SAE International® SURFACE VEHICLE STANDARD

SAE J1807 FEB2012

Issued 2000-11
Stabilized 2012-02

Superseding J1807 NOV2000

Hydraulic Power Assist Brake Booster Test Procedure

RATIONALE

This procedure is applicable to existing hydraulic powered brake boosters of a design which is still in current production but for which there have been no significant changes in many years. It is not expected that the type of unit covered by this procedure will be redesigned. The current state of the art of non-vacuum power assist units involves technology not covered by this procedure.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE Hydraulic Brake Components Standards Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

1. ***Scope***—This SAE Standard applies to direct acting hydraulic power assist brake boosters only, of the type which provide “push through” manual braking of the static brake circuit(s) via a separate master cylinder, in event of inoperative power assistance similar to existing vacuum boosters (SAE J1808), for passenger cars and light trucks [4500 kg GVW (10 000 lb)].

1.1 Purpose—This document specifies minimum test standards for direct acting hydraulic power assist brake boosters of current established designs utilizing mineral oil based hydraulic fluids. It is applicable to assemblies from commercial production and after production shipment.

2. ***References***

2.1 Applicable Publication—The following publication forms a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version of SAE publications shall apply.

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

SAE J1808—Vacuum Power Assist Brake Booster Test Procedure

3. ***Definitions***—In order to establish and maintain a continuity of discussion throughout this document, the following definition of terms will be utilized. See Figure 1 for illustration of terms as applied to a typical input-output force curve.

3.1 Released—The unapplied, fully returned state with no force on the input pushrod.

3.2 Poise—The condition of placing the control valve in a steady-state of force equilibrium so that the hydraulic power assist brake booster is neither fully applied, nor fully released.

3.3 Cut-In—The input force required to actuate the valving and produce an output force.

3.4 Power Slope—The ratio of change in output force to change in input force in the area of performance.

3.5 Hydraulic Runout Line—The line defined by two or more points on the input-output curve beyond the input force at which all available pressure differential exists across the power piston.

3.6 Hydraulic Runout Point—The point defined by the intersection of the power slope line and the hydraulic runout line.

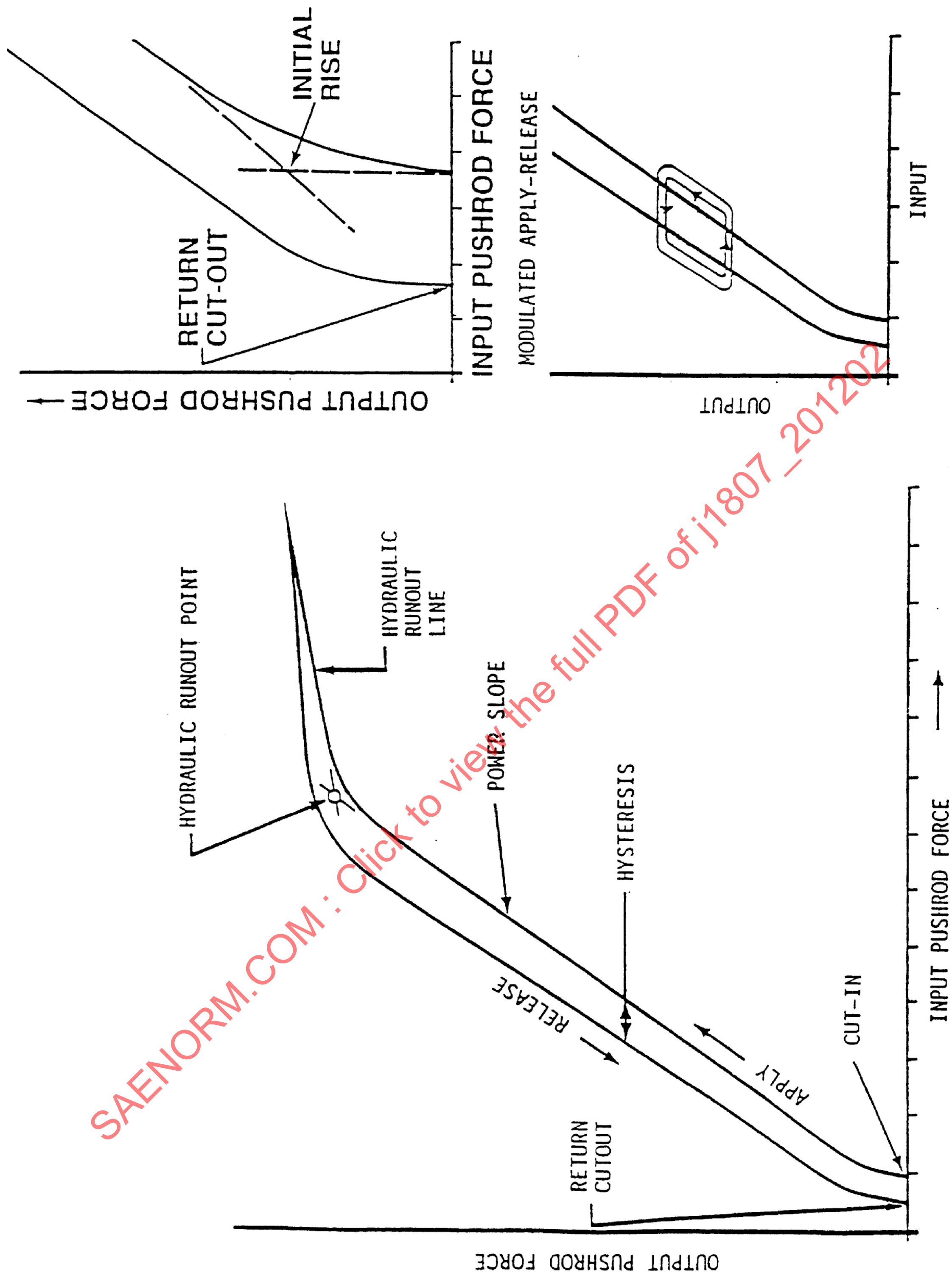

FIGURE 1—TYPICAL INPUT-OUTPUT (X-Y) CURVE

3.7 Hysteresis—The difference between apply and release input forces at a given output force during the power slope.

3.8 Return Cut-Out—The input force at which the output force drops to zero or some specified level during release.

3.9 Boost Pressure—The pressure level from the primary power or reserve supply system acting to apply the power piston.

3.10 Pressure Limiter or Relief—The device used to limit the maximum boost pressure.

3.11 Travel Ratio—The ratio of input rod travel to output rod travel.

3.12 Ratio Changer—The device integral with the booster that is used to provide a travel ratio different than one-to-one.

3.13 Travel Limiter—A device used to reduce input rod travel losses when above the power runout point of the hydraulic power assist unit.

3.14 Reserve System—An alternate power system of a power assist unit that provides assist in the event the primary system is inoperative.

3.15 Flow Switch—A switch used to provide an electrical signal to a warning or motor in the event of loss of fluid flow.

3.16 Pressure Switch—A switch used to provide an electrical signal to a warning light or motor in the event of loss of pressure.

3.17 Accumulator—A means of storing energy for a reserve system.

3.18 Accumulator Unloading Valve—A mechanism for releasing stored energy from an accumulator.

3.19 By-Pass Flow—Hydraulic fluid flow directed around the primary flow path to the booster outlet or outlet line.

3.20 Power Boost (When Applicable)—The output force minus the input force for a given hydraulic level and with the maximum available pressure differential across the power piston(s), and at 80% of the usable output stroke.

3.21 Initial Rise (When Applicable)—The intersection of a vertical line through the cut-in point and the power slope line.

4. Test Apparatus

4.1 General—The basic apparatus shall be that shown and as arranged in Figure 2, or equivalent. The apparatus shall operate per the following description and as called for in Section 6. It is desirable to have the test apparatus portable to facilitate cold, hot, and room temperature testing.

4.2 Force Absorbing Mechanism—The force absorbing mechanism shall be connected to the hydraulic power assist brake booster front housing. This mechanism shall be capable of absorbing a minimum of 150% of booster hydraulic runout point output force or 17600 N (4000 lb) output force, whichever is greater. In addition, this mechanism shall be capable of restricting the output force – stroke relationship to the shaded area of Figure 3.

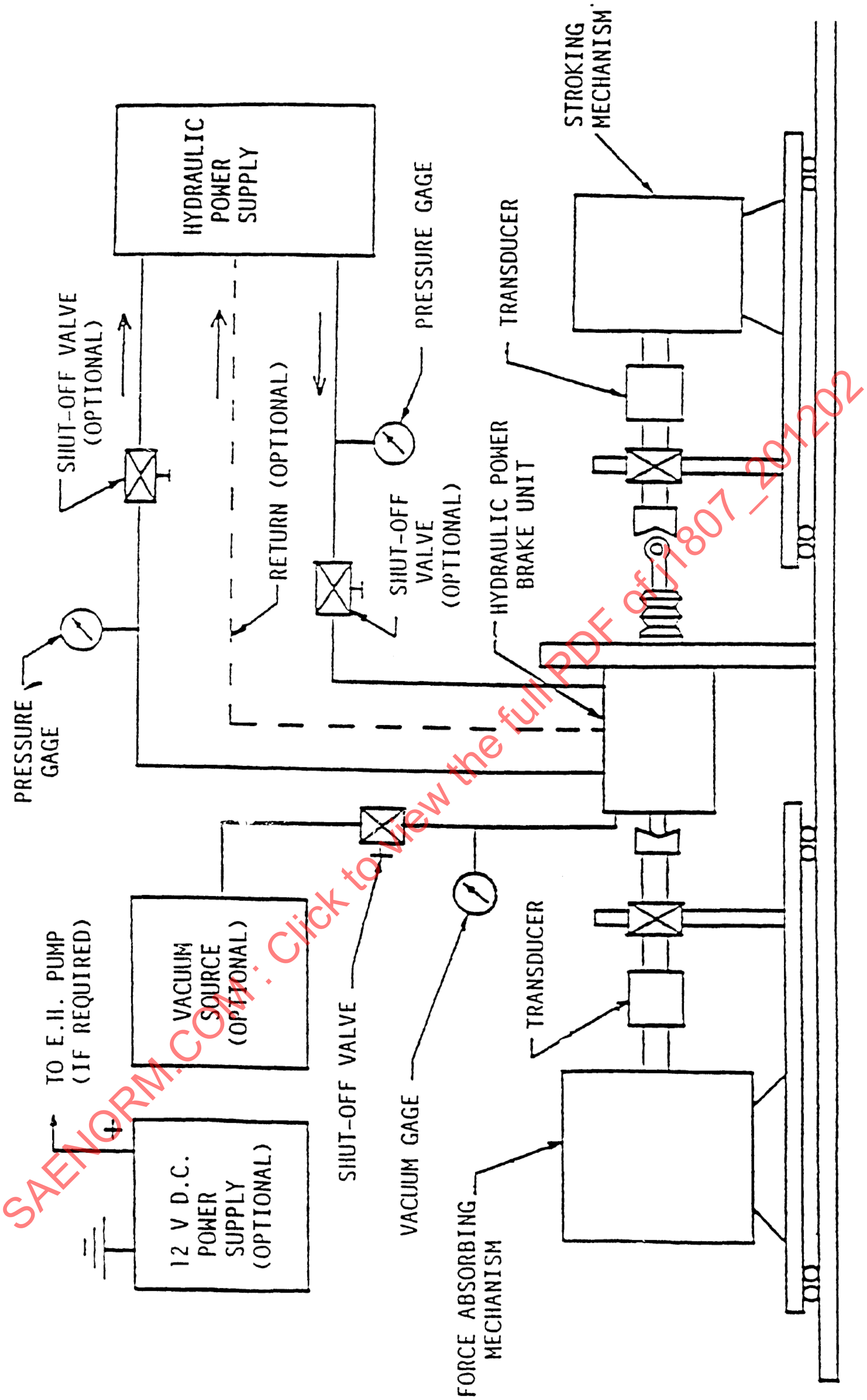

FIGURE 2—SCHEMATIC OF RECOMMENDED SETUP FOR HYDRAULIC POWER ASSIST TEST

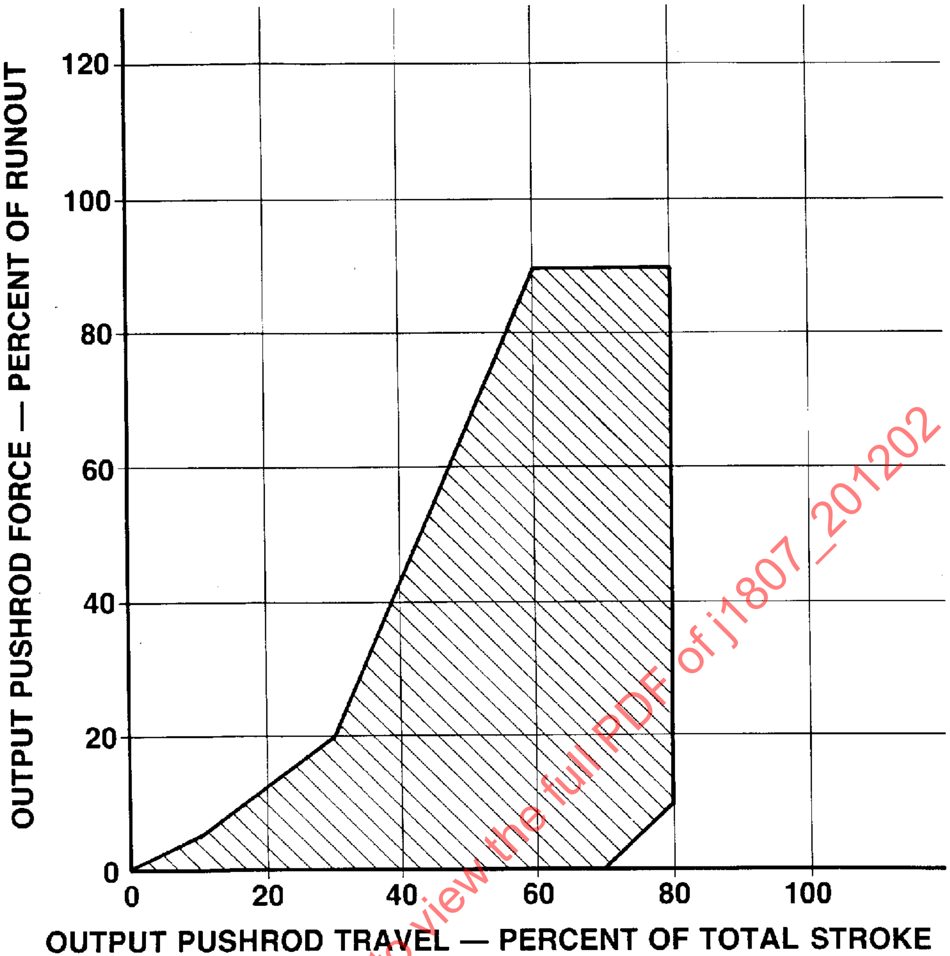

FIGURE 3—RECOMMENDED STROKING PERFORMANCE CURVES FOR FORCE ABSORBING MECHANISM

4.3 Stroking Mechanism—The stroking mechanism shall contain a rigid mounting plate to which the booster can be attached. The actuator shall be compatible with the input pushrod(s) of the booster and shall operate coaxially within 3 degrees of the longitudinal axis of the booster. The fixture shall be constructed such that full release of the booster is obtained. The stroking mechanism may accommodate multiple boosters if desired, and shall be designed so that it does not apply a tensile force to the input pushrod. Means must be provided for the stroking mechanism to stroke the booster both singly and cyclically.

4.3.1 For single stroke operation, the mechanism shall be capable of generating input pushrod forces up to 4500 N (1000 lb) at its maximum travel and holding this position.

4.3.2 For cyclic operation, the stroking mechanism shall be capable of applying the input pushrod to generate 0% ± 10% of the hydraulic runout point output force, at a rate that can be adjusted from 250 to 1000 apply/release cycles per hour. The input pushrod shall be stroked forward at a smooth rate and allowed to return rapidly to its fully released position. The time cycles shall be adjusted to allow maximum time for forward stroking while insuring that the input pushrod returns to the fully released position before the start of the next forward stroke.

4.3.3 In 6.8 structural test, utilize a suitable compression test apparatus for performing the structural test.

4.4 Instrumentation

4.4.1 A two-channel X-Y electronic plotter (with real time capability) or equivalent that is compatible with 4.4.2 and 4.4.3.

4.4.2 Force transducers or equivalent measuring devices to measure input and output pushrod forces of 0 to 4500 N (0 to 1000 lb) and 0 to 17600 N (0 to 4000 lb). Overall accuracy should be ±0.5% of full scale.

4.4.3 Linear transducers or equivalent measuring devices must be provided to measure

4.4.3.1 Input pushrod travel of 0 to 50 mm (0 to 2 in).

4.4.3.2 Output pushrod travel of 0 to 50 mm (0 to 2 in).

4.4.3.3 Travel accuracy 0.5% of full scale.

4.4.4 Vacuum measuring devices capable of measuring 0 to –100 kPa ± 0.5% of full scale (0 to 30 in Hg).

4.4.5 Hydraulic measuring devices capable of measuring 0 to 20 700 kPa ± 0.5% of full scale (0 to 3000 psi).

4.5 Environmental Equipment

4.5.1 HOT TEST CHAMBER—A hot test chamber shall be provided having sufficient capacity to house the test apparatus fixtures. The hydraulic power system fluid source for internal use in the booster shall be at room temperature or at test chamber temperature as specified by the manufacturer. A suitable thermostatically controlled heating system is required to maintain a uniform atmosphere at the desired temperature up to 85 °C ± 3 °C (185 °F ± 5 °F). Heaters shall be shielded to prevent direct radiation to the booster.

4.5.2 COLD TEST CHAMBER—A cold test chamber shall be provided having sufficient capacity to house the test apparatus fixtures. The hydraulic power system fluid source for internal use in the booster shall be at room temperature or at test chamber temperature as specified by the manufacturer. A suitable thermostatically controlled cooling system is required to maintain a uniform atmosphere at the desired temperature down to -40 +0/–3 0 °C (–40 +0/–5 °F).

4.6 Vacuum Source (when applicable)—A vacuum source including all lines and fittings shall be capable of maintaining a set vacuum level of –69 kPa ± 0.1 kPa (20 in Hg ± 0.5 in Hg) during the apply portion of all cyclic tests and as specified for single stroke operation.

4.7 Hydraulic Source—A hydraulic fluid source including all lines and fittings shall be capable of maintaining a set hydraulic fluid pressure level and minimum flow rate of fluid according to the vehicle manufacturer's recommended practice during the apply portion of all cyclic tests and as specified for single stroke operation.

5. Test Samples—The test booster(s) shall come from one of the sources described in Section 1. They shall be new or not used after rebuild, and shall not be disassembled prior to testing. Separate boosters may be used for the various tests.

6. Test Set Up and Procedure

6.1 General—The tests which follow shall be conducted in the sequence shown and at room temperature except where otherwise specified. The booster shall not be disassembled until after all tests are completed or unless testing is discontinued.

6.2 Initial Evaluation

6.2.1 GENERAL—The purpose of this phase of the testing is to obtain a performance profile of the booster without disrupting or otherwise altering its internal parts or integrity.

6.2.2 INITIAL SET UP—Install the booster on the mounting plate, as shown in Figure 2, and tighten the mounting bolts to the recommended torque level. Make certain that the input pushrod is properly aligned with the longitudinal axis of the booster within 3 degrees. Adjust the apply actuator and/or input pushrod to allow the booster to return to its fully released position with zero preload on the input pushrod. Attach the force absorbing mechanisms to the front housing of the booster and adjust according to Figure 3. Install the hydraulic fluid lines to their respective auxiliary power source according to the vehicle manufacturer's recommended practice. Install vacuum hoses and/or electrical connections if required to vacuum hydraulic combination units or units with electro-hydraulic reserve systems.

Turn on the auxiliary power supply if so equipped and allow fluid to circulate within the system for approximately 5 min to allow fluid to warm to 38 °C ± 6 °C (100 °F ± 10 °F). Pressure relief setting and minimum flow rate of the fluid shall be according to the vehicle manufacturer's recommended practice. Make sufficient power and no-power brake applies to purge air entrapped within the booster or system.

On hydraulic/vacuum combination systems, evacuate the booster to –68 kPa ± 1.7 kPa (20 in Hg ± 0.5 in Hg), and allow to stabilize for a minimum of 15 s before each test.

6.2.3 RECORDER—Connect the input pushrod force transducer to the "X"-axis and the output pushrod force transducer to the "Y"-axis of the X-Y plotter. Assure that the output pushrod is not preloaded.

6.2.4 APPLY-RELEASE—Apply force to the input pushrod at a rate of 135 N/s ± 90 N/s (30 lbf/s ± 20 lbf/s). After the apply force generates 110 to 150% of the hydraulic runout point output force, release the force to the input pushrod at the same rate and allow the booster to return to the fully released condition.

6.2.5 MODULATED APPLY-RELEASE—Repeat the procedure given in the Apply-Release procedure (see 6.2.4) except modulate the apply force to generate output force increments of 450 N ± 90 N (100 lb ± 20 lb) from 25 to 110% of the hydraulic runout point output force. During the modulated apply mode, reduce the output pushrod force to 450 N ± 90 N (100 lb ± 20 lb), then reapply. Do not reduce the output pushrod force to zero before reapply. When complete, return to the fully released condition.

6.2.6 RESERVE APPLY-RELEASE CAPABILITY

6.2.6.1 Accumulator Reserve System—With the input and output pushrod force transducers connected to the X-Y plotter, turn on the hydraulic power supply and make an apply-release per 6.2.4, to charge the reserve accumulator, and then shut the hydraulic power supply off. Apply a force to the input pushrod at a rate of 135 N/s ± 90 N/s (30 lb/s ± 20 lb/s) to generate 25 to 30% of the hydraulic runout point output force and 25 to 35% of the usable output stroke. Hold for 15 s, and then return the input pushrod force to zero. Repeat this apply-release cycle and record, to the nearest cycle, the number of cycles until power assist is reduced to zero.

6.2.6.2 Motor Driven Reserve System—With the input and output pushrod force transducer connected to the X-Y plotter, connect the motor driven reserve system to an electrical power source as recommended by the manufacturer. Apply a force to the input pushrod at a rate of 135 N/s ± 90 N/s (30 lb/s ± 20 lb/s) to generate 25 to 30% of the hydraulic runout point output force and 25 to 35% of the usable output stroke. Hold for 15 s and then return the input pushrod force to zero.

6.2.7 Hydraulic Reserve on Hydraulic/Vacuum Combination Systems—With the input and output pushrod force transducers connected to the X-Y plotter, connect the hydraulic power unit to the power supply as recommended by the manufacturer. Shut off the vacuum unit power supply and make repeated apply-release cycles until vacuum power assist is reduced to zero. Apply a force to the input pushrod at a rate of 135 N/s ± 90 N/s (30 lb/s ± 20 lb/s) to generate 25 to 30% of the hydraulic runout point output force and 25 to 35% of the usable output stroke. Hold for 15 s, and then return the input pushrod force to zero

6.2.8 Vacuum Reserve on Hydraulic/Vacuum Combination Systems—With the input and output pushrod force transducers connected to the X-Y plotter, evacuate the vacuum portion of the unit to –68 kPa ± 1.7 kPa (20 in Hg ± in Hg). Shut off the hydraulic unit power supply, and where applicable make repeated apply-release cycles until hydraulic power assist is reduced to zero. Apply a force to the input pushrod at a rate of 135 N/s ± 90 N/s (30 lbf/s ± 20 lbf/s) to generate 25 to 30% of the hydraulic runout point output force and 25 to 35% of the usable output stroke. Hold for 15 s and return the input pushrod force to zero. Repeat this apply-release cycle and record, to the nearest cycle, the number of cycles until power assist is reduced to zero.

6.2.9 "No Power" Apply-Release on Hydraulic/Vacuum Combination Systems—With the auxiliary hydraulic power supply and vacuum supply disconnected at the vacuum check valve, and the outlet to the vacuum check valve vented to atmosphere, stroke the booster until all internal hydraulic pressure and vacuum is depleted. Repeat the Apply-Release procedure (see 6.2.4) using the same input values.

6.2.10 Hydraulic Leak Check (and Vacuum Leak Check on Hydraulic/Vacuum Combination Systems)

6.2.10.1 General—Where applicable, install a vacuum gage at the vacuum outlet to measure vacuum level in the booster. The volume of the vacuum between the booster and the shut-off valve, including the vacuum gage, should not exceed 100 cm^3 (6 in^3).

6.2.10.2 Fully Released—With zero force on the input pushrod, close the vacuum and hydraulic shut-off valves, and measure the drop in hydraulic and vacuum levels in the unit after 15 s.

6.2.10.3 Poise—Apply and maintain a steady output force to the input pushrod to generate 25 to 30% of the hydraulic runout point output force, and allow to stabilize for 15 s minimum. Close the hydraulic and vacuum shut-off valves, and measure the drop in hydraulic and vacuum levels in the unit after 15 s. Since hydraulic flow is normally continuous, hydraulic pressure at the gages will drop immediately when flow is stopped.

6.2.10.4 Runout—Apply and maintain a steady output force to the input pushrod to generate 110 to 150% of the hydraulic runout point output force, and allow to stabilize for 15 s minimum. Close the hydraulic and vacuum shut-off valves, and measure the drop in hydraulic and vacuum levels in the unit after 15 s. Pressure will drop immediately when flow is shut off.

6.2.11 Apply and Release Response

6.2.11.1 General—Adjust the output force absorbing mechanism to provide 65 to 75% of the usable output stroke at 125 to 135% of the hydraulic runout point output force. Maintain the vacuum level at –68 kPa ± 1.7 kPa (20 in Hg ± 0.5 in Hg).