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SURFACE VEHICLE RECOMMENDED PRACTICE

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ANTILOCK BRAKE SYSTEMS ENERGY CONSUMPTION TEST PROCEDURE FOR AIR-BRAKED-EQUIPPED TRUCK TRACTORS, BUSES, TRAILERS, AND DOLLIES

***Foreword*—**This Document has not changed other than to put it into the new SAE Technical Standards Board Format.

1. ***Scope*—**This SAE Recommended Practice provides instructions and test procedures for measuring air consumption of air braked vehicles equipped with Antilock Brake Systems (ABS) used on highways.

1.1 **Purpose—**This document provides a method to determine the air consumption of highway vehicles when the brake system must maintain performance when the service brake control is applied for long periods of time.

2. ***References***

2.1 **Applicable Publications—**The following publications form a part of this specification to the extent specified herein. Unless otherwise specified, the latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1626—Braking, Stability, and Control Performance Test Procedure

2.1.2 FMVSS PUBLICATION—Available from The Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Federal Motor Vehicle Safety Standard 121

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 J813—Automotive Air Brake Reservoir Volume
SAE J992—Brake System Performance Requirements
SAE J1911—Test Procedure for Air Reservoir Capacity

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3. Instrumentation and Equipment

3.1 Instrumentation

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

3.1.2 Pressure measuring systems accurate to within 5% of the pressure readings.

3.2 Equipment

3.2.1 Dummy coupler for attachment to the emergency line for sealing the supply (emergency) line.

3.2.2 A 820 cc (50 in^3) reservoir attached to the control/service line.

3.2.3 A device to isolate the system from the air compressor, (i.e., electronic solenoid, valve, etc.).

3.2.4 Pressure transducers.

4. Vehicle Condition

4.1 All air connections shall be assembled so that the leakage rate for the entire air system, with all service brakes applied at a pressure of 655 kPa ± 33 kPa (95 psi ± 5 psi), shall not be more than 6.9 kPa (1 psi) per minute. For leakage rate evaluation of towing vehicles, the 820 cc (50 in^3) 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 654 kPa ± 33 kPa (95 psi ± 5 psi).

4.2 Brakes shall be burnished.

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 air reservoir(s) to operate systems other than the brake system, such reservoirs shall be isolated. All air operated accessories other than of the brake system shall be in the "off" position.

4.5 Record the required vehicle information on the test data sheet (see Figure 1 and Figure 2).

5. Test Conditions

5.1 **Test Lanes—**3.7 m (12 ft) wide, 152.4 m (500 ft) straight and level with a PFC = 0.5 or less (wet Jennite in good condition).

5.2 **Vehicle Position—**Centered in lane at the initiation of braking.

5.3 **Steering—**Driver to steer as necessary during braking to maintain vehicle control.

5.4 **Full Apply—**Brake application where the rate of air pressure rise at the foot valve is from 0 to 483 kPa (60 psi) or greater within 0.2 s.

5.5 **Initial Brake Temperature—**As required by FMVSS 121. 65 to 93 °C (150 to 200 °F) in the brake lining of the hottest brake. Install thermocouples per FMVSS 121 (see Figure 3).

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	Forward Drive Axle	Rear Drive Axle
Brake Type:			
Brake Size:			
Lining Code:			
Slack Ajuster Length:			
Brake Chamber Size:			
Left Brake Chamber Stroke @ 586 kPa (85 psi)			
Right Brake Chamber Stroke @ 586 kPa (85 psi)			

Front Axle Limiting: **YES** **NO** Bobtail Proportioning: **YES** **NO**

AIR RESERVOIR VOLUME: (liters) or (cubic inches) - as applicable

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

TIRES:

Front-Steer-Size:_____ Mfgr:_____ Model: _____ Pressure: _____

Rear-Drive-Size: _____ Mfgr:_____ Model: _____ Pressure _____

CONTROL TRAILER INFORMATION:

Wheelbase (kingpin to axle):_____ mm (ft) Empty Weight - Kingpin:_____ N (lb)

Deck Length:_____ mm (ft) Tire Size:_____ Axle:_____ N (lb)

ABS:

System Manufacturer:_____ System Type:_____

Number of Channels: _____ Axle Controlled:_____ Axle Sensed:_____

FIGURE 1—TRUCK/TRACTOR/BUS DATA SHEET

GENERAL INFORMATION: Test No.:_____ Test Date:_____

Test Facility and Location:_____

TRAILER/DOLLY INFORMATION:

	LOADED	EMPTY
Gross Vehicle Weight:	_____ N (lb)	_____ N (lb)

Axle Load: L1 _____ L2 _____ L3 _____ L4 _____ N (lb)

Wheelbase (kingpin to axle): _____ mm (ft)

Vehicle Year, Make, and Model: _____

Vehicle Identification Number: _____

BRAKE DATA:	Front Axle	Middle Axle	Rear Axle
Brake Type:	_____	_____	_____
Brake Size:	_____	_____	_____
Lining Code:	_____	_____	_____
Slack Ajuster Length:	_____	_____	_____
Brake Chamber Size:	_____	_____	_____
Left Brake Chamber Stroke @ 586 kPa (85 psi)	_____	_____	_____
Right Brake Chamber Stroke @ 586 kPa (85 psi)	_____	_____	_____

AIR RESERVOIR VOLUME: (liters) or (cubic inches) - as applicable

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

SUSPENSION: Manufacturer: _____ Type: _____

Spring Deflection (Loaded/Empty): _____ mm (in) Balanced Unbalanced

Bellow Pressure (Loaded/Empty): _____ kPa (psi)

Axle lift? NO YES Axle: 1 2 3 4

TIRES: Size: _____ Mfgr: _____ Model: _____ Pressure: _____

ABS: System Manufacturer:_____ System Type:_____

Number of Channels: _____ Axle Controlled:_____ Axle Sensed:_____

FIGURE 2—TRAILER/DOLLY DATA SHEET

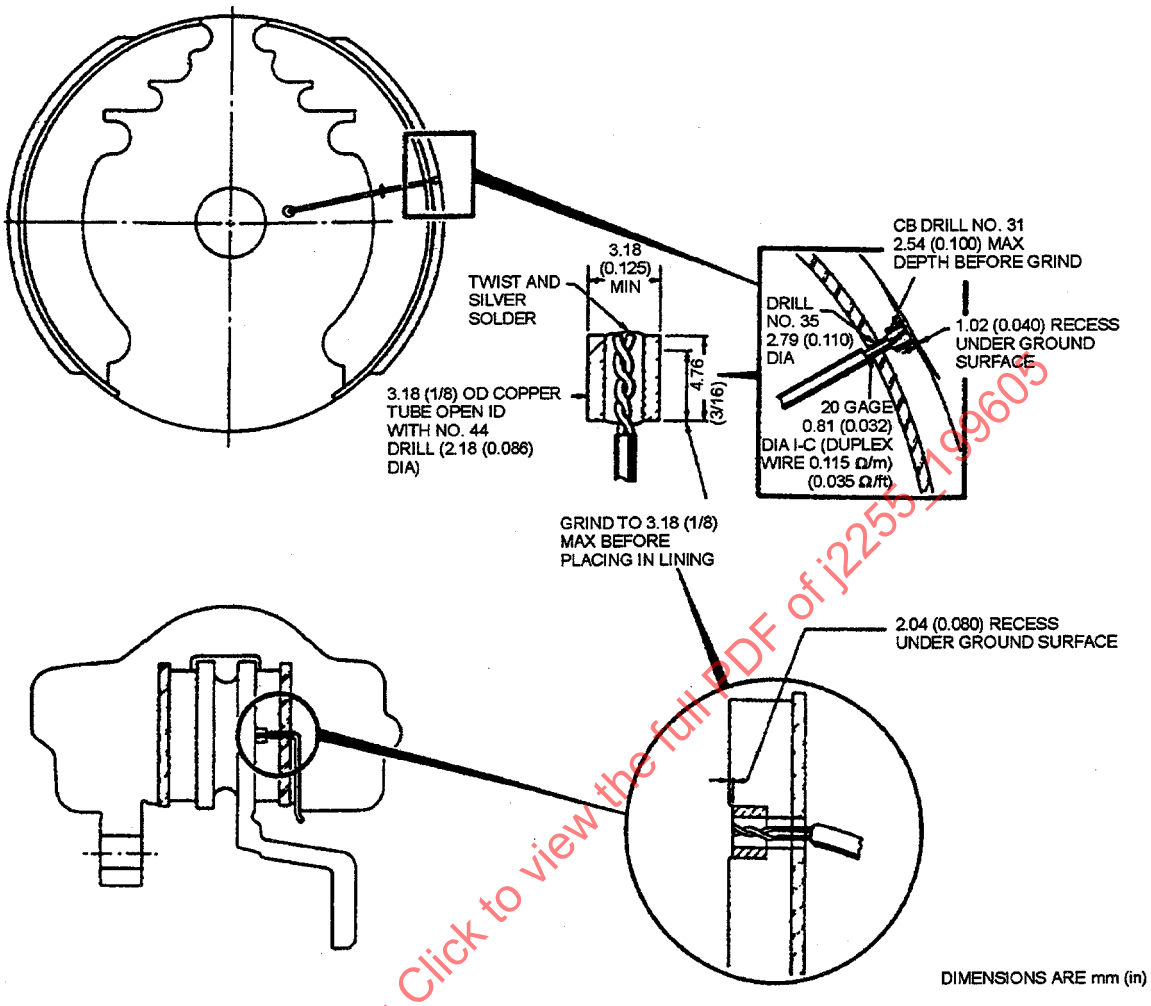

FIGURE 3—TYPICAL PLUG TYPE THERMOCOUPLE INSTALLATION

5.6 Brake Warming—If necessary, warm the brakes by making snubs from 64 to 32 km/h (40 to 20 mph) at 3 m/s (10 ft/s) deceleration at one-mile intervals.

5.7 Transmission—Neutral (or clutch depressed).

5.8 Full Load—Vehicle at GVWR.

5.8.1 TRACTORS—Are loaded with an unbraked control trailer, as defined in SAE J1626.

5.8.2 TRAILERS—Are loaded to GAWR.

5.8.3 DOLLIES—Are loaded to GAWR with an unbraked control trailer, as defined in SAE J1626.

5.9 Surface Friction—Peak friction coefficient (PFC) as identified in SAE J1626.

6. Truck, Truck-Tractors, and Buses

6.1 Install a pressure transducer at the output of the foot valve and in each reservoir system.

6.2 On towing vehicles attach the 820 cc (50 in^3) reservoir to the control line coupler and a dummy coupler to the vehicle supply line.

6.3 Position the air control knobs in the cab so that the parking brakes are released and air flows to the control and supply line couplers provided for the trailer.

6.4 Charge the air system to the vehicle manufacturer's specified minimum "cut-out" pressure and make five "full apply" brake applications to exercise the brake system.

6.5 Charge the air system to the vehicle manufacturer's specified minimum "cut-out" pressure and with the vehicle stationary then isolate the air system from the air supply so that the reservoirs are not resupplied with air.

6.6 With the vehicle stationary make three "full apply" brake applications. Hold each brake application for 5 to 15 s and record reservoir pressure(s) on the data sheet for each brake application. Fully release the brakes after each brake application.

6.7 Repeat 6.5.

6.8 Run one "full apply" brake application from 56 km/h (35 mph) to a complete stop on a surface per 5.1. Record on the data sheet (Figure 4) the reservoir pressure at the completion of the stop while holding the brakes for 5 to 15 s. Pressure measurements may be taken during the stop.

6.9 Repeat 6.5 and 6.8 two more times and record the average pressures from the three complete ABS stops.

7. Trailers

7.1 Attach the trailer to an Antilock Brake System (ABS) equipped towing vehicle and load the trailer as specified in 5.8.2. Both the towed and towing vehicle brakes will be applied during the test.

7.2 Install a device to isolate the trailer air system from the supply output of the tractor protection valve of the towing vehicle.

CHECK LIST:	YES	NO
Brakes adjusted to manufacturer's specification?		
All air reservoirs drained prior to test start?		
Trailer control lines open to 820 cc (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 6.9 kPa/min (1 psi/min)?		

TEST DATA:

	Air Pressure (kPa) or (psi)		
Brake Application Number:	Reservoir One	Reservoir Two	Reservoir Three
Static Application:			
Application 1			
Application 2			
Application 3			
Average Pressure:			
Dynamic Application:			
Initial Cut-Out Pressure:			
Time (optional) / Stop 1	____|____	____|____	____|____
Time (optional) / Stop 2	____|____	____|____	____|____
Time (optional) / Stop 3	____|____	____|____	____|____
Time (optional) / Average Stop	____|____	____|____	____|____

COMMENTS: _____

_____

Ambient Temperature:_____ Prepared By:_____

FIGURE 4—TRUCK/TRACTOR/BUS DATA SHEET

7.3 Install a pressure transducer in the trailer reservoir.

7.4 Trailers equipped to tow another trailer:

7.4.1 Attach the 820 cc (50 in^3) reservoir to the control line coupler and a dummy coupler to the trailer supply line coupler.

7.5 Lower all lift axles.

7.6 Charge the trailer air system to 827 kPa (120 psi) and with the vehicle stationary make five "full apply" brake applications to exercise the brake system.

7.7 Charge the trailer system to 827 kPa (120 psi) and then isolate the air system from the tractor air supply using the isolation device at the tractor protection valve so that the reservoirs are not resupplied with air.

7.8 Make three "full apply" static brake applications. Hold each brake application for 5 to 15 s and record the reservoir pressure(s) on the data sheet for each brake application. Fully release the brakes after each brake application.

7.9 Repeat 7.7.

7.10 Run one "Full Apply" brake application from 56 km/h (35 mph) to a complete stop on a surface as specified in 5.1. Record on the data sheet (Figure 5) the reservoir pressure(s) at completion of the stop while holding the brakes for 5 to 15 s. Pressure measurements may be taken during the stop.

7.11 Repeat 7.7 and 7.10 two more times and record the average pressure from the three complete ABS stops.

8. Dollies

8.1 Attach the dolly to an Antilock Brake System (ABS) equipped tractor and load the dolly as specified in 5.8.3. The towed and towing vehicles brakes will be applied during the test.

8.2 Install a device to isolate the dolly air system from the supply output of the tractor protection valve of the towing vehicle.

8.3 Install a pressure transducer in the dolly reservoir.

8.4 For all dollies attach the 820 cc (50 in^3) reservoir to the control line coupler and a dummy coupler to the supply line coupler.

8.5 Charge the trailer air system to 827 kPa (120 psi) pressure and with the vehicle stationary make five "full apply" brake applications to exercise the brake system.

8.6 Charge the air system to 827 kPa (120 psi) and then isolate the dolly air system from the tractor air supply using the isolation device at the tractor protection valve so that the reservoir is not resupplied with air.

8.7 Make three "full apply" static brake applications. Hold each brake application for 5 to 15 s and record the reservoir pressure(s) on the data sheet. Fully release the brakes after each brake application.