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SURFACE VEHICLE RECOMMENDED PRACTICE

Submitted for recognition as an American National Standard

SAE J1911

Issued 1990-09

TEST PROCEDURE FOR AIR RESERVOIR CAPACITY - HIGHWAY TYPE VEHICLES

1. SCOPE:

This SAE Recommended Practice provides instructions and test procedures for air braked vehicles including but not limited to trucks, truck-tractors, trailers, dollies, and buses used on highways but does not include off-highway vehicles.

1.1 Purpose:

This document provides a method of determining the air reservoir capacity of highway type vehicles using compressed air to actuate or transmit actuation power to the foundation brakes. Air reservoir capacity is the ability to provide adequate brake pressure after a number of brake applications.

2. REFERENCES:

2.1 Applicable Documents:

SAE J813 Automotive Air Brake Reservoir Volume

Federal Motor Vehicle Safety Standard 121

3. INSTRUMENTATION AND EQUIPMENT:

3.1 Instrumentation:

3.1.1 Timing device accurate to within 1% of elapsed time.

3.1.2 Pressure gauges or electronic pressure measuring systems accurate to within 2% of the pressure readings.

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3.2 Equipment:

3.2.1 Trucks and Buses: None

3.2.2 Truck-Tractors:

3.2.2.1 Dummy coupler capable of sealing the supply (emergency) line.

3.2.2.2 A $50 \text{ in}^3 \pm 5$ ($820 \text{ cc} \pm 8$) reservoir attached to an air line coupler by a pipe having an inside diameter of at least $1/2 \text{ in}$ (1.27 cm) so as that the total volume of the coupler, pipe, and 50 in^3 (820 cc) reservoir is 51 in^3 (836 cc).

3.2.3 Trailers and Dollies:

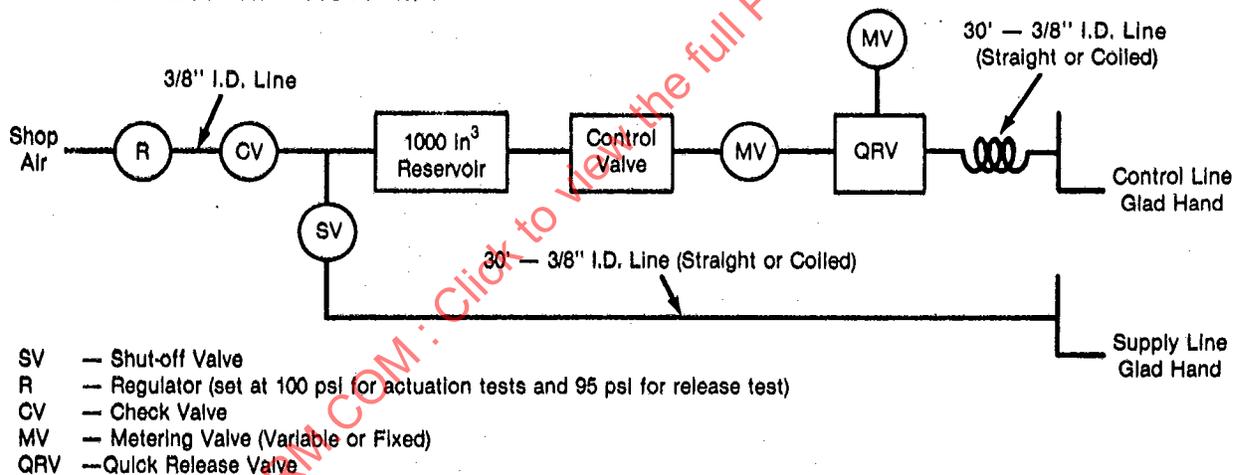
3.2.3.1 Air source regulated to $120 \text{ psi} \pm 5$ ($827 \text{ kPa} \pm 34$) with shut-off valve.3.2.3.2 "Mini-tractor" (the test fixture described in Figure 1 of FMVSS 121) with an additional reservoir volume plumbed directly into the "mini-tractor" reservoir to give a total "mini-tractor" reservoir volume of 1200 in^3 (19.7 L).

FIGURE 1 - Trailer Test Rig

3.2.3.3 Same as 3.2.2 for all dollies and trailers equipped to tow another trailer.

4. VEHICLE CONDITION:

4.1 All air connections shall be secured so that the leakage rate for the entire air system, with all service brakes applied at a pressure of $95 \text{ psi} \pm 5$ ($654 \text{ kPa} \pm 33$), shall not be more than 1 psi (6.9 kPa) per minute. For leakage rate evaluation of towing vehicles, the 50 in^3 (820 cc) reservoir coupler shall be connected to the rear control line coupler and the dummy coupler to the rear supply line coupler. For truck-tractors, the air control knobs in the cab shall be positioned so that the parking brakes are released and air flows to couplers provided for towing trailers. For trailers, the supply line coupler shall be pressurized to $95 \text{ psi} \pm 5$ ($654 \text{ kPa} \pm 33$).

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- 4.2 Brakes shall be burnished to provide good lining to drum (disc) contact.
- 4.3 Brakes (including those with automatic adjusters) are to be adjusted to the vehicle manufacturer's published instructions. Where the instructions differ for new and burnished linings, the adjustment specified for burnished linings shall be followed.
- 4.4 If the vehicle is equipped with any type of load proportioning valve(s), the vehicle axles affected by these valves shall be loaded to their GAWRs or the valve(s) bypassed.
- 4.5 If the vehicle is equipped with any air reservoir(s) to operate systems other than the brake system, such reservoirs shall be isolated. All air operated equipment outside of the brake system shall be in the "off" position.
- 4.6 Record the required vehicle information on the test data sheet (see Figures 2 and 3).
5. TEST PROCEDURE:
 - 5.1 Trucks, Truck-Tractors, and Buses:
 - 5.1.1 Park the vehicle on a level surface and chock the wheels.
 - 5.1.2 On towing vehicles, attach the 50 in³ (820 cc) reservoir coupler to the vehicle's trailer control line coupler and the dummy coupler to the trailer supply line coupler.
 - 5.1.3 Install a pressure gage (transducer) in the 50 in³ (820 cc) reservoir, the reservoir that controls the compressor "cut-in" and "cut-out", and in one service brake actuator of each set of actuators having a common input pressure.
 - 5.1.4 Position the air control knobs in the cab so that the parking brakes are released and air flows to control and supply line couplers provided for towing trailers.
 - 5.1.5 Charge the air system to the vehicle manufacturer's specified minimum "cut-out" pressure. Isolate the air system from the air supply so that the reservoirs are not supplied with air during the test.
 - 5.1.6 Make at least 5 full brake applications to exercise the brake system.
 - 5.1.7 Repeat 5.1.5
 - 5.1.8 Fully apply the service brakes and hold for 5 to 15 s. While holding, record the brake chamber pressure(s) on the data sheet. Fully release the brakes.
 - 5.1.9 Repeat 5.1.8 seven additional times, pausing for 5 to 10 s between each successive application.

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GENERAL INFORMATION

Test No: _____ Test Date: _____
 Test Facility and Location: _____
 Vehicle Year, Make, and Model: _____
 Vehicle Identification Number: _____
 Minimum Governor "Cut-Out" Air Pressure: _____

BRAKE DATA

	Front (Steer) Axle	Front (Drive) Axle	Rear (Drive) Axle
Brake Type:	_____	_____	_____
Brake Size:	_____	_____	_____
Slack Adjuster Length:	_____	_____	_____
Brake Chamber (B.C.) Size:	_____	_____	_____
Left B.C. Stroke @ 85 psi:	_____	_____	_____
Right B.C. Stroke @ 85 psi:	_____	_____	_____

AIR RESERVOIR VOLUME (cubic inch) - as applicable:

Common: _____ System I: _____ System II: _____ Total: _____

CHECK LIST

	Yes	No
Brakes adjusted to manufacturer's specification?	_____	_____
All load proportioning valves (if any) bypassed?	_____	_____
Or, all axles affected by such valves loaded to GAWRs?	_____	_____
All air reservoirs drained prior to test start?	_____	_____
Trailer control line open to 50 in ³ reservoir?	_____	_____
Air flow out of trailer supply line coupler blocked?	_____	_____
All auxiliary air operated equipment off?	_____	_____
Air leakage with applied brakes less than 1 psi/min?	_____	_____

TEST DATA

Brake Appl. Number	Compressor Control Reservoir	50 in ³ Reservoir	Air Pressure (psi)		
			Front (Steer) Axle Brake Chamber	Front (Drive) Axle Brake Chamber	Rear (Drive) Axle Brake Chamber
Initial	_____	_____	_____	_____	_____
1	_____	_____	_____	_____	_____
2	_____	_____	_____	_____	_____
3	_____	_____	_____	_____	_____
4	_____	_____	_____	_____	_____
5	_____	_____	_____	_____	_____
6	_____	_____	_____	_____	_____
7	_____	_____	_____	_____	_____
8	_____	_____	_____	_____	_____

COMMENTS

Prepared By: _____

FIGURE 2 - Air Reservoir Volume Test Data Sheet
 (Trucks, Truck-Tractors, Buses)

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GENERAL INFORMATION

Test No: _____ Test Date: _____
 Test Facility and Location: _____
 Vehicle Year, Make, and Model: _____
 Vehicle Identification Number: _____

BRAKE DATA

	First Axle	Second Axle	Third Axle
Brake Type:	_____	_____	_____
Brake Size:	_____	_____	_____
Slack Adjuster Length:	_____	_____	_____
Brake Chamber (B.C.) Size:	_____	_____	_____
Left B.C. Stroke @ 85 psi:	_____	_____	_____
Right B.C. Stroke @ 85 psi:	_____	_____	_____

AIR RESERVOIR VOLUME (cubic inch) - as applicable:

Service: _____ Parking: _____ Total: _____

CHECK LIST

	Yes	No
Brakes adjusted to manufacturer's specification?	_____	_____
All load proportioning valves (if any) bypassed?	_____	_____
Or, all axles affected by such valves loaded to GAWR?	_____	_____
All air reservoirs drained prior to test start?	_____	_____
Rear control line coupler open to 50 in ³ reservoir?	_____	_____
Air flow out of rear supply line coupler blocked?	_____	_____
All auxiliary air operated equipment off?	_____	_____
Air leakage with applied brakes less than 1 psi/min?	_____	_____

TEST DATA

Brake Appl. Number	Air Pressure (psi)				
	Mini-Tract. Reservoir	50 in ³ Reservoir	First Axle Brake Chamber	Second Axle Brake Chamber	Third Axle Brake Chamber
Initial	_____	_____	_____	_____	_____
1	_____	_____	_____	_____	_____
2	_____	_____	_____	_____	_____
3	_____	_____	_____	_____	_____
4	_____	_____	_____	_____	_____
5	_____	_____	_____	_____	_____
6	_____	_____	_____	_____	_____
7	_____	_____	_____	_____	_____
8	_____	_____	_____	_____	_____

COMMENTS

Prepared By: _____

FIGURE 3 - Air Reservoir Volume Test Data Sheet
 (Trailers and Dollies)

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- 5.1.10 Reapply parking brakes, remove instrumentation and wheel chocks. Reconnect all items disconnected in Section 4.
- 5.2 Trailers and Dollies:
- 5.2.1 Park the vehicle on a level surface and chock the wheels.
- 5.2.2 On towing vehicles, connect the 50 in³ (820 cc) reservoir coupler to the rear control line coupler and the dummy coupler to the rear supply line coupler.
- 5.2.3 Install a pressure gage (transducer) in the 50 in³ (820 cc) reservoir, the "mini-tractor" reservoir, and each set of service brake actuators having a common input pressure.
- 5.2.4 Connect the "mini-tractor" to the vehicle front air couplings.
- 5.2.5 Charge the "mini-tractor" reservoir to a stabilized 120 psi \pm 5 (827 kPa \pm 34). Close the "mini-tractor" on/off valve to isolate the "mini-tractor" from the air source.
- 5.2.6 Make at least five full brake applications, using the "mini-tractor" control valve, to exercise the brake system.
- 5.2.7 Open the on/off valve and charge the "mini-tractor" reservoir to a stabilized 120 psi \pm 5 (827 kPa \pm 34). Close the on/off valve.
- 5.2.8 Fully apply the service brakes and hold for 5 to 15 s. While holding, record the brake chamber pressure(s) on the data sheet. Fully release the brakes.
- 5.2.9 Repeat 5.2.8 seven additional times, pausing for 5 to 10 s between each successive application.
- 5.2.10 Release the pressure in the supply line, disconnect the "mini-tractor" couplers, remove the instrumentation and wheel chocks and reconnect all items disconnected in Section 4.

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RATIONALE:

The former SAE Recommended Practice J813, "Automotive Air Brake Reservoir Volume", which was issued in 1961 and cancelled in 1985, based its recommendation for the amount of air volume to be placed on a vehicle on the combined volume of all the vehicle's brake actuators. The volume of each actuator was specified to be the displacement volume at maximum travel of the actuator piston or diaphragm. The volume to be provided on different types of vehicles was specified in multiples of total actuator volumes. For example, the recommended air reservoir volume for a highway truck or truck-tractor was eight times the total volume of its brake actuators.

J813 was the basis for the Federal reservoir volume requirements contained in Federal Motor Vehicle Safety Standard 121 issued in 1971 by the National Highway Traffic Safety Administration. Standard 121, however, specified greater reservoir volumes for trailers and trucks; for example, the reservoir volumes for trucks and truck-tractors was increased to twelve times the total volume of the actuators.

The problems with the way J813 specified reservoir volume were:

1. J813 required more reservoir volume for vehicles equipped with long stroke brake actuators than vehicles equipped with standard stroke actuators. This was so even though long stroke actuators use the same amount of air for all strokes within the range of standard stroke actuators. Outside this stroke, long stroke actuators use more air but standard actuators no longer produce an acceptable output.
2. J813 required more air volume for brake power arrangements having large actuators and short slack adjusters than those providing the same amount of brake actuating power but used smaller actuators and longer slack adjusters. This was so even though smaller actuator arrangements require roughly the same amount of air when inputting the same torque to the camshaft. Outside the range of slack adjuster rotation for the smaller actuator arrangement, the larger actuator arrangement uses more air but in this range the smaller actuator no longer produces an acceptable output.
3. J813 required the same reservoir volume for vehicles which store air at high pressures as for vehicles which store air at low pressures. This was true even though the high pressure air can provide more brake applications at a given brake application pressure.
4. J813 also did not account for the effect(s) of the air brake system of a towed vehicle(s) on the towing vehicle.

There is a need to establish a method of specifying the amount of reservoir volume needed on a vehicle which is based on vehicle performance and does not penalize more effective brake system arrangements (e.g., long stroke actuators) or discourage the development of new brake systems (e.g., high pressure air systems).

Two new recommended practices are recommended to establish a new procedure. One, J1911, specifies a test and the second will establish recommended levels of performance. The J1911 test procedure specifies a method of testing for reservoir capacity rather than volume. That is, the test procedure specifies testing to determine the amount of brake application pressure that a vehicle can develop after making a number of full brake applications with fully adjusted brakes.

RATIONALE (Continued):

J1911 is based on a European procedure¹ for determining air reservoir capacity and is as compatible with the European procedure as practicable. The European regulation was not accepted in total primarily because the procedure for tractors includes an emergency brake system stopping distance test. Once the SAE has established the new performance oriented recommended practices, it is hoped that those organizations which have standards and practices based on the old cancelled SAE J813 recommended practice will consider the use of these new recommended practices.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

APPLICATION:

This SAE Recommended Practice provides instructions and test procedures for air braked vehicles including but not limited to trucks, truck-tractors, trailers, dollies, and buses used on highways but does not include off-highway vehicles.

REFERENCE SECTION:

SAE J813 Automotive Air Brake Reservoir Volume

Federal Motor Vehicle Safety Standard 121

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¹Section 1, Capacity of Reservoirs, of Annex IV, Energy Reservoirs and Sources of Energy for Compressed Air Brakes, to EEC Directive 71/320.