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SAE J1859 APR89

Test Procedures for Determining Air Brake Valve Input-Output Characteristics

SAE Recommended Practice
Issued April 1989

Submitted for Recognition as an American National Standard

The Engineering Society For Advancing Mobility Land Sea Air and Space ®
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TRUCK AND BUS PRACTICE

SAE J1859

Issued April 6, 1989

Submitted for recognition as an American National Standard

TEST PROCEDURES FOR DETERMINING AIR BRAKE VALVE INPUT-OUTPUT CHARACTERISTICS

1. SCOPE:

This recommended practice establishes uniform test procedures for determining input-output characteristics for those pilot-operated and mechanically-actuated, modulating-type valves and through-type valves used in the service brake control system.

1.1 Input-Output Characteristics:

1.1.1 Crack (opening) pressure or force

1.1.2 Pressure differential (input-output)

1.1.3 Hysteresis (increasing-decreasing pressure)

1.2 Pilot Operated Modulating-Type Valves:

1.2.1 Relay valve

1.2.2 Ratio relay valve

1.2.3 Decaying ratio relay valve

1.2.4 Booster relay valve

1.3 Mechanically-Actuated Modulating-Type Valves:

1.3.1 Dual service brake valve

1.4 Through-Type Valves:

1.4.1 Quick release valve

1.4.2 Tractor protection valve

1.4.3 Limiting valve

2. PURPOSE:

This SAE Recommended Practice is intended as a guide toward standard practice but may be subject to frequent change to keep pace with experience and technical advances, and this should be kept in mind when considering its use. This recommended practice provides a uniform definition of input-output characteristics of pneumatic valves designed to operate in 125 psi (862 kPa) nominal pressure air brake systems and establishes uniform test procedures to determine these characteristics. This recommended practice serves as a supplement to SAE J1409 JUN88, Air Brake Valves Test Procedure.

3. GENERAL NOTES:

3.1 Temperature: Unless otherwise specified, all testing shall be conducted at a temperature of 60-90°F (12-30°C) inclusive.

3.2 Mounting: All testing shall be conducted with the valve mounted essentially as in service. The actual mounting position of each test shall be recorded.

3.3 Pressure Units: All pressure units are expressed as a gage pressure (above atmospheric pressure).

3.4 Supply Air: Unless otherwise specified, the supply air shall be clean and dry.

3.5 Leakage: No bubble leakage is permitted from any connection to the valve or the test apparatus. The valve to be tested must comply to SAE J1410 JUL86, Air Brake Valve--Performance Requirements leakage requirements.

3.6 The line sizes for all test setups should be 1/2 in (13 mm) O.D. tube per SAE J844 OCT88, Nonmetallic Air Brake System Tubing or 3/8 in (9.5 mm) I.D. rubber hose per SAE J1402 JUN85, Automotive Air Brake Hose and Hose Assemblies. The length of the lines as recommended in the respective figures are for standardization.

3.7 Instrumentation:

3.7.1 The instrumentation system accuracy, reference Figs. 1, 2 and 3, is very critical to the results of this recommended practice. Specific instrumentation selection is at the discretion of the test engineer, therefore, the following overall instrumentation system output accuracies are specified. The dynamic response of the recorder used must be capable of those accuracies specified from zero to the maximum reading recorded.

3.7.1.1 The air pressure measurements shall be within ±2.5%.

3.7.1.2 The travel measurements shall be within ±2.5%.

3.7.1.3 The force measurements shall be within ±5.0%.

3.7.2 Air Pressure Instrumentation: Calibration shall be verified and recorded by connecting all the measurement devices to a common plenum and recording all the readings. Calibration is to be done before and after the test is conducted. Records should be kept with the test results.

4. DEFINITIONS:

4.1 Crack Pressure or Force: The increasing input pressure or input force to initiate an output pressure or flow resulting in a transducer reading.

4.2 Pressure Differential: The difference between the increasing input pressure and the increasing output pressure at pressures above the crack pressure.

4.3 Hysteresis: The difference in the input pressure between the increasing and decreasing output curve at a given output pressure.

4.4 Relay Valve: A pneumatically actuated valve used to remotely control the application and release of air pressure.

4.5 Ratio Relay Valve: A relay valve with a fixed ratio of output pressure to input pressure.

4.6 Decaying Ratio Relay Valve: A relay valve with a variable ratio of increased output pressure to the input pressure that decays in time to a one-to-one ratio.

4.7 Booster Relay Valve: A relay valve that initially sends the output pressure to one or more outlet ports faster than to the other ports but balances to equal pressure at all output ports.

4.8 Quick Release Valve: A valve which accelerates the release of air pressure.

4.9 Dual Service Brake Valve: A service brake valve that has a primary (No. 1) system that is mechanically actuated and a secondary (No. 2) system that is pneumatically actuated by the primary system or mechanically actuated in the event of the loss of primary system pressure. Each system has its own input and output circuit.

4.10 Tractor Protection Valve: A pneumatically actuated shutoff valve that controls the application and release of service and supply pressure to the towed vehicle.

4.11 Limiting Valve: A valve that reduces the amount of output pressure by a fixed percentage of the input pressure. This reduction may be for all input pressures or the output pressure may gradually blend back to the full input pressure.

5. CRACK PRESSURE, PRESSURE DIFFERENTIAL, AND HYSTERESIS TEST PROCEDURES:

5.1 Pilot-Operated and Through Valves:

5.1.1 Unless otherwise specified, the general test parameters are:

Supply Pressure: 120 psi ± 5 (827 kPa ± 34)
Supply and Control Reservoir: 1000 in^3 ± 100 (16 400 cm^3 ± 164)
Output Port Volume(s): 50 in^3 ± 5 (820 cm^3 ± 82)
Rate of Control Pressure: 2 psi/s (14 kPa/s) Maximum (increasing and decreasing)

5.1.2 Install the valve in the test setup per Fig. 1 or 2.

5.1.2.1 Unless otherwise specified, use one output volume and one supply volume and plug all the other unusued ports.

5.1.2.2 Cycle the valve three times to the full delivery pressure.

5.1.3 Apply pressure to the control port and record the input and output pressures.

5.1.3.1 Record the input and output pressures continuously or in increments not to exceed 0.2 psi (1.4 kPa) for input pressures up to 20 psi (140 kPa) and 2 psi (14 kPa) for input pressures greater than 20 psi (140 kPa).

5.1.4 When input pressure reaches 120 psi ± 5 (827 kPa ± 34), maintain pressure to the valve for 1 s minimum or until output pressure stabilizes.

5.1.5 Release the pressure to the control port and record input and output pressures until input pressure decreases to 0 psi (0 kPa).

5.1.5.1 Record the input and output pressures continuously or in increments not to exceed 2 psi (14 kPa) for all input pressures.

5.2 Mechanically-Actuated Valves:

5.2.1 Unless otherwise specified, the general test parameters are:

Supply Pressure: 120 psi ± 5 (827 kPa ± 34)
Supply Reservoir: 1000 in^3 ± 100 (16 400 cm^3 ± 164)
Output Port Volume: 50 in^3 ± 5 (820 cm^3 ± 82)
Rate of Control Force: 9 lb/s (40 N/s) ±10% as per 5.2.2.1 (increasing and decreasing)

5.2.2 Install the valve in the test setup per Fig. 3.

5.2.2.1 It is recommended to test the valves without pedals, treadles or mounting plates attached.

5.2.2.2 Cycle the valve three times to full delivery pressure.

5.2.3 Apply the input force to the valve.

5.2.3.1 Record the input force, plunger travel, primary (No. 1) system output pressure, and secondary (No. 2) system output pressure. The pressures are to be recorded continuously or in increments not to exceed 0.2 psi (1.4 kPa) for output pressures less than 20 psi (140 kPa) and 2 psi (14 kPa) for output pressures greater than 20 psi (140 kPa).

5.2.4 When primary (No. 1) system output pressure reaches 120 psi ± 5 (827 kPa ± 34) and maximum specified travel hold input force to the valve for 1 s minimum or until secondary (No. 2) system output pressure stabilizes.

5.2.5 Release input force and record force, plunger travel and output pressures until input force decreases to 0 lb (0 kPa).

5.2.5.1 Follow the same recording sequence in 5.2.3.1.

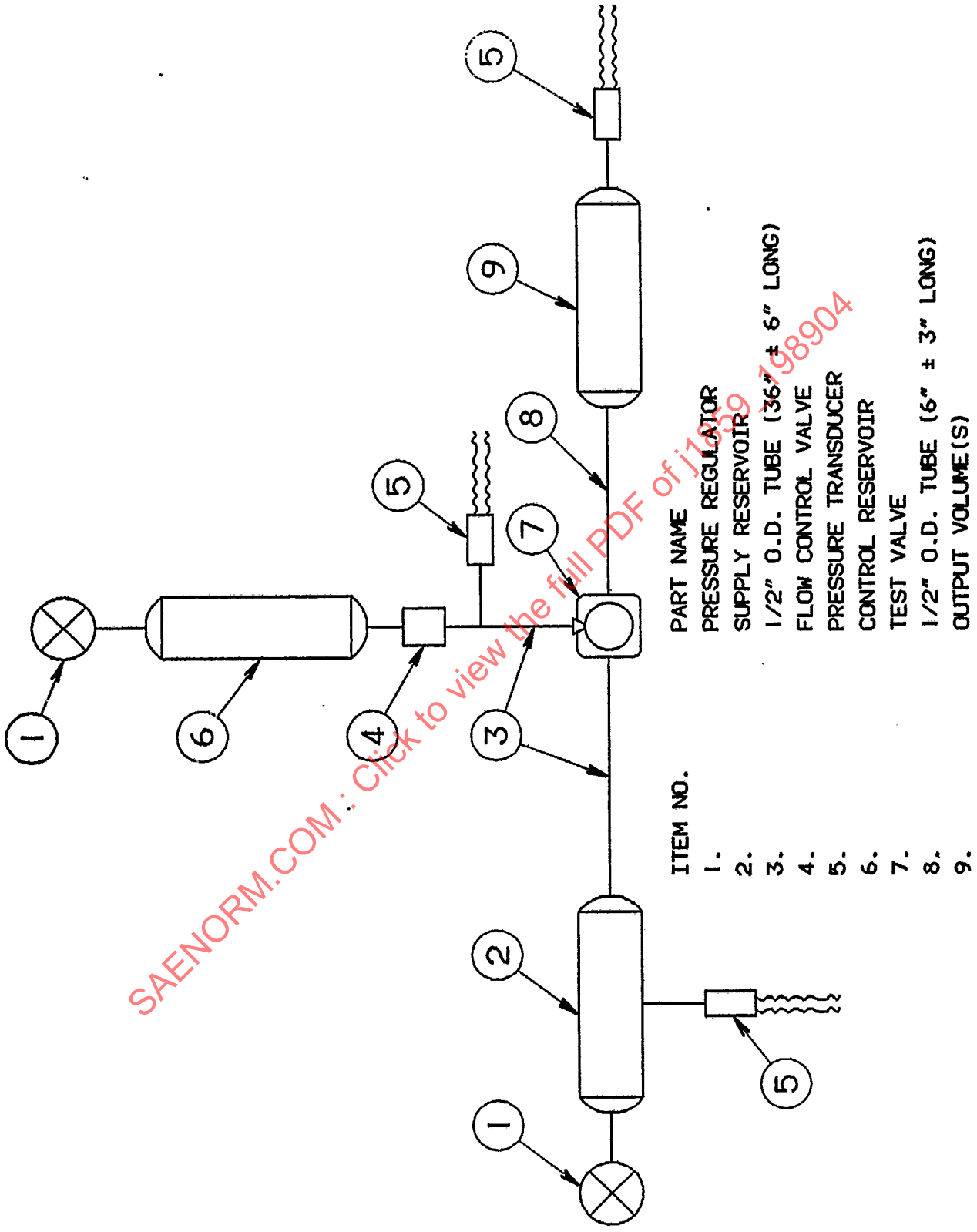
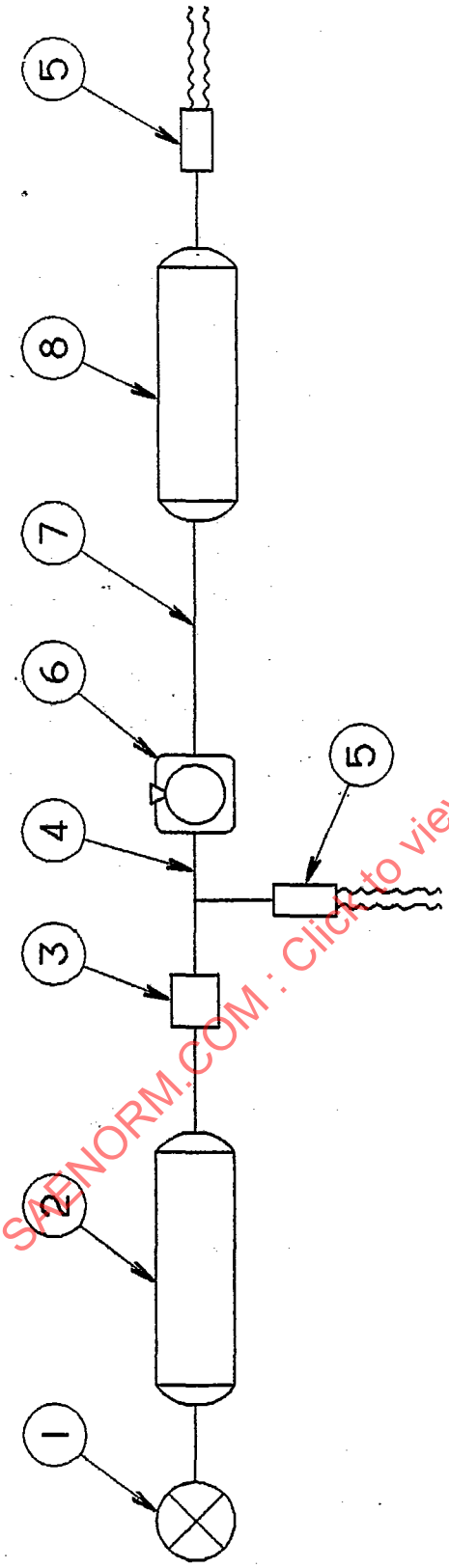


FIGURE 1 - Test Setup for Pilot Operated Modulating Valves



ITEM NO.	PART NAME
1.	PRESSURE REGULATOR
2.	SUPPLY RESERVOIR
3.	FLOW CONTROL VALVE
4.	1/2" O.D. TUBE (36" ± 6" LONG)
5.	PRESSURE TRANSDUCER
6.	TEST VALVE
7.	1/2" O.D. TUBE (6" ± 3" LONG)
8.	OUTPUT VOLUME(S)

FIGURE 2 - Test Setup for Through Valves

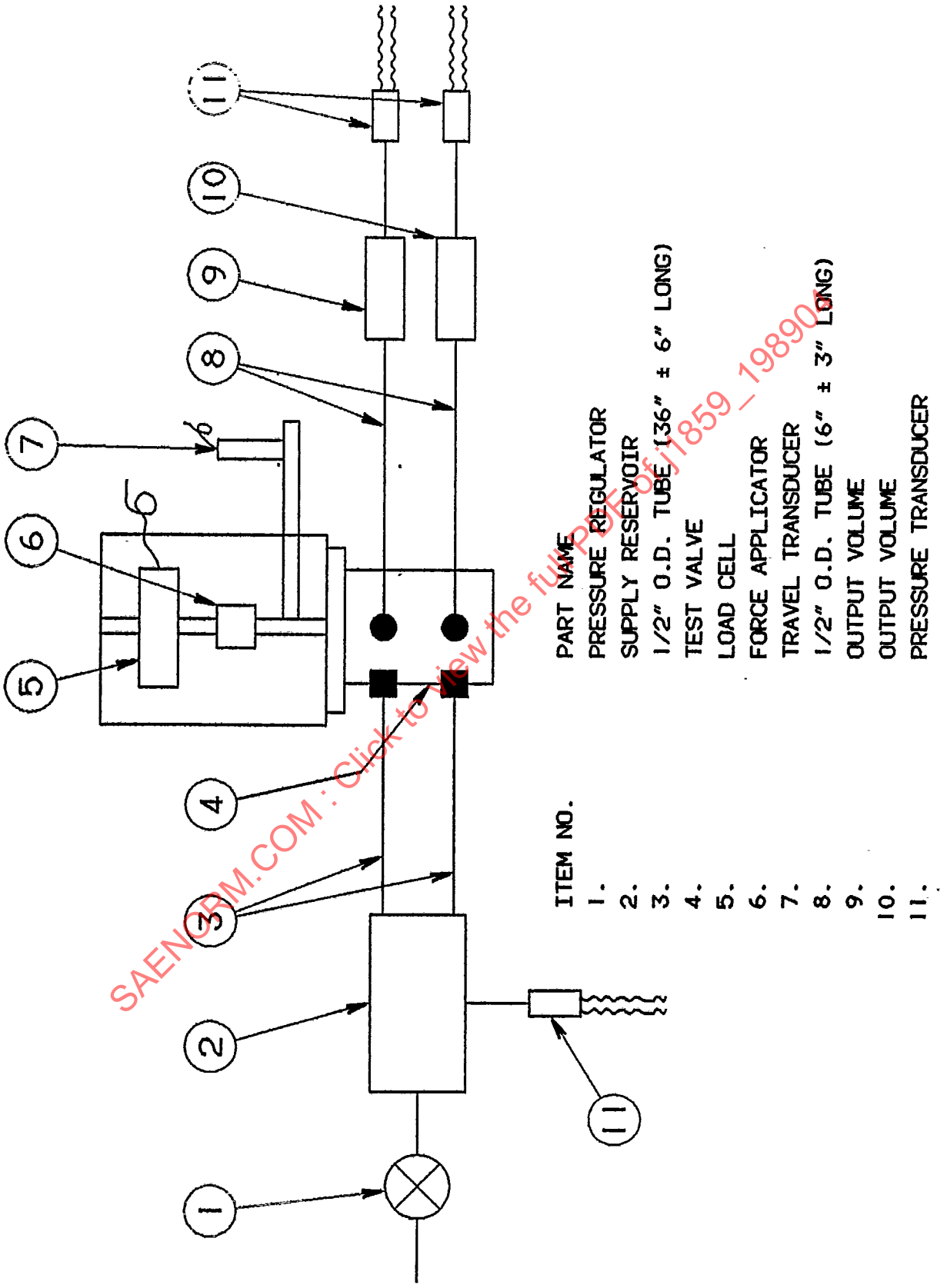


FIGURE 3 - Test Setup for Mechanically Actuated Modulating Valves

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RATIONALE:

Summary:

This SAE Recommended Practice provides a uniform definition of input-output performance characteristics of pneumatic valves designed to operate in 125 psi (862 KPa) nominal air brake systems and establishes uniform test procedures to determine these characteristics. It serves as a supplement to SAE J1409 Air Brake Valves Test Procedure Recommended Practice.

General:

This practice establishes uniform performance characteristics and test procedures with respect to:

1. Crack (Opening) Pressure
2. Pressure Differential (Input/Output)
3. Hysteresis (Increasing/Decreasing Pressure)

Details:

The Task Force has completed an extensive search of existing reference documents and North American supplier and vehicle OEM test procedures on the subject. SAE J1859 is an accumulation of existing state-of-the-art test procedures and definitions used in the determination and definition of input-output performance characteristics of pneumatic valves used in the service brake control system.

Since these are existing and well documented test procedures, the Task Force did minimal testing to verify them. A sample of pilot-operated valves was tested successfully to verify several parameters. Results were not deemed necessary to be included in this rationale and ballot.

Valve capacity or low pressure timing (apply and release) test procedures were not included in this report at this time. Several reasons for not doing this follow:

1. The Task Force wanted to quickly document existing procedures and definitions because of the industry need for this and the Task Force's objective to continue with the labeling (J1860) report. It is estimated that 12 to 18 months would be required to define and validate these new procedures. The Task Force is aware of the previous J1409 Task Force work on a timing test procedure and of several European vehicle OEM valve timing test procedures.

2. There exists within the North American valve suppliers a capacity test procedure with over 30 years of experience. The Task Force voted not to include this procedure at this time because of the unfavorable costs and resources required by the other suppliers to construct and qualify this test.

   This Task Force acknowledges that this capacity test procedure is done with the valve fully open; which is not a typical condition in actual vehicle service.