The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE RECOMMENDED PRACTICE

An American National Standard

SAE J1469

REAF. AUG95

Issued 1988-06
Reaffirmed 1995-08

Superseding J1469 JUN88

AIR BRAKE ACTUATOR TEST PROCEDURE, TRUCK-TRACTOR, BUS, AND TRAILERS

***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 procedures and methods for testing service, spring applied parking, and combination brake actuators with respect to durability, function, and environmental performance. A minimum of five test units designated A, B, C, D, and E are to be used to perform all tests per 1.1 and 1.2.

1.1 Test Procedures

Leak rate-parking and service chambers (Section 4)
Chamber volume-parking and service chambers (Section 5)
Maximum release and hold-off pressure-parking chamber (Section 6)
Force output and stroke-parking chamber (Section 7)
Force output and stroke-service chamber (Section 8)
Low temperature leakage-parking and service chambers (Section 9)
Low temperature maximum release and hold-off pressure (Section 10)
Low temperature force output-parking chamber (Section 11)
Low temperature operational test-service chamber (Section 12)
Corrosion resistance-parking and service chamber (Section 13)
Mechanical back-off release mechanism (Section 14)
Proof pressure test-parking and service chambers (Section 15)
Cycle test-parking chamber (Section 16)
Cycle test-service chamber (Section 17)
Elevated temperature cycle test-parking and service chambers (Section 18)
Vibration test (Section 19)

1.2 Test Sequence Chart—The test sequence as charted in the "Test Sequence Chart" shall be mandatory (see Figure 1).

1.3 Purpose—This document provides uniform procedures and methods for laboratory testing of brake actuators used in air brake systems.

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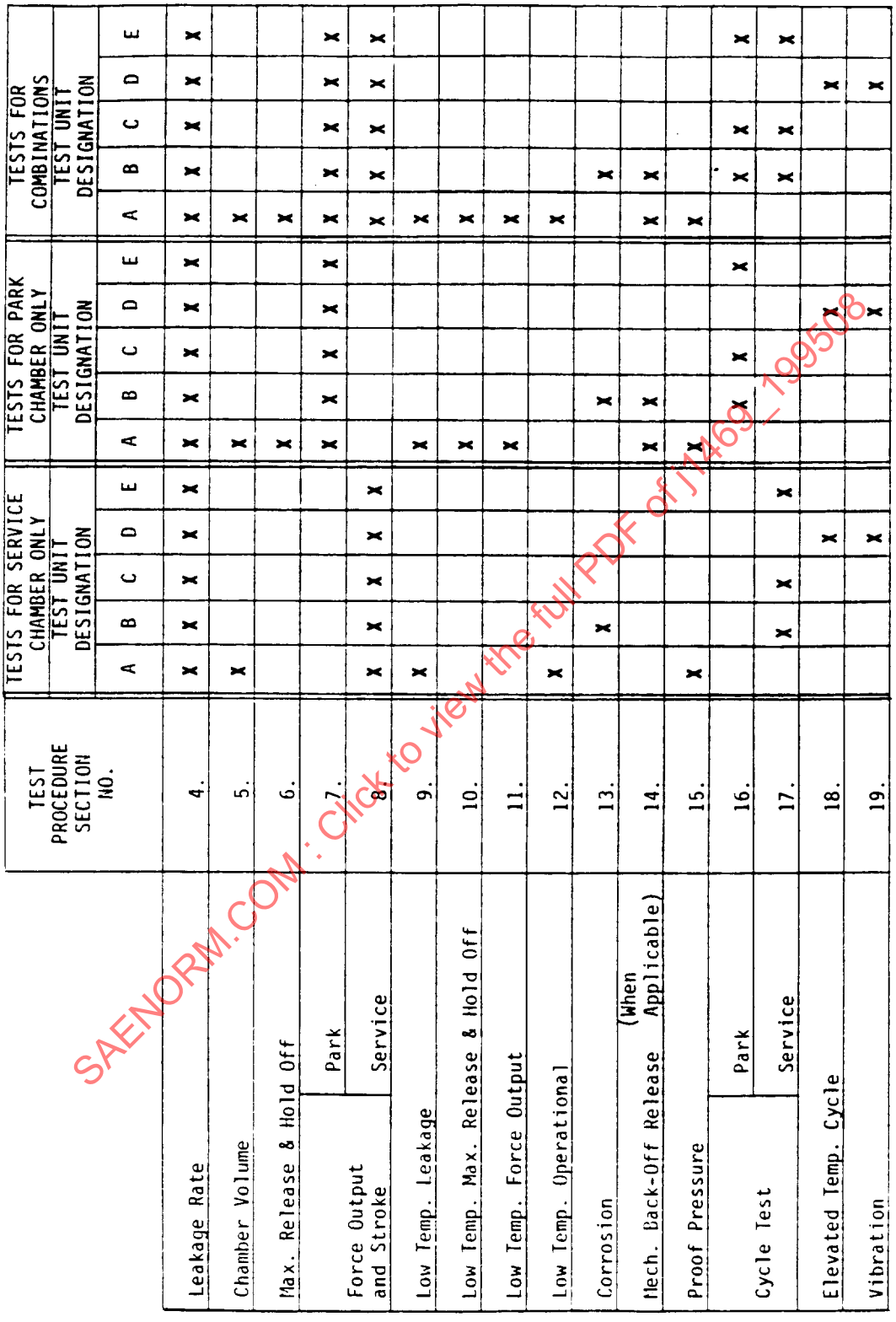

TEST PROCEDURE SECTION NO.		TESTS FOR SERVICE CHAMBER ONLY TEST UNIT DESIGNATION					TESTS FOR PARK CHAMBER ONLY TEST UNIT DESIGNATION					TESTS FOR COMBINATIONS TEST UNIT DESIGNATION				
		A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
Leakage Rate	4.	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Chamber Volume	5.	X					X					X				
Max. Release & Hold Off	6.						X					X				
Force Output and Stroke — Park	7.						X	X	X	X	X	X	X	X	X	X
Force Output and Stroke — Service	8.	X	X	X	X	X						X	X	X	X	X
Low Temp. Leakage	9.	X					X					X				
Low Temp. Max. Release & Hold Off	10.						X					X				
Low Temp. Force Output	11.						X					X				
Low Temp. Operational	12.	X										X				
Corrosion	13.		X					X					X			
Mech. Back-Off Release (When Applicable)	14.						X	X					X	X		
Proof Pressure	15.	X					X					X				
Cycle Test — Park	16.									X	X		X	X		X
Cycle Test — Service	17.			X	X	X							X	X		X
Elevated Temp. Cycle	18.				X					X					X	
Vibration	19.				X					X					X	

Rev. 2 - 16B & 17B deleted 3 places

FIGURE 1—TEST SEQUENCE CHART

2. References

2.1 Applicable Publication—The following publication forms a part of this specification to the extent specified herein.

2.1.1 ASTM PUBLICATION—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 117—Method of Salt Spray (Fog) Testing

3. Definitions

3.1 Hold-Off Pressure—A decrease of parking chamber air pressure for parking brake application (extend power spring).

3.2 Release Pressure—An increase of parking chamber air pressure to release the parking brake (compress power spring).

3.3 Parking Chamber Apply—Extend power spring.

3.4 Parking Chamber Release—Compress power spring.

3.5 Full Stroke—Maximum stroke of a unit.

3.6 Rated Stroke—The minimum design stroke of a unit.

3.7 Service Brake Actuator—Air activated actuator for applying the foundation brake.

3.8 Parking Brake Actuator—Mechanically applied actuator for restraining the vehicle.

3.9 Combination Brake Actuator—Combined service and parking section actuator.

3.10 Zero Stroke—Brake actuator push rod must be in retracted position (foundation brake full-off).

3.11 Fully Caged Power Spring—Power spring restrained in its most compressed position within the brake actuator.

NOTE—This may be accomplished either pneumatically or mechanically per the manufacturer's recommended procedure.

4. Leak Rate-Parking and Service Chambers

4.1 Leakage—Parking chamber.

4.1.1 CONDITIONS

4.1.1.1 27 °C ± 11 °C (80 °F ± 20 °F) ambient temperature.

4.1.1.2 Parking chamber is to be uncaged.

4.1.2 TEST PROCEDURE

4.1.2.1 *Preconditioning Cycle*—Pneumatically actuate the parking chamber from fully applied to fully released and back to fully applied three times using 620 to 830 kPa (90 to 120 lbf/in^2) (gage) air pressure.

4.1.2.2 Pressurize the parking chamber with air to 860 to 900 kPa (25 to 130 lbf/in^2) (gage).

4.1.2.3 Allow the air pressure in the unit to stabilize for 5 min ± 1 min.

4.1.2.4 Establish air pressure at 860 kPa ± 7 kPa (125 lbf/in^2 ± 1 lbf/in^2) (gage).

4.1.2.5 Measure leakage rate with a flow meter.

4.1.2.6 Record leakage rate.

4.1.3 ALTERNATE TEST PROCEDURE

4.1.3.1 *Preconditioning Cycle*—Per 4.1.2.1.

4.1.3.2 Connect the parking chamber to a 20 484 cm^3 ± 820 cm^3 (1250 in^3 ± 50 in^3) air tank.

4.1.3.3 Connect a pressure gage (or equivalent device) to measure pressure change.

4.1.3.4 Pressurize the parking chamber and air tank to 860 to 900 kPa (125 to 130 lbf/in^2) (gage) air pressure.

4.1.3.5 Stabilize the air pressure for 5 min ± 1 min.

4.1.3.6 Establish a pressure of 860 kPa ± 7 kPa (125 lbf/in^2 ± 1 lbf/in^2) (gage) in the parking chamber and air tank and close shut-off valve at the air tank inlet.

4.1.3.7 Record the pressure change after 10 min ± 0.1 min.

4.2 Leakage—Service Chamber

4.2.1 CONDITIONS

4.2.1.1 27 °C ± 11 °C (80 °F ± 20 °F) ambient temperature.

4.2.1.2 Limit the stroke to 75% ± 5% of rated stroke.

4.2.1.3 Maintain the parking chamber at 860 to 900 kPa (125 to 130 lbf/in^2) (gage)—if applicable.

4.2.2 TEST PROCEDURE

4.2.2.1 *Precondition Cycles*—Cycle the service chamber three times pneumatically, by applying 620 to 830 kPa (90 to 120 lbf/in^2) (gage) from full stroke to zero stroke and back to full stroke position.

4.2.2.2 Pressurize the service chamber with 860 to 900 kPa (125 to 130 lbf/in^2) (gage) air pressure.

4.2.2.3 Allow the air pressure in the unit to stabilize for 5 min ± 1 min.

4.2.2.4 Establish a pressure of 860 kPa ± 7 kPa (125 lbf/in^2 ± 1 lbf/in^2) (gage) in the service chamber.

4.2.2.5 Measure leakage rate with a flow meter.

4.2.2.6 Record leakage rate.

4.2.3 ALTERNATE TEST PROCEDURE

4.2.3.1 Apply preconditioning cycle per 4.2.2.1.

4.2.3.2 Connect the service chamber to a 20 485 cm^3 ± 820 cm^3 (1250 in^3 ± 50 in^3) air tank.

4.2.3.3 Connect a pressure gage (or equivalent device) to measure pressure change.

4.2.3.4 Pressurize the service chamber and air tank to 860 to 900 kPa (125 to 130 lbf/in^2) (gage).

4.2.3.5 Stabilize the air pressure in the service chamber and air tank for 5 min ± 1 min.

4.2.3.6 Establish a pressure of 860 kPa ± 7 kPa (125 lbf/in^2 ± 1 lbf/in^2) (gage) in the service chamber and air tank and close shut-off valve at the air tank inlet.

4.2.3.7 Record the pressure change after 10 min ± 0.1 min.

5. Chamber Volume—Parking and Service Chamber

5.1 Parking Chamber

5.1.1 CONDITIONS—27 °C ± 11 °C (80 °F ± 20 °F) ambient temperature.

5.1.2 TEST PROCEDURE

5.1.2.1 Fully cage the power spring in the parking chamber pneumatically.

5.1.2.2 Record the distance from a reference point on the actuator pushrod to a fixed part of the actuator to obtain the zero stroke position.

5.1.2.3 Release the power spring and allow the pushrod to return to its full stroke position or use a stroke limiting device to restrain the pushrod to the required test stroke.

5.1.2.4 Connect the parking chamber air port to the test apparatus as shown in Figure 2 with the inlet port in the highest position. The fluid reservoir shall be of sufficient capacity to insure an adequate amount of fluid for all bleeding and measurement of chamber volume.

5.1.2.5 Close the drain valve, open the inlet valve, and pressurize the fluid reservoir with 690 to 860 kPa (100 lbf/in^2 ± 125 lbf/in^2) (gage). After the actuator rod has moved to its zero stroke position, close the inlet valve, open the drain valve, and return the chamber to its test stroke position. Repeat this procedure several times to insure adequate bleeding.

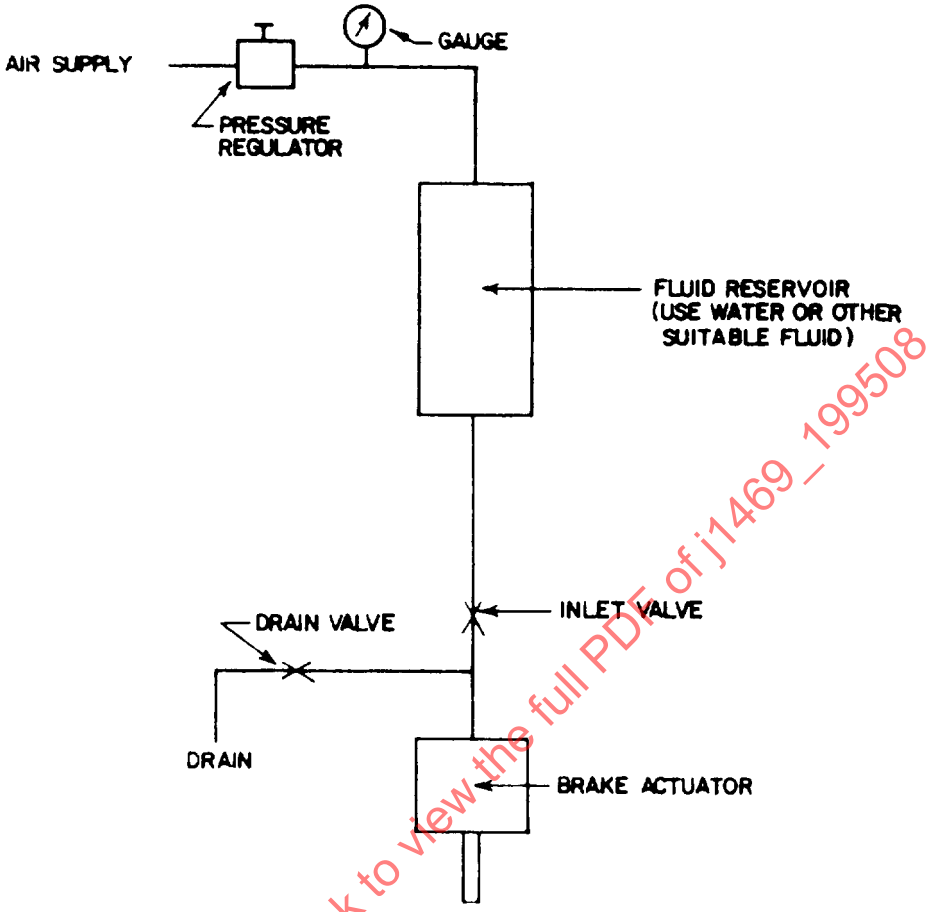

FIGURE 2—CONNECTION

5.1.2.6 Close the drain valve, open the inlet valve, and pressurize the fluid reservoir to 690 kPa ± 35 kPa (100 lbf/in^2 ± 5 lbf/in^2) (gage). Allow the actuator rod to move to the zero stroke position. After 30 s, close the inlet valve, open the drain valve, and measure the amount of fluid expelled when the actuator pushrod returns to its test position (rated, full, or other specified stroke). Record the distance from the reference point on the actuator pushrod to the fixed point of the actuator used in 5.1.2.2. The recorded distance measured minus the recorded distance measured in 5.1.2.2 for zero stroke position is the actuator test stroke.

5.1.2.7 Close the drain valve and carefully disconnect the actuator from the test apparatus holding the parking chamber inlet up. Drain and measure the fluid remaining in the actuator.

NOTE—Care must be taken that any fluid expelled from the test apparatus circuit is not included in the measurement of chamber test volume.

5.1.2.8 The volume of the parking chamber for the given test stroke shall consist of the sum of the volumes measured in 5.1.2.6 and 5.1.2.7.

5.2 Service Chamber

5.2.1 CONDITIONS—27 °C ± 11 °C (80 °F ± 20 °F) ambient temperature.

5.2.2 TEST PROCEDURE

5.2.2.1 Cage the power spring per 5.1.2.1 (if applicable). The power spring shall remain caged for this entire procedure.

5.2.2.2 Obtain zero stroke position per 5.1.2.2.

5.2.2.3 Use a stroke limiting device to restrain the pushrod to the required test stroke.

5.2.2.4 Connect the service chamber air port to the test apparatus as shown in Figure 2 with the inlet port in the highest position.

5.2.2.5 Close the drain valve, open the inlet valve, and pressurize the fluid reservoir with 690 to 860 kPa (100 to 125 lbf/in^2) (gage). After the actuator pushrod has moved to the required test stroke position, close the inlet valve, open the drain valve, and return the chamber to its zero stroke position. Repeat this procedure several times to insure adequate bleeding.

5.2.2.6 Close the drain valve, open the inlet valve, and pressurize the fluid reservoir to 690 kPa ± 35 kPa (100 lbf/in^2 ± 5 lbf/in^2) (gage). Allow the actuator pushrod to move to its test stroke position (rated, full, or other specified stroke). When at this test stroke position, measure the distance from the reference point on the actuator pushrod to the fixed point of the actuator used in 5.1.2.2. This recorded distance measured minus the recorded distance measured in 5.1.2.2 for zero stroke position is the service chamber test stroke. After 30 s of the pushrod in its test stroke position, close the inlet valve, open the drain valve, and measure the amount of fluid expelled when the actuator pushrod returns to its zero stroke position.

5.2.2.7 Measure residue chamber fluid per 5.1.2.7.

NOTE—Care must be taken that any fluid expelled from the test apparatus circuit is not included in the measurement of chamber test volume.

5.2.2.8 The volume of the service chamber for the given test stroke shall consist of the sum of the volumes measured in 5.2.2.6 and 5.2.2.7.

6. Maximum Release and Hold-Off Pressure—Parking Chamber

6.1 Conditions—27 °C ±11 °C (80 °F ± 20 °F) ambient temperature.

6.2 Test Procedure

6.2.1 POWER SPRING PRESET—PARKING BRAKE

6.2.1.1 Fully cage the power spring in the parking chamber either pneumatically or mechanically as specified by the manufacturer.

6.2.1.2 Maintain the power spring in the caged position for 24 h minimum.

6.2.1.3 Release the power spring to a full stroke position after the required preset period.

6.2.2 PRECONDITIONING CYCLES—Apply preconditioning cycles per 4.1.2.1.

6.2.3 On the third cycle, measure and record stroke versus air pressure in the apply and release direction for the full stroke of the brake actuator. It is recommended measurements be taken in 6.4 mm (0.25 in) increments or as otherwise specified.

7. Force Output and Stroke—Parking Chamber

7.1 Conditions—27 °C ± 11 °C (80 °F ± 20 °F) ambient temperature.

7.2 Test Procedure

7.2.1 MOUNT UNIT TO TEST FIXTURE—Mount the test actuator to a holding fixture using mounting hardware specified by the manufacturer and tightened to the manufacturer's recommended torque. The holding fixture shall be constructed with sufficient strength and rigidity to minimize fixture deflection under loading (Figure 3).

7.2.2 Cycle the parking chamber three times pneumatically from full stroke to zero stroke and back to full stroke using 620 to 830 kPa (90 to 120 lbf/in^2) (gage).

7.2.3 Install the test unit and holding fixture in a suitable force versus stroke measuring equipment.

NOTE—The test fixturing must provide guiding of the test units pushrod which will assure a pushrod angularity with the mounting surface of the chamber of 90 degrees ± 1 degree during force output testing.

7.2.4 Apply 690 to 830 kPa (100 to 120 lbf/in^2) (gage) air pressure to the parking chamber to fully compress the power spring (if applicable).

7.2.5 If an X-Y recorder is used to measure force versus stroke, "zero" the force output on the X-Y recorder at this point in the procedure.

7.2.6 Apply a 35 to 45 N (8 to 10 lb) preload to the end of the test unit's pushrod.

7.2.7 If an X-Y recorder is used, "zero" the linear displacement (pushrod travel) on the X-Y recorder after the 35 to 45 N (8 to 10 lb) preload has been applied.

7.2.8 Gradually release all air pressure from the parking chamber and record the parking chamber force versus stroke from zero to full stroke in the brake application direction (stroke extend) in 0 to 6.4 mm (0 to 0.25 in) increments. If an X-Y recorder is used, plot a force versus stroke curve. Force outputs shall be measured at the end of the service chamber pushrod when activated by the parking chamber from zero to full stroke.

8. Force Output and Stroke—Service Chamber

8.1 Conditions—27 °C ± 11 °C (80 °F ± 20 °F) ambient temperature.

8.2 Test Procedure

8.2.1 MOUNT UNIT TO TEST FIXTURE—Same as procedure specified in 7.2.1.

8.2.2 Cycle the service chamber three times pneumatically from full stroke to zero stroke and back to full stroke using 620 to 830 kPa (90 to 120 lbf/in^2) (gage).

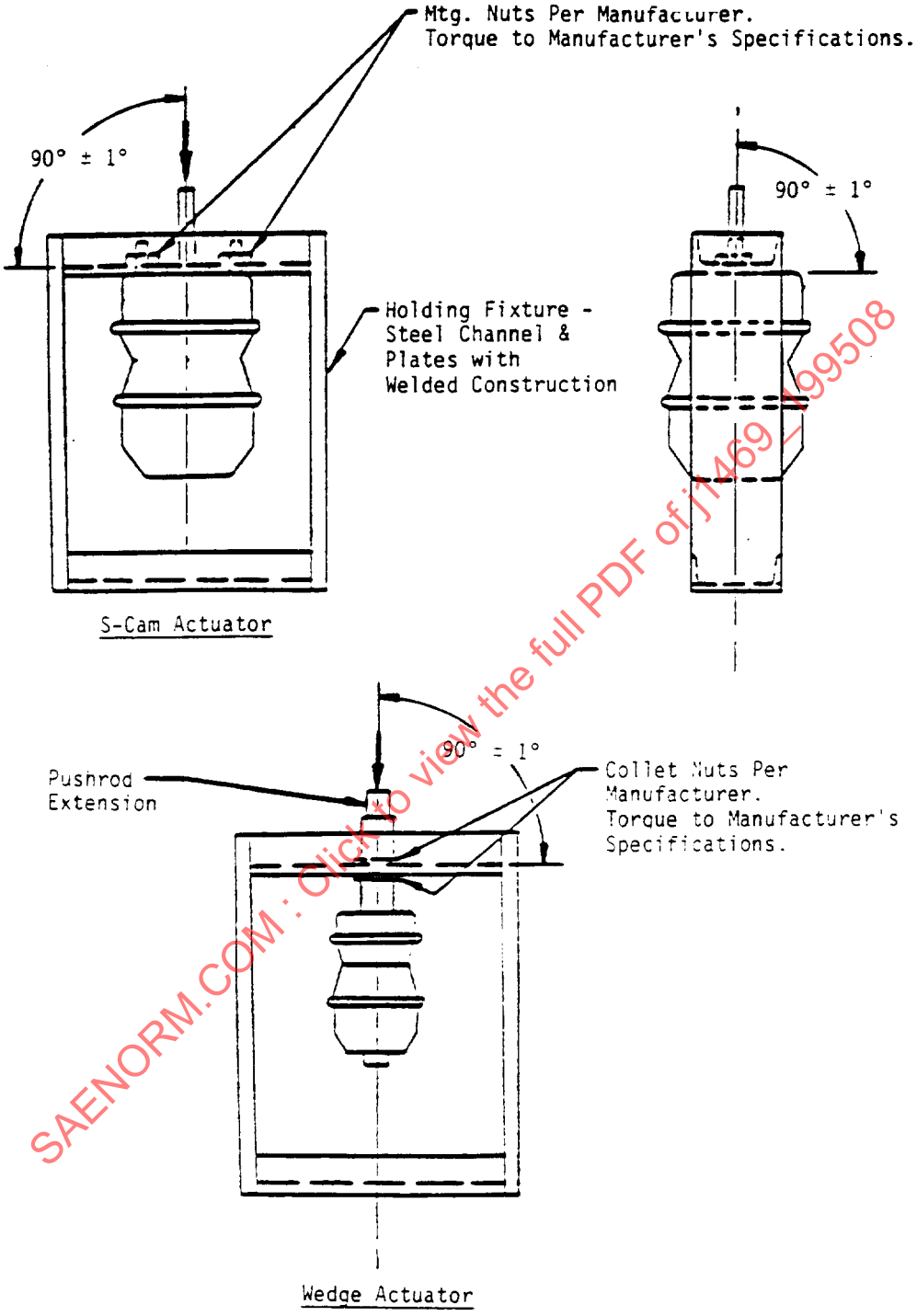

FIGURE 3—MOUNT UNIT TO TEST FIXTURE

8.2.3 Install the test unit and holding fixture in suitable force versus stroke measuring equipment.

NOTE—The test fixturing must provide guiding of the test units pushrod which will assure a pushrod angularity with the mounting surface of the chamber of 90 degrees ± 1 degree during force output testing.

8.2.4 Fully cage the power spring in the parking chamber (if applicable) either pneumatically or mechanically as specified by the manufacturer.

8.2.5 If an X-Y recorder is used to record force versus stroke, "zero" the force output on the X-Y recorder at this point in the procedure.

8.2.6 Apply a 35 to 45 N (8 to 10 lb) preload to the end of the test unit's pushrod.

8.2.7 If an X-Y recorder is used, "zero" the linear displacement (pushrod travel) on the X-Y recorder after the 35 to 45 N (8 to 10 lb) preload has been applied.

8.2.8 Apply 830 kPa ± 14 kPa (120 lbf/in^2 ± 2 lbf/in^2) (gage) to the service chamber and record the service chamber force output from zero to full stroke in the brake application direction (stroke extend) in 0 to 6.4 mm (0 to 0.25 in) increments. If an X-Y recorder is used, plot a force versus stroke curve.

8.2.9 Repeat procedures specified in 8.2.3 to 8.2.6 for 690, 550, 415, 275, 140 kPa (100, 80, 60, 40, and 20 lbf/in^2) (gage).

9. Low Temperature Leakage—Parking and Service Chamber

9.1 Leakage, Low Temperature—Parking Chamber

9.1.1 CONDITIONS

9.1.1.1 –40 °C ± 1 °C (–40 °F ± 2 °F).

9.1.1.2 Care must be taken to assure that the test unit is maintained at the specified temperature.

9.1.2 TEST PROCEDURE

9.1.2.1 Connect the parking chamber to a 20 485 cm^3 ± 820 cm^3 (1250 in^3 ± 50 in^3) air tank. Pressurize the air tank to 860 to 900 kPa (125 to 130 lbf/in^2) (gage). Do not pressurize the parking chamber. Parking chamber is to be uncaged.

9.1.2.2 Limit stroke of unit to 75% ± 5% of rated stroke.

9.1.2.3 Soak test unit and pressurized air tank at –40 °C ± 1 °C (–40 °F ± 2 °F) for 16 h minimum.

9.1.2.4 After the low temperature soak is completed, pressurize the parking chamber to 860 to 900 kPa (125 to 130 lbf/in^2) (gage) with air from the 20 485 cm^3 ± 820 cm^3 (1250 in^3 ± 50 in^3) air tank. If the 860 to 900 kPa (125 to 130 lbf/in^2) (gage) air pressure cannot be maintained, it is permissible to apply room temperature make-up air.

9.1.2.5 Stabilize the parking chamber and air tank air pressure for 5 min minimum.

9.1.2.6 Establish air pressure at 860 kPa ± 7 kPa (125 lbf/in^2 ± 1 lbf/in^2) (gage) and close shut-off valve.

9.1.2.7 Measure leakage rate with a flow meter. Record all results.

9.1.3 ALTERNATE TEST PROCEDURE

9.1.3.1 Connect the parking chamber to a 20 485 cm^3 ± 820 cm^3 (1250 in^3 ± 50 in^3) air tank.

9.1.3.2 Connect a pressure (gage) (or equivalent device) to measure pressure change.

9.1.3.3 Pressurize the air tank to 860 to 900 kPa (125 to 130 lbf/in^2) (gage). Do not pressurize the parking chamber. Parking chamber is to be uncaged. Perform procedures specified in 9.1.2.2 to 9.1.2.6.

9.1.3.4 Record the pressure change after 10 min ± 0.1 min.

9.2 Leakage, Low Temperature Service Chamber

9.2.1 CONDITIONS— –40 °C ± 1 °C (–40 °F ± 2 °F).

9.2.2 TEST PROCEDURE

9.2.2.1 Connect the service chamber to a 20 485 cm^3 ± 820 cm^3 (1250 in^3 ± 50 in^3) air tank. Pressurize the air tank to 860 to 900 kPa (125 to 130 lbf/in^2) (gage). Do not pressurize the parking chamber.

9.2.2.2 Cage the parking chamber mechanically or pneumatically with 860 to 900 kPa (125 to 130 lbf/in^2) (gage) to maintain the power spring in the fully caged position (if applicable).

9.2.2.3 Limit stroke of unit to 75% ± 5% of rated stroke.

9.2.2.4 Soak test unit and pressurized air tank at –40 °C ± 1 °C (–40 °F ± 2 °F) for 16 h minimum.

9.2.2.5 After the low temperature soak is completed, pressurize the service chamber to 860 to 900 kPa (125 to 130 lbf/in^2) (gage) with air from the 20 485 cm^3 ± 820 cm^3 (1250 in^3 ± 50 in^3) air tank. If the 860 to 900 kPa (125 to 130 lbf/in^2) (gage) air pressure cannot be maintained, it is permissible to apply room temperature make-up air.

9.2.2.6 Stabilize the service chamber and air tank air pressure for 5 min minimum.

9.2.2.7 Establish air pressure at 860 kPa ± 7 kPa (125 lbf/in^2 ± 1 lbf/in^2) (gage).

9.2.2.8 Measure leakage rate with a flow meter. Record all results.

9.2.3 ALTERNATE TEST PROCEDURE

9.2.3.1 Connect the service chamber to a 20 485 cm^3 ± 820 cm^3 (1250 in^3 ± 50 in^3) air tank.

9.2.3.2 Connect a pressure gage (or equivalent device) to measure pressure change.

9.2.3.3 Pressurize the air tank to 860 to 900 kPa (125 to 130 lbf/in^2) (gage). Perform procedures specified in 9.2.2.2 to 9.2.2.7.

9.2.3.4 Record the pressure change after 10 min ± 0.1 min.

10. Low Temperature Maximum Release and Hold-Off Pressure—Parking Chamber

10.1 Conditions—Same as 9.1.

NOTE—If the test is to be performed outside of the cold box, soak at –43 °C ± 1 °C (–45 °F ± 2 °F) and all testing must be completed within 15 min after removal from the cold box.

10.2 Test Procedure

10.2.1 Soak test unit and pressurized air tank at test condition temperature for 16 h minimum.

10.2.2 Power spring pre-set per 6.2.1.

10.2.3 Precondition cycle per 4.1.2.1.

10.2.4 Measure and record the service chamber pushrod stroke versus air pressure when actuated by the parking chamber in the apply and release direction per 6.2.3.

11. Low Temperature Force Output—Parking Chamber

11.1 Conditions—Same as 9.1.

NOTE—If the test is to be performed outside of the cold box, soak at –43 °C ± 1 °C (–40 °F ± 2 °F) and all testing must be completed within 15 min after removal from the cold box.

11.2 Test Procedure

11.2.1 Soak test unit at the test condition temperature for 16 h minimum.

11.2.2 Measure and record force output per 7.2.

12. Low Temperature Operational Test—Service Chamber

12.1 Conditions— –40 °C ±1 °C (–40 °F ±2 °F).

12.2 Test Procedure

12.2.1 Establish zero stroke position of the pushrod relative to a reference surface. Mark the pushrod for stroke measurement required in 12.2.9.

12.2.2 Limit the pushrod stroke to 75% ± 5% of rated stroke.

NOTE—The test fixturing must guide pushrod, when actuated, to maintain perpendicularity to the chamber mounting surface within ±1 degree.

12.2.3 Connect the service chamber to a 20 485 cm^3 ± 820 cm^3 (1250 in^3 ± 50 in^3) air tank with a three-way air shut-off valve attached between the air port and air tank to enable cycling of the service chamber.

12.2.4 With the shut-off valve closed, pressurize the air tank to 860 to 900 kPa (125 to 130 lbf/in^2) (gage) air pressure.

12.2.5 Soak the test unit and air tank at –40 °C ± 1 °C (–40 °F ± 2 °F) per 9.1.1 for 16 h minimum as follows:

12.2.5.1 *Combination Actuator*—Parking chamber applied (extend power spring) to allow pushrod to stroke per 12.2.2.

12.2.5.2 Service brake actuator (service chamber) zero pushrod stroke.

12.2.6 After the soak period, pneumatically cage the combination actuator parking chamber power spring. (Room temperature air permissible, do not use air from air tank per 12.2.3.)

12.2.7 Open shut-off valve between air tank and air port and pressurize the service chamber to 620 kPa ± 35 kPa (90 lbf/in^2 ± 5 lbf/in^2) (gage).

12.2.8 Pneumatically cycle the service chamber, from zero to the pushrod stroke limit (75% ± 5% rated stroke) and back to zero stroke three times. It is permissible to use room temperature make-up air to the air tank to maintain 620 kPa ± 35 kPa (90 lbf/in^2 ± 5 lbf/in^2) (gage).

12.2.9 On the third release stroke, measure and record the time required for the pushrod to retract to within 0 to 6.4 mm (0.25 in) of its original position after the air pressure is released to 0 kPa (0 lbf/in^2) (gage).

13. Corrosion Resistance—Combination, Parking, and Service Actuators

13.1 Service Chamber

13.1.1 CONDITIONS—The test unit shall be exposed for 96 h to a continuous salt test per ASTM B 117.

13.1.2 The test unit shall cycle at a minimum rate of 48 cycles/h.

13.1.3 After the unit has been air dried, test per the following procedures:

a. Service chamber leakage per 4.2
b. Service chamber force output and stroke per Section 8
c. Service chamber disassembly and inspection

13.2 Parking Chamber

13.2.1 CONDITIONS—The test unit shall be exposed for 96 h to a continuous salt spray test per ASTM B 117.

13.2.2 TEST PROCEDURE

13.2.2.1 Limit the piston rod stroke to 75% ± 5% of rated stroke.

13.2.2.2 The test unit shall cycle at a minimum rate of 12 cycles/h.

NOTE—Parking chamber may be tested in tandem as a combination unit.

13.2.2.3 After the unit has been air dried, test per the following procedures:

a. Parking chamber leakage per 4.1

13.3 Combination Actuator

13.3.1 CONDITIONS—The test unit shall be exposed for 96 h to a continuous salt spray test per ASTM B 117.

13.3.2 TEST PROCEDURE

13.3.2.1 Limit the piston rod stroke to 75% ± 5% of rated stroke.

13.3.2.2 The test unit cycle sequence shall consist of eight service chamber cycles followed by two parking chamber cycles and repeated at a minimum rate of 60 cycles/h.

13.3.2.3 After the unit has been air dried, test per the following procedures:

a. Parking chamber leakage per 4.1
b. Service chamber leakage per 4.2
c. Service chamber force output and stroke per Section 8
d. Service chamber disassembly and inspection

14. Mechanical Back-Off Release Mechanism

14.1 Exceptions—This test applies only to actuators designed with mechanical back-off (release) mechanisms.

14.2 Conditions—27 °C ± 11 °C (80 °F ± 20 °F) ambient temperature.

14.3 Test Procedure—Establish zero stroke position of the pushrod per 12.2.1. Apply the parking chamber mechanical back-off mechanism per the manufacturer's instructions to manually cage (compress) the parking chamber power spring. Manually compress and release the power spring to within 0 to 6.4 mm (1/4 in) of full release five times. Record the maximum running torque for each application.

15. Proof Pressure Test—Parking and Service Chamber

15.1 Parking Chamber

15.1.1 CONDITIONS

15.1.1.1 27 °C ± 11 °C (80 °F ± 20 °F) ambient temperature.

15.1.1.2 Limit actuator stroke to 75% ± 5% of rated stroke.

15.1.2 TEST PROCEDURE

15.1.2.1 Place test unit in a burst chamber and connect parking chamber air port to a hydraulic pressurizing means.

WARNING—In the event a pressurized unit explodes, the burst chamber must prevent injury to personnel in the area.

15.1.2.2 Pressurize the parking chamber to 2070 kPa ± 70 kPa (300 lbf/in^2 ± 10 lbf/in^2) (gage) hydrostatic pressure (oil or water) for a minimum of 15 s.

15.1.2.3 Release the pressure and purge the unit of liquid medium.

15.1.2.4 Leak test the parking chamber per 4.1.

15.1.2.5 After all testing is completed, disassemble the parking chamber, using manufacturer's recommended procedures and inspect components for structural damage.

15.2 Service Chamber

15.2.1 CONDITIONS

15.2.1.1 27 °C ± 11 °C (80 °F ± 20 °F) ambient temperature.

15.2.1.2 Limit actuator stroke to 75% ± 5% of rated stroke.

15.2.1.3 Cage the power spring per 6.2.1.1 (if applicable).

15.2.2 TEST PROCEDURE

15.2.2.1 Place test unit in a burst chamber and connect the service chamber air port to a hydrostatic pressurizing means.

WARNING—In the event a pressurized unit explodes, the burst chamber must prevent injury to persons in the area.

15.2.2.2 Pressurize the service chamber to 2070 kPa ± 70 kPa (300 lbf/in^2 ± 10 lbf/in^2) (gage) hydrostatic pressure (oil or water) for a minimum of 15 s.

15.2.2.3 Release the pressure and purge the unit of liquid medium.

15.2.2.4 Leak test the service chamber per 4.2.

15.2.2.5 After all testing is completed, disassemble the service chamber and inspect components for structural damage.

16. Cycle Test—Parking Chamber

16.1 Conditions—27 °C ± 11 °C (80 °F ± 20 °F) ambient temperature.

16.2 Test Procedure

16.2.1 A complete parking and service chamber assembly, when applicable, will be tested.

16.2.2 Preset power spring per 6.2.1.

16.2.3 Pneumatically cycle the test unit from its compressed position (zero stroke) to 75% ± 5% of rated stroke by pressurizing the parking chamber with air from 0 to 690 kPa (0 to 100 lbf/in^2) (gage) at a rate of 20 cycles/min ± 10 cycles/min. The test unit shall be cycled against a resisting service chamber of equivalent size (that is, a type 30 test unit opposed by a type 30 resisting service chamber). At zero stroke of the test unit, the resisting service chamber shall have 105 kPa ± 35 kPa (15 lbf/in^2 ± 5 lbf/in^2) (gage) and the pressure shall be allowed to increase to the maximum attainable pressure when the test unit reaches 75% ± 5% of its rated stroke. At this position, the test unit shall exert a force in the extend direction against a positive stop.

16.2.4 Pressure must dwell at 0 to 14 kPa (0 to 2 lbf/in^2) (gage) and 690 kPa ± 35 kPa (100 lbf/in^2 ± 5 lbf/in^2) (gage) for a minimum of 0.1 s.

16.2.5 Test unit for 200 000 cycles minimum.

16.2.6 After cycling, test the unit per the following procedures:

a. Parking chamber leakage per 4.1
b. Parking chamber force output per Section 7
c. Maximum release and hold-off per Section 6

17. Cycle Test—Service Chamber

17.1 Conditions—27 °C ± 11 °C (80 °F ± 20 °F) ambient temperature.

17.2 Test Procedure

17.2.1 Cage the power spring per 6.2.1.1 (if applicable).

17.2.2 Pneumatically cycle the service chamber from zero stroke to 75% ± 5% of rated stroke. The test unit shall be cycled against a resisting service chamber of equivalent size (that is, a type 30 test unit opposed by a type 30 resisting service chamber). At zero stroke of the test unit, the resisting service chamber shall have 105 kPa ± 35 kPa (15 lbf/in^2 ± 5 lbf/in^2) (gage) and it shall increase to 310 kPa ± 35 kPa (45 lbf/in^2 ± 5 lbf/in^2) (gage) when the test unit reaches 75% ± 5% of its rated stroke. At this position, the test unit shall exert a force in the extend direction against a positive stop.

17.2.3 To cycle service chamber, apply air pressure from 0 to 515 kPa ± 35 kPa (0 to 75 lbf/in^2 ± 5 lbf/in^2) (gage).

17.2.4 Cycle test unit at a rate of 20 cycles/min ± 10 cycles/min.

17.2.5 Pressure must dwell at 0 to 14 kPa (0 to 2 lbf/in^2) (gage) and 515 kPa ± 35 kPa (75 lbf/in^2 ± 5 lbf/in^2) (gage) for 0.1 s minimum.

17.2.6 Test unit must complete 1 000 000 cycles minimum.

17.2.7 After cycling, the unit shall be leak tested per Section 4.

18. Elevated Temperature Cycle Test—Parking and Service

18.1 Parking Chamber

18.1.1 CONDITIONS—70 °C ± 3 °C (158 °F ± 5 °F).

18.1.2 TEST EQUIPMENT

18.1.2.1 An environmental chamber capable of maintaining 70 °C ± 3 °C (158 °F ± 5 °F).

18.1.2.2 A minimum of 690 kPa (100 lbf/in^2) (gage) air supply.

18.1.2.3 Pneumatic circuit to cycle test unit in environmental chamber.

18.1.3 TEST PROCEDURE

18.1.3.1 Connect parking brake air port to the pneumatic circuit.

18.1.3.2 Soak test unit for 2 h at 70 °C ± 3 °C (158 °F ± 5 °F); then pneumatically cycle the parking chamber from the fully released to the fully applied position (full stroke to zero stroke and back to full stroke position) while maintaining 70 °C ± 3 °C (158 °F ± 5 °F) by applying 0 to 690 kPa ± 35 to 0 kPa (0 to 100 lbf/in^2 ± 5 to 0 lbf/in^2) (gage) air pressure at a rate of 6 cycles/min minimum for 22 h.