RATIONALE

This technical report has been revised to include the option of performing corrosion testing using the alternate approach detailed in the comprehensive SAE J2721 Recommended Practice.

### 1. SCOPE

This SAE Recommended Practice establishes uniform test procedures for air brake systems pneumatic, electronic, and electrical/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
- h. Vibration testing

#### 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.

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## 2. REFERENCES

### 2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

#### 2.1.1 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610 832-9585, [www.astm.org](http://www.astm.org).

ASTM B117 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 SAE Technical Report.

#### 2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

SAE J1410 Air Brake Valve - Performance Requirements

SAE J1859 Test Procedures for Determining Air Brake Valve Input-Output Characteristics

SAE J2721 Corrosion Test

## 3. DEFINITIONS

### 3.1 SERVICE BRAKE VALVE

Any valve which operates in a normal service brake application and could include, but not limited to, such valves as foot valves, relay valves, quick release valves, front limit valves, and one-way and two-way check valves.

### 3.2 PILOT OPERATED VALVE

A valve which is activated by means of a pressure at one or more control ports.

### 3.3 MECHANICALLY ACTUATED VALVE

A valve which is activated by means of a mechanical input.

### 3.4 ELECTRICALLY ACTUATED VALVE

A valve which is activated by means of an electrical signal to one or more solenoids.

### 3.5 AUTOMATIC PRESSURE ACTUATING VALVE

A valve which is activated automatically when the supply pressure reaches a preset level.

### 3.6 THROUGH TYPE VALVE

A valve in which the delivery pressure is equivalent to the supply pressure, which may be modified by valve characteristics.

### 3.7 MODULATING TYPE VALVE

A valve in which the delivery pressure is proportional to the pilot pressure, mechanical force, or electrical input.

### 3.8 NON-MODULATING TYPE VALVE

A valve in which the delivery pressure is equivalent to the supply pressure when activated by a pilot pressure, mechanical force, or electrical input.

### 3.9 ACTIVE BRAKING VALVE

An electrically actuated modulating or non-modulating type valve with one or more solenoid(s) used to electronically apply brake pressure to be used during an active braking event (i.e., traction control, stability control, collision mitigation, etc.).

### 3.10 ABS MODULATOR VALVE

A through type valve that builds, holds, and exhausts pressure using electric solenoids.

NOTE: One or more of the above valve definitions may be combined in a single valve. Some examples of the various valve type combinations are listed below. Refer to SAE J1859 for additional valve type examples.

Pilot Operated Modulating Type Valve: Relay Valve, Relay Emergency Valve

Mechanically Actuated Modulating Type Valve: Dual Service Foot Brake Valve

Pilot Operated Non-Modulating Type Valve: Inverse Control Valve, Synchronizing Valve

Mechanically Actuated Non-Modulating Type Valve: Push-Pull Valve, Flipper Valve

Automatic Pressure Actuating Valve: Pressure Protection Valve

Through Valve: Two-Way Check Valves, Quick Release Valve

## 4. GENERAL NOTES

### 4.1 Temperature

Unless otherwise specified, all testing shall be conducted at a temperature of 15.5 to 43.3 °C (60 to 110 °F), inclusive.

### 4.2 Mounting

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

### 4.3 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.

### 4.4 Pressure Units

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

### 4.5 Cycle Rate (Endurance Test)

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

#### 4.6 Supply Air

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

#### 4.7 Testing Sequence

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

#### 4.8 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.

#### 4.9 Delivery Volume (Endurance Test)

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

### 5. INPUT-OUTPUT PERFORMANCE

Refer to SAE J1859. The test and acceptance criteria for the input-output characteristics shall be determined by the intended design and functions as agreed upon by the valve manufacturer and purchaser.

### 6. LEAKAGE CHARACTERISTICS

#### 6.1 No Delivery Condition Test

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

##### 6.1.1 Low Supply Pressure Test

NOTE: This test does not apply to through type valves.

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.

##### 6.1.2 Full Supply Pressure Test

Repeat 6.1.1 with 931 kPa  $\pm$  34 kPa (135 psi  $\pm$  5 psi) air pressure at the supply port(s).

##### 6.1.3 Automatic Pressure Actuating Type Valves Only

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.

#### 6.2 Applied Condition Test

For all modulating and non-modulating type valves, apply 931 kPa  $\pm$  34 kPa (135 psi  $\pm$  5 psi) air pressure at the supply port throughout this test. The low and intermediate delivery tests do not apply to the non-modulating or automatic pressure actuating type valves.

##### 6.2.1 Low Delivery Pressure Test

With all delivery ports and any other 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.

##### 6.2.2 Intermediate Delivery Pressure Test

Repeat 6.2.1 with an ascending delivery pressure of 414 kPa  $\pm$  34 kPa (60 psi  $\pm$  5 psi). Measure and record leakage.

### 6.2.3 Full Delivery Pressure Test

Repeat 6.2.1 ascending to full delivery pressure of the valve. For Automatic Pressure Actuated type valves, apply 931 kPa  $\pm$  34 kPa (135 psi  $\pm$  5 psi) air pressure at the inlet port. Measure and record leakage.

## 7. STRUCTURAL INTEGRITY

### 7.1 Over Pressurization

#### 7.1.1 No Delivery Condition Test

NOTE: This test does not apply to through type valves

With 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 seconds at the supply port.

#### 7.1.2 Full Delivery Condition Test

7.1.2.1 With 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 seconds at the supply port and control port (if applicable).

NOTE: Valves with two independent inlet ports, such as two-way check valves, 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

7.1.2.2 For one-way check valves only: apply and maintain 1138 kPa  $\pm$  34 kPa (165 psi  $\pm$  5 psi) air pressure for 10 seconds at the outlet port with the inlet port vented.

7.1.2.3 Test the valve per Sections 5 and 6.

### 7.2 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.

#### 7.2.1 No Delivery Condition Test

NOTE: This test does not apply to through type valves.

With 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 seconds and visually inspect valve. Record leakage location or damage to the valve.

#### 7.2.2 Full Delivery Condition Test

7.2.2.1 With 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 seconds and visually inspect valve. Record leakage location or damage to the valve.

NOTE: Valves with two independent inlet ports, such as two-way check valves, 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.

7.2.2.2 For one-way check valves only: with the inlet port vented, 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). Record leakage location or damage to the valve.

### 7.3 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.

## 8. LOW TEMPERATURE EVALUATION

### 8.1 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 hours  $\pm$  4 hours 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 6.

### 8.2 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.

### 8.3 Room Temperature Test

Allow the valve to return to room temperature and test per Sections 5 and 6.

## 9. ELEVATED TEMPERATURE EVALUATION

### 9.1 Elevated Temperature Leakage

Subject the valve to a temperature of  $105\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$  ( $221\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$ ) for 24 hours  $\pm$  4 hours with 0 kPa (0 psi) pressure applied. Maintain the surrounding temperature and supply air at  $105\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$  ( $221\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$ ) and conduct leakage test per Section 6.

### 9.2 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.

### 9.3 Elevated Temperature Endurance

#### 9.3.1 Endurance Test

Higher temperatures may be appropriate for some applications, depending on the location of the valve. Test for the number of cycles listed as follows:

- a. Service brake system valve: 100000 cycles.
- b. Active braking valve: 10000 cycles (in addition to any other applicable requirement if part of another system).
- c. ABS modulator valve: 5000 major cycles (in addition to any other applicable requirement if part of another system).
- d. All other valves: 20000 cycles.