ITT GRINNELL CORPORATION
PIPE HANGER DIVISION
RESEARCH, DEVELOPMENT AND
ENGINEERING DEPARTMENT

PHD-7556-12

FILL, PURGE & TEST PROCEDURE
ITT GRINNELL FIGURES 670, 671, 672, 673, 674 & 675
HYDRAULIC SHOCK & SWAY SUPPRESSORS

PRELIMINARY

PROCEDURE NO. PHD-7556-12

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APPROVED BY: _____ SECT. MGR. DATE: _____

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I. Introduction to the ITT Grinnell Hydraulic Shock and Sway Suppressor Tester Model PHD-7556C for 1 1/2" & 2" bore Cylinders, PHD-5434-3 for 2 1/2", 4" & 5" bore cylinders and PHD-5434-1A for 6" & 8" bore cylinders.

The ITT Grinnell Hydraulic Shock and Sway Suppressor Tester (Snubber Tester) Model PHD-7556C is designed for functional testing of hydraulic snubbers to a maximum load of 6,000 lbs. Model PHD-5434-3 is for loads up to 75,000 lbs. and Model PHD-5434-1A is for loads up to 288,000 lbs. The snubber testers operate in two modes -- Velocity Control and Force (pressure) Control. Velocity Control operates with low system forces and is used for stroking the snubber and measuring drag forces. Force Control operates with high system pressures to maintain a constant force on the snubber for measuring limiting velocity. In both modes of operation, a transducer attached to the ram provides direct, instantaneous feedback of snubber velocity.

Attached to the test machines is a snubber purge and fill system utilizing a central fluid conditioner and appropriate lines and valves. The purpose of the fluid conditioner is to remove particles to level 5 or greater of National Aerospace Standard NAS 1638, deaerate to 4% or less by volume and dehumidify.

A vacuum purge system is also attached to Model PHD-5434-3 tester, however, it is not utilized for Fig. 670 series snubbers.

See Figure 1 for the Fill, Purge and Test Sequence.

II. Snubber Tester Operations

A. Ram Position Adjustment

1. Close both velocity controls (6) * & (7) fully clockwise for PHD-7556C or fully counterclockwise for PHD-5434-3 and -1A.

2. Push start button (10).

3. Set pressure regulators (4) & (5) as follows:

   a. Turn the direction selector (8) to tension.

   b. Set the tension pressure regulator (5) by adjustment of the knob directly below the tension system pressure gage (2) to 150 psi (Models PHD-7556C & PHD-5434-3), 500 psi (Model PHD-5434-1A) or the system pressure for tension (refer to Table 2) for the desired test, whichever is lower.

   c. Tighten the locknut at the pressure regulator knob(5).

   d. Turn the direction selector (8) to compression.

   e. Repeat Steps b. & c. for compression.

   f. Turn the direction selector (8) to the "OFF" position.

4. To Retract the Tester Ram

   a. Turn the direction selector (8) to tension.

   b. Open the tension velocity control valve (7) until the desired ram position is obtained.

   c. Close the velocity control valve (7).

   d. Turn the direction selector (8) to the off position.

5. To Extend the Tester Ram

   a. Turn direction selector (8) to compression.

* For items numbers shown in ( ), see Fig. 2 which shows snubber details & test machine Model PHD-5434-3. Models PHD-7556C and PHD-5434-1A have similar controls.

II. Snubber Tester Operations (Cont'd)

b. Open the compression velocity control valve (6) until the desired ram position is obtained.

c. Close velocity control valve (6).

d. Turn direction selector (8) to the OFF position.

B. Snubber Installation

NOTE: If an extension piece model snubber is to be installed, the extension assembly must be removed and replaced with a pivot mount oriented as shown on Figure 2.

1. Model PHD-7556C (1 1/2"-2" cylinders)

a. Select the proper pair of bushings (15) according to Table 1 and install into clevises (13) and secure using setscrews.

b. Installing the snubber (14)

1) Retract the ram (11) for clearance

2) Position the snubber pivot lug (A)(located at the cylinder cap end)in the adapter (13) attached to the rear upright (16) and install the pivot pin (B).

3) Supporting the snubber, advance the ram (11) as required and install the pivot pin (B) between the snubber rod eye (C)(located at the rod end) and adapter (13) attached to the ram runner plate (12).

2. Model PHD-5434-3 (2 1/2" - 5" cylinders)

a. Select the proper pair of adapter clevises (13) and bushings (15) (if required) according to Table 1 and bolt them to the ram runner plate (12) located at the end of the tester drive ram) and to the rear upright (16) (located on the two gear racks) using the bolts provided. Tighten firmly. Install bushings & secure —

2. Model PHD-5434-3 (2 1/2" - 5" cylinders) (Cont'd)

a. Cont'd

using setscrews.

b. Adjust the position of the rear upright (16), if necessary, by loosening the four socket head bolts (17) at the bottom and lifting the upright over the teeth of the rack (18). Adjust to a position where the pin-to-pin distance between the two adapter clevises (13) (with the tester drive ram (11) fully retracted - refer to Section II.A for adjustment of the snubber tester ram position) is as close to, but not less than, the pin-to-pin distance of the snubber to be tested (with the snubber piston rod fully extended). Securely tighten the four bolts (17) at the bottom of the rear upright (16).

c. Installing the snubber (14)

1) Retract the ram (11) for clearance.

2) Position the snubber pivot lug (A)(located at the cylinder cap end) in the adapter (13) attached to the rear upright (16) and install the pivot pin (B).

3) Supporting the snubber, advance the ram (11) as required and install the pivot pin (B) between the snubber rod eye (C) (Located at the rod end) and adapter (13) attached to the ram runner plate (12).

3. Model PHD-5434-1A (6" & 8" cylinders)

a. Same as B.2.a. (Note: there is no adjustment necessary on the rear upright).

b. Installing the snubber (14)

1) Retract the ram (11) for clearance

3. Model PHD-5434-1A (6" & 8" cylinders) Cont'd

b. Cont'd

2) Position the snubber pivot lug (A)(located at the cylinder cap end) in the adapter (13) attached to the ram plate (12) and install pivot pin (B).

3) Supporting the snubber, advance the ram (11) as required and install the pivot pin (B) between the snubber rod eye (C) (located at the rod end) and adapter (13) attached to the rear upright (16).

C. Fill & Purge System

1. Equipment - The operation of the fluid conditioner is covered in Appendix B.

2. Fluid Handling

a. General

1) All drums and/or containers of General Electric Silicone Fluid #SF-1154 should be inspected upon arrival.

2) If fluid drums and/or containers are damaged in any fashion (punctures, seams split, etc.) that may result in foreign matter entering the drum and/or container the fluid shall be returned to the vendor.

3) Prior to opening fluid drum and/or containers, the top of the containers shall be wiped clean to insure against any particles entering the fluid while opening.

4) Fluid containers should not be left open to the atmosphere for any extended period of time and should not be opened at any time in areas where airborne particles may enter the container.

II.C. 2.a. Cont'd

5) All fittings and hose connections used for transferring fluid and for filling and purging snubbers shall be cleaned by applying clean fluid (SF-1154) to the fitting and then blow-dry with oil-free air or wipe dry with a clean lint free cloth.

6) CAUTION: Used fluid from any shock suppressor shall be discarded. This fluid shall not at any time be introduced into any drum and/or container with clean shop fluid or into any portion of the fill and purge system.

III. Dry Drag Measurement

As a check on the proper functioning of the snubber, a dry drag measurement is to be performed.

A. Blow off the area around the reservoir fill port plug with filtered shop air, remove the reservoir fill port plug (D) and replace with a clean LENZ breather filter P/N BFA-6.

CAUTION: Every effort must be taken to avoid getting contaminants into reservoir fill port.

B. Safety Devices

CAUTION:

1. The Strainsert load sensing pins are designed to accurately measure forces up to 500 or 1,100 lbs, however, if a snubber should reach end of stroke a load of up to 165,000 lbs, would be applied to the load pin.

2. To prevent these destructive loads from being applied to the load pins, safety devices have been installed in the load measuring system which shut off the directional control on the test machine under the following circumstances:

   a. If the snubber should reach end of stroke

   b. If the channel selector (d2)* on the transducer indicator is set for the wrong pin.

   c. If the oper/cal switch (d5) is on cal (calibrate) instead of oper (operate).

3. A separate safety system will not allow the direction selector (8) to function if both velocity control valves (6 & 7) are not closed.

* ITEM NUMBERS WHICH BEGIN WITH THE LETER "d" ARE AS SHOWN IN FIG. 3. ALL OTHER ITEM NUMBERS ARE SHOWN IN FIG. 2.

4. If at any time the directional selector (8) ceases to function, proceed to the safety check list in Section III.D.

5. See Fig.'s 4 & 5 for wiring diagrams.

C. Equipment Setup

1. Replace the standard pin (B) and bushings (15) at the cylinder rod eye (C) with the appropriate bushings as listed in Table 3 and load pin (d10 or d11) See Figs. 6, 7 & 8. Be sure to tighten the set screw which holds the adapter bushings (See Figs. 6 & 7).
CAUTION: Care must be taken that the pin orientation tabs are in place to locate the drag pin. (Fig. 6, 7 & 8). Improper pin orientation will result in incorrect load readings & possible damage to the pins.

2. Remove the shorting plug (29) on the test machine from the connector socket (28) on the test machine.

3. Plug in the adapter (d12) from the BLH transducer indicator to the connector socket (28) on the test machine.

4. Turn on the power switch (d3) to the BLH transducer indicator.

5. Switch channel selector (d2) to match the pin number.

6. Turn the oper/cal switch (d5) to oper (operate) and set the digital readout to zero using the zero set (d6 or d8) for the correct pin no. prior to installing the pin.

7. Turn the oper/cal switch (d5) to cal (calibrate) and insure the span matches the number identified on the calibration sticker.

CAUTION: Do Not Attempt To Set The Span!! If The Span Is Not Within ± 3 lbs. of The Listed Number, Contact the Q.C. Department. The Span is a Verification of the Calibration (See Appendix A)

8. Turn the oper/cal switch (d5) back to oper
9. Close both velocity control valves (6 & 7), fully counterclockwise.
10. Close both pressure regulators (4 & 5) fully counterclockwise and tighten the locknuts.

D. Drag Force Measurement

CAUTION: Before Proceeding, Insure That the Following Steps are Taken.

- Both velocity control valves (6 & 7) are fully closed.
- Both pressure regulators (4 & 5) are fully closed.
- The channel selector (d2) is switched to the correct load pin (d10 or d11).
- The oper/cal switch (d5) is on oper
- The rod eye is centered on the pin per Figs. 6 & 7.
- The snubber position is within plus or minus 1 1/2" from mid-stroke.
- The re-set switch (d13) has been activiated.

If at any time the direction selector (8) fails to function or the operational light (30) fails to illuminate, all of the above items must be checked.

1. Install pin into clevis bracket as shown in Fig. 6, 7 & 8.
2. Set the piston position 1 1/2" retracted from the mid-stroke position (i.e. 1" from fully retracted on a 5" stroke snubber).
3. Check the load pin (d10 or d11) and bushing alignment against Fig. 6 or 7 and the pin orientation tabs per Fig. 8.
4. Turn the direction selector (8) to tension.
5. Very slowly open the tension velocity control valve (7) until the velocity meter (3) reads 6 in/min ($\pm$0.1).
6. Observe the highest value drag force on the load meter (d1) on the BLH transducer indicator.

   CAUTION: If the snubber position exceeds 1 1/2" extended from mid-stroke, it must be reset per steps 2. and steps 3. thru 6. repeated.

   NOTE: If the drag force measured exceeds the pre-set levels of the BLH unit, the test machine directional control will shutoff. Proceed to check list in Section III.D. and Repeat Steps 1 thru 6.

7. Close the tension velocity control valve (7) fully counterclockwise.
8. Turn the direction selector (8) to "OFF".
9. Set the piston position 1 1/2" extended from mid-stroke (i.e., 1" from fully extended on a 5" stroke snubber).
10. Repeat Steps 3 thru 8 in the compression direction.
11. Position the piston rod to the mid-stroke position.

12. Push stop button (9).

13. If the measured drag forces exceed the following values, the snubber must be torn down:

Cylinder Bore (in.)	Acceptable Dry Drag Force (Tension & Compression) (lbs)
1 1/2	100
2	100
2 1/2	200
4	500
5	900
6	1400
8	2200

E. Equipment Teardown

1. Turn off the BLH Model 450 Transducer Indicator power switch (d3).

2. Replace the load pin (d10 or d11) and bushings with the standard pin (B) and bushings (15).

3. Remove the adapter plug (d12) from the connector socket (28) and replace the shorting plug (29).

CAUTION: Test machine will not operate unless the shorting plug is back in place

IV. Fill and Purge

A. Setup

NOTE: All fittings are to be cleaned in accordance with Sect. II.C.2.a.5.

1. Snubber should be installed in accordance with Sect. II.B.

2. Adjust the tester ram position so that the snubber piston is centered at approximately mid-stroke. Mid-stroke is determined by fully retracting the snubber piston, measuring the distance from the piston rod collar to the head of the cylinder, adding one half of the cylinder stroke to this measurement and extending the snubber piston to this position. (Refer to Section II.A for adjustment of tester ram position).

3. Blow off the area around the reservoir fill port with filtered shop air. Remove the reservoir breather filter and install the adapter (23) (with a 9/16"-18 straight thread and O'ring) into the reservoir fill port. Tighten snug only.

   CAUTION: Every effort must be taken to avoid getting contaminants into the reservoir fill port.

4. Blow off the area around the cylinder fill ports with filtered shop air. Remove the snubber fill port plugs (E) located at the cylinder cap and rod ends. Install the two adapters (23) (with a 9/16"-18 straight thread) for 1-3 Kip units or (24) (with a 3/4"-16 straight thread) for 10 Kip and larger units into the cylinder fill ports. Tighten snug only.

   CAUTION: Every effort must be taken to avoid getting contaminants into the cylinder fill ports.

IV.A. Cont'd

5. Verify purge valve (27) is to the OFF position.
6. Attach the two ends of the "Y" connector (25) to the adapters installed in the cylinder fill ports.
7. Connect the end of the hose (26) to the adapter (20) installed in the reservoir fill port.
8. Install a retaining ring (WALDES-KOHINOOR INC. P/N N5100-37) onto reservoir rod.
9. Install the appropriate reservoir rod stop assembly (ITT P/N 670-53100) as follows (See Figure 9):
   a. Remove two diagonally opposite reservoir bellows-to-housing screws and washers - See Figure 9 for location.
   b. Attach reservoir rod stop assembly using two socket head cap screws (sizes shown on Figure 9). Tighten hand tight only.
   c. Install purge clip (ITT P/N 670-53125) by sliding (small end first) into slots in reservoir rod stop from top to bottom. Verify clip passes through both slots.

B. Fill & Purge - See Figure 1 for Sequence

1. Open all valves on the reservoir and cylinder fill port adapters. Slowly position purge valve to the "TO RES" position to allow the fluid to flow into the snubber.
2. When all lines are completely filled with fluid, reposition purge valve to the "TO CYL" position and again wait until all lines are completely filled with fluid.
3. Reposition purge valve to the "TO RES" position.
4. Stroke snubber (refer to Table 4 for maximum stroke speed) to the fully retracted position, then to the fully extended position then return to mid-stroke.

   NOTE: Continuously rock the cylinder slowly about it's axis while stroking.
5. Position purge valve to the OFF position.
6. Remove purge clip from the reservoir rod stop.
7. Position purge valve to the "TO CYL" position.
8. Close valve on reservoir adapter (23) (fully clockwise) to fill reservoir.
9. When reservoir rod is fully extended, open valve on reservoir adapter and close valves on both cylinder fill port adapters while watching reservoir hose (26) for bubbles.
10. When reservoir has fully drained (reservoir rod retaining ring bottomed against reservoir), open valves on both cylinder fill port adapters.
11. Repeat steps 8 thru 10 until no air bubbles are seen flowing through the reservoir hose.
12. Close valves on both cylinder fill port adapters.
13. Reinstall purge clip on reservoir rod stop.
14. Position purge valve to the "TO RES" position and open valves on both cylinder fill port adapters.
15. Stroke snubber (refer to Table 4 for maximum stroke speed)—

IV.B.15. Cont'd

to the fully retracted position, then to the fully extended position, then return to mid-stroke.

NOTE: Continuously rock the cylinder slowly about it's axis while stroking.

16. Position purge valve to the "TO CYL" position.
17. Stroke snubber (refer to Table 4 for maximum stroke speed) to the fully retracted position, then back to the fully extended position.

NOTE: Continuously rock the cylinder slowly about it's axis while stroking.

18. Position purge valve to the OFF position.
19. Remove purge clip from the reservoir rod retainer.
20. Close all valves on the reservoir and cylinder fill port adapters.
21. Position purge valve to the "TO RES" position.
22. Partially open the valve on the reservoir adapter until the reservoir rod extends approximately 1/4", then close valve.
23. Turn the direction selector (8) to the compression direction.
24. Set the compression pressure regulator (4) by adjusting the knob directly below the compression system pressure gage (1) to the system pressure for compression at 50% of rated load (See Table 2).
25. Fully open the compression velocity control valve (6).
26. When the cylinder is fully retracted, close the compression pressure regulator.
27. Close the compression velocity control valve.

IV.B. Cont'd

28. Repeat steps 23 thru 27 for the tension direction until the cylinder is fully extended. Inspect snubber for evidence of leaking. If leaks do occur, the snubber must be disassembled.

29. Repeat steps 23 thru 28 two times (a total of 3 complete cycles)

30. Open valves on both cylinder fill port adapters.

31. When reservoir has fully drained (reservoir rod retaining ring bottomed against reservoir), reinstall purge clip on reservoir rod retainer.

32. Verify/position purge valve to the "TO RES" position & open the valve on the reservoir fill port adapter.

33. Stroke snubber (refer to Table 4 for maximum stroke speed) to the fully retracted position, then back to the fully extended position.

NOTE: Continuously rock the cylinder slowly about it's axis while stroking.

34. Position purge valve to the "TO CYL" position.

35. Repeat Step 33.

36. If air bubbles were seen flowing from the snubber during steps 33 or 35, repeat steps 32 thru 36. If no air bubbles were seen flowing through any of the lines proceed.

37. Position purge valve to the OFF position.

38. Remove the pivot mount pin and raise the cylinder such that the cylinder is at a 30 to 45° angle with the tester.

39. Remove purge clip from the reservoir rod retainer.

40. Position purge valve to the "TO CYL" position.

41. Close valve on reservoir adapter (23) (fully clockwise) to fill reservoir.

IV.B. Cont'd

42. When reservoir rod is fully extended, open valve on reservoir adapter and close valves on both cylinder fill port adapters while watching reservoir hose (26) for bubbles, until reservoir has fully drained (reservoir rod retaining ring bottomed against reservoir).

43. If no air bubbles were seen during Step 42, proceed to Step 45.

44. If air bubbles were seen during Step 42 open valves on both cylinder fill port adapters and repeat steps 41 through 43.

45. Remove the reservoir rod retainer & reinstall reservoir bellows-to-housing screws and washers. Tighten hand tight only.

46. Close valve on reservoir adapter and open valves on both cylinder fill port adapters until the appropriate reservoir rod spacer (ITT P/N 670-) can be placed between the reservoir rod retaining ring and the reservoir, close valves on both cylinder fill port adapters.

47. While holding the reservoir rod spacer in place, open the valve on the reservoir adapter until the spacer is in contact with both the retaining ring and the reservoir then close the valve.

48. Disconnect the reservoir hose from the adapter installed in the reservoir fill port.

49. Disconnect the two ends of the "Y" connector from the adapters installed in the cylinder fill ports.

50. Spray off the reservoir fill port plug and both cylinder fill port plugs with filtered freon.

51. Using shims or blocks, orient snubber so that the top of the unit is horizontal.

IV.B. Cont'd

52. Remove the adapter from the reservoir fill port. Top off the port with filtered silicone fluid until slightly overflowing. Screw the plug into the fill port and torque to 25-27 ft-lbs. See procedure PHD-7556-6, Appendix C for calibration & adapter adjustments.

CAUTION: Every effort must be taken to avoid getting contaminants into the reservoir fill port.

53. Remove one of the cylinder fill port adapters. Top off the port with filtered silicone fluid until slightly overflowing. Screw the plug into the fill port and torque to 25-27 ft-lbs (1 1/2" & 2" units) or 45-50 ft-lbs (2 1/2" and larger units).

CAUTION: Every effort must be taken to avoid getting contaminants into the cylinder fill ports.

54. Repeat Step 53 for the other cylinder fill port.

55. Stroke cylinder in the compression direction until the rod spacer can be removed.

56. Remove the reservoir rod retaining ring.

V. TESTING

A. Setup

1. Verify snubber has been filled & purged in accordance with Section IV.
2. Verify reservoir rod stop, rod spacer and retaining ring have been removed.

B. Limiting Velocity Measurement

1. Close both velocity controls (6) & (7).
2. Push start button (10).
3. Position the snubber to approximately 1" retracted from it's mid-stroke position.
4. Turn the direction selector (8) to tension.
5. Set the tension pressure regulator (5) by adjustment of the knob directly below the tension system pressure gage (2) to the tension system pressure for 25% of rated load (refer to Table 2) for the test snubber.
6. Fully open the tension velocity control valve (7) and observe the limiting velocity.
7. Immediately close the tension pressure regulator (5), close the tension velocity control valve (7) and turn the direction selector to OFF.
8. Record the tension limiting velocity on the ID & Routing Tag - See Figure 10. NOTE: Use a fine pen or sharp pencil and press firmly).
9. If the measured limiting velocity is not within 8 to 15 in/min, the snubber must be reworked.
10. Position the snubber to approximately 1" extended from it's mid-stroke position.
11. Repeat Steps 4 through 9 for compression.
12. Repeat Steps 3 through 11 for 50% and 100% of rated load for tension and compression.

13. Turn the direction selector to tension.
14. Set the tension pressure regulator by adjustment of the knob directly below the tension system pressure gage to the tension system pressure for 150% of rated load (refer to Table 2) for the test snubber.
15. Fully open the tension velocity control valve and observe the limiting velocity.

    NOTE: The limiting velocity may be higher than 15 in/min.
16. When the snubber is fully extended, close the tension pressure regulator, close the tension velocity control valve and turn the direction selector to OFF.
17. Record the tension limiting velocity on the ID & routing tag.
18. Turn the direction selector to compression.
19. Repeat Steps 14 through 17 for compression until the snubber is fully retracted.
20. Repeat Steps 13 through 19 one time.
21. Inspect the snubber for evidence of leaking. If leaks do occur, the snubber must be disassembled.

C. Drag Force Measurement

1.0 Safety Devices -- See Section III.B.

2.0 Equipment Setup -- See Section III.C.

3.0 Drag Force Measurement

CAUTION: Before Proceeding Insure That The Following Steps Are Taken.

- Both velocity control valves (6 & 7) are fully closed.
- Both pressure regulators (4 & 5) are fully closed.
- The channel selector (d2) is switched to the correct load pin (d10 or d11).
- The oper/cal switch (d5) is on oper
- The rod eye is centered on the pin per Figs. 6 & 7.
- The snubber position is within plus or minus 1 1/2" from mid-stroke.
- the re-set switch (d13) has been activated.

If at any time the direction selector (8) fails to function or the operational light (30) fails to illuminate, all of the above items must be checked.

a. Install pin into clevis bracket as shown in Figure 6, 7 & 8.

b. Set the piston position ± 1/2" retracted from the mid-stroke position (i.e. 1" from fully retracted on a 5" stroke snubber).

c. Check the load pin (d10 or d11) and bushing alignment against Fig. 6 or 7 and the pin orientation tabs per Fig. 8.

d. Turn the direction selector (8) to tension.

e. Very slowly open the tension velocity control valve (7) and observe the peak breakaway force on the load meter (d1) on the BLH transducer indicator.

f. Continue to slowly open the tension velocity control valve until the velocity meter (3) reads 6 in/min (± 0.1).

g. Observe the drag force on the load meter for 5 seconds.

<u>CAUTION</u>: If the snubber position exceeds 1 1/2" extended from midstroke, it must be reset per step b. and steps c. thru g. repeated.

NOTE: If the drag force measured exceeds the pre-set levels of the BLH unit, the test machine directional control will shutoff. Proceed to check list in Section IV.C.3. and Repeat Steps a. thru g.

h. Record the peak breakaway force and highest value drag force (at 6 in/min) on the ID & Routing tag -- See Figure 10.

i. If the peak breakaway force or 6 in/min drag force exceeds the following values, the snubber must be torn down.

3.0 i. Cont'd

Cylinder Bore (in.)	Acceptable Peak Breakaway Force and 6 in/min Drag Force (Tension & Compression) (lbs.)
1 1/2	100
2	100
2 1/2	200
4	500
5	900
6	1400
8	2200

j. Close the tension velocity control valve (7) fully counter-clockwise.

k. Turn the direction selector (8) to "OFF"

l. Set the piston position 1 1/2" extended from mid-stroke (i.e., 1" from fully extended on a 5" stroke snubber).

m. Repeat Steps c. thru k. in the compression direction.

n. Position the piston rod to the mid-stroke position.

o. Push stop button (9).

4.0 Equipment Teardown

a. Turn off the BLH Model 450 Transducer Indicator power switch (d3).

b. Remove the load pin (d10 or d11).

c. Remove the adapter plug (d12) from the connector socket (28) and replace the shorting plug (29).

CAUTION: Test machine will not operate unless the shorting plug is back in place.

D. Piston Position Indicator

Verify unit is at mid-stroke. Torque the indicator rod locking set screw (F) to 31-34 in-lb (1 1/2", 2" & 2 1/2" cyl) or 75-80 in-lb. (4", 5", 6" & 8" cyl).

E. The following information is to be written on the ID & Routing Tag.

E. Cont'd

(NOTE: Use a fine pen or sharp pencil and press firmly):

DATE OF TEST

TESTED BY

MACHINE NO.

DRAG PIN S/N & CAL. DATE

TESTER CAL. DATES

QA TEST INSPECTOR SIGNOFF

F. Removal

Remove pivot pin at cap end of cylinder and remove snubber. The snubber is now ready for completion of assembly - See Assembly Procedure PHD-7556-6, Section 7.0.

VI. TESTER INSTALLATION & MAINTENANCE

A. The testers should be securely bolted to the floor or bench top.

B. The testers come pre-wired for 440V-30-60 Hz power. The testers can run on 220V-30-60 Hz power by rewiring the motor and transformers and replacing the motor heaters.

C. The testers come filled with hydraulic fluid. If the fluid is changed, it should be replaced with heavy duty, anti-wear hydraulic fluid with a viscosity of 150 ssu.

D. Velocity Meter Calibration (All Models)

1. Wait 15 minutes after pressing the start button. The velocity meter should indicate a readout of 000 and display toggling between + and -. If this is not the case, adjust the zero potentiometer (located directly above extreme right hand digit on display) for the required readout.

2. Calibration Determination

a. Zero the meter.

b. Fully retract the ram.

c. Close both velocity controls. Set compression pressure regulator to 150 psi for PHD-5434-3 and PHD-7556C, 500 psi for PHD-5434-1A.

d. Turn the direction selector to compression. Open the compression velocity control slowly until the velocity meter indicates readout of 10.0 and display toggling above and below 10.0. Using a scale and calibrated stop watch, measure the time required for five (5) inches of ram travel. Time should be between 29 and 31 seconds; if this is not the case, calibration is required as described below.

3. Calibration

Adjust ram velocity to a point where the time required for

3. Cont'd

five (5) inches of displacement falls between the above specified limits.

a. For PHD-7556-C:

To Be Supplied Later

b. For PHD-5434-3:

Adjust the potentiometer located in the lower right hand corner of the electrical junction box until the velocity meter indicates a readout of 10.0 and display toggling above and below 10.0.

c. For PHD-5434-1A:

Adjust the potentiometer located in the readout meter panel, directly above the DC power unit until the velocity meter indicates a readout of 10.0 and display toggling above and below 10.0.

E. Pressure Gauge Calibration

Both compression and tension pressure gauges should be removed once every six (6) months and calibrated in a static hydraulic system (See Fig. 11) or a dead weight tester. The calibrated gauge in the static hydraulic system or the dead weight tester must be calibrated with traceability to the standards of the National Bureau of Standards. Calibration points and calibration limits shall be as shown below:

Standard Reading	Min. Reading Test Gauge	Max. Reading Test Gauge
100	93	107
200	193	207
400	388	412
700	679	721
1000	970	1030
1500	1455	1545
2500	2425	2575

NOTE: Gauge pointer to be set to zero after installation in test fixture and to be set to zero after reinstallation in snubber tester.

F. Whitey Ball Valve Packing Adjustments

At monthly intervals (or sooner if bubbles or fluid are seen coming from the valves) the ball valve packings must be adjusted.

Use a 3/32" (for 44 series valves) or 1/8" (for 45 series valves) allen wrench to remove the valve handle. The packing bolt is to be loosened and retorqued (clockwise) using a 1/2" (for 44 series valves) or 5/8" (for 45 series valves) crowfoot wrench. Torque values are 125 in-lbs (for 44 series valves) or 225 in-lbs (for 45 series valves) for stainless steel valves and 65 in-lbs (for 44 series valves) or 150 in-lbs (for 45 series valves) for brass valves. If leaks still persist, adjust packing in 1/8 turn increments until leak-tight.

G. Swagelok Quick Disconnects

At quarterly intervals or sooner if leaks are present, the quick disconnects should be checked for looseness (a sideways motion between the stem end and body end of the quick disconnect). See Figure 12. Swagelok recommends that the quick disconnects be factory serviced; however, if servicing is to be performed by plant maintenance it should be performed in the following manner:

1. Disconnect the stem end from the body end.
2. Remove the body end from the line it is connected by turning the tubing nut counterclockwise until it is completely off of the body.

G. Cont'd

3. Remove tubing.

4. Place the body hex end in a vise with the body nut facing up.

5. With a pair of vice grip pliers or channel lock pliers, firmly grasp the body nut and turn in a counterclockwise direction.

   NOTE: (There is a special tool for this operation available from Swagelok and should be purchased).

6. Place the body nut thread end down on a work bench and with a thin rigid object (such as a very stiff wire or rod) gently push the teflon sleeve and "O" ring down until free.

7. Remove the "O" ring from it's groove in the teflon sleeve.

8. Discard both "O" rings.

9. Replace both -012 "O" rings with ethylene propylene (EP) or other SF-1154 compatible compound and reverse the procedure to assemble.

TABLE 1

BRACKET & BUSHING SIZES

SNUBBER BORE (in.)	BRACKET HOLE SIZE (in.)	BUSHING SIZE	
		OD (in.)	ID (in.)
1 1/2	1 1/4	1 1/4	1/2
2	1 1/4	1 1/4	3/4
2 1/2	1 1/4	1 1/4	1
4	1 3/4	1 3/4	1 1/2
5	1 3/4	Not Required	
6	2 1/2	2 1/2	2
8	2 1/2	Not Required	

TABLE 2

TEST MACHINE SYSTEM PRESSURES

TEST MACHINE MODEL NO.	SNUBBER BORE (in.)	% OF RATED LOAD	LOAD (LBS)	SYSTEM PRESSURE (PSI)	
				TENSION	COMPRESSION
PHD-7556C	1 1/2	25	250	106	80
		50	500	212	159
		100	1,000	424	318
		150	1,500	636	478
	2	25	750	318	239
		50	1,500	636	478
		100	3,000	1270	955
		150	4,500	1910	1435
PHD-5434-3	2 1/2	25	2,500	80	65
		50	5,000	159	130
		100	10,000	318	260
		150	15,000	477	390
	4	25	6,250	199	162
		50	12,500	398	325
		100	25,000	796	650
		150	37,500	1195	975
	5	25	11,250	358	292
		50	22,500	716	585
		100	45,000	1430	1170
		150	67,500	2150	1755
PHD-5434-1A	6	25	17,500	272	220
		50	35,000	468	375
		100	70,000	862	684
		150	105,000	1255	994
	8	25	27,500	384	308
		50	55,000	693	552
		100	110,000	1310	1040
		150	165,000	1930	1525

PRESSURES FOR NON-STANDARD LOADS

TEST MACHINE MODEL NO.	SYSTEM PRESSURE (PSI)	
	TENSION	COMPRESSION
PHD-7556C	$\frac{\text{Rated Load}}{2.36}$	$\frac{\text{Rated Load}}{3.14}$
PHD-5434-3	$\frac{\text{Rated Load}}{31.42}$	$\frac{\text{Rated Load}}{38.46}$
PHD-5434-1A	$\frac{\text{Rated Load}}{69}$ +75 PSI	$\frac{\text{Rated Load}}{113}$ +65 PSI

TABLE 3

LOAD PIN & BUSHING IDENTIFICATION

CYLINDER BORE (in.)	TEST MACHINE MODEL NO.	DRAG PIN NO.	DRAG PIN SIZE (LBS)	CLEVIS BUSHING (ID x OD x LG) (2 REQ'D)	ROD EYE BUSHING (ID x OD x LG) (1 REQ'D)
1 1/2	PHD-7556C	2	500	1/2 x 1 1/4 x 1	Not Req'd
2	"	2	500		1/2 x 3/4 x .88
2 1/2	PHD-5434-3	2	500		1/2 x 1 x 1.375
4	"	1	1100	3/4 x 1 3/4 x 1 1/4 3/4 x 2 x 7/16 with Flats	3/4 x 1 1/2 x 1.6[illegible]
5	"	1	1100		3/4 x 1 3/4 x 1.8[illegible]
6	PHD-5434-1A	1	1100	3/4 x 2 1/2 x 1 1/2	3/4 x 2 x 1.94
8	"	1	1100	3/4 x 2 1/2 x 1 1/2	3/4 x 2 1/2 x 2.0[illegible]

TABLE 4

MAXIMUM PURGE STROKING SPEEDS

CYLINDER BORE (in.)	MAX. TESTER PURGE STROKING SPEEDS (in/min)
1 1/2	4
2	4
2 1/2	4
4	3
5	3
6	2
8	2

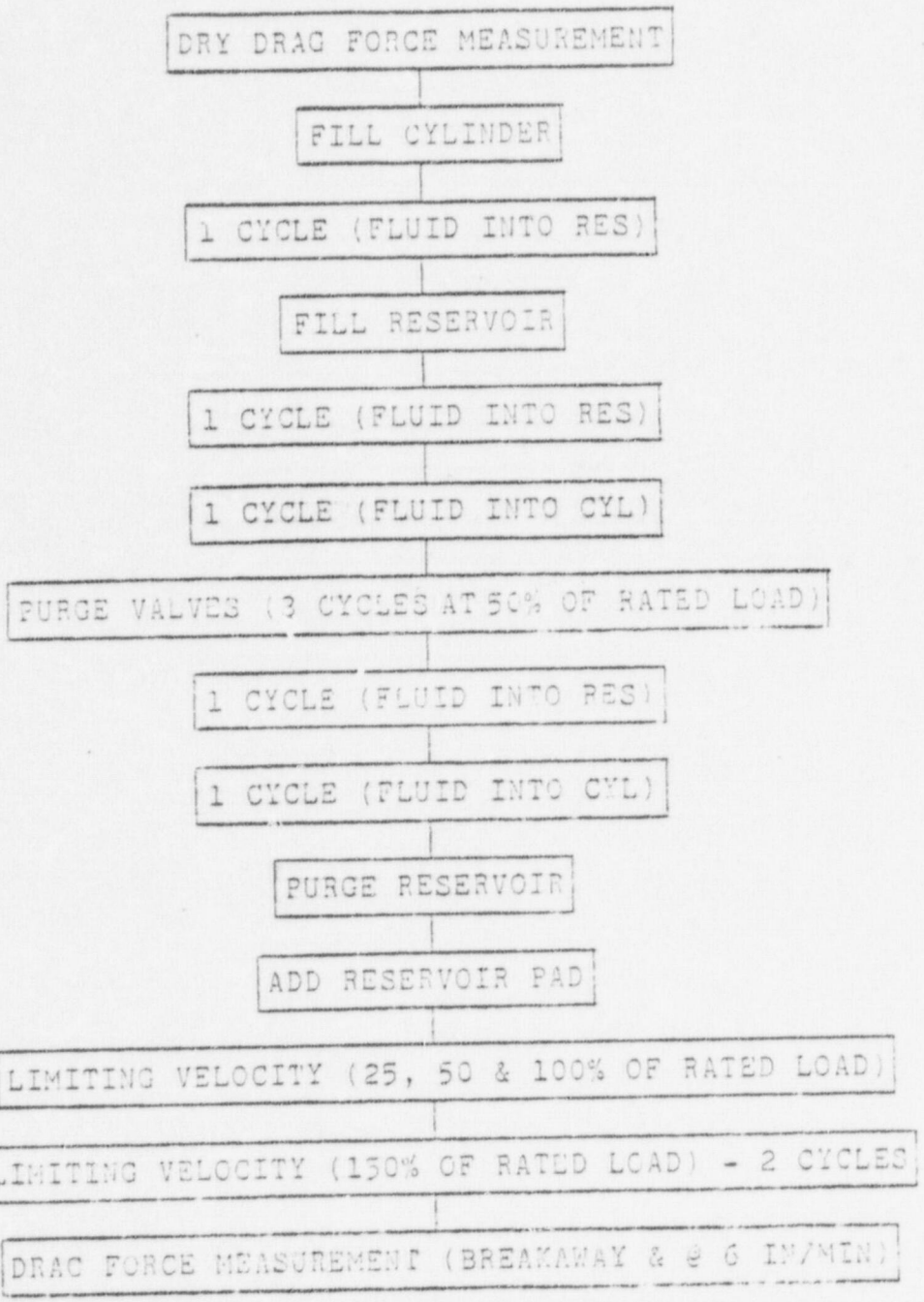
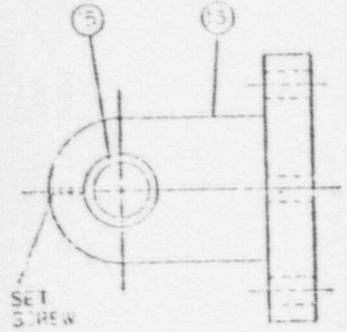
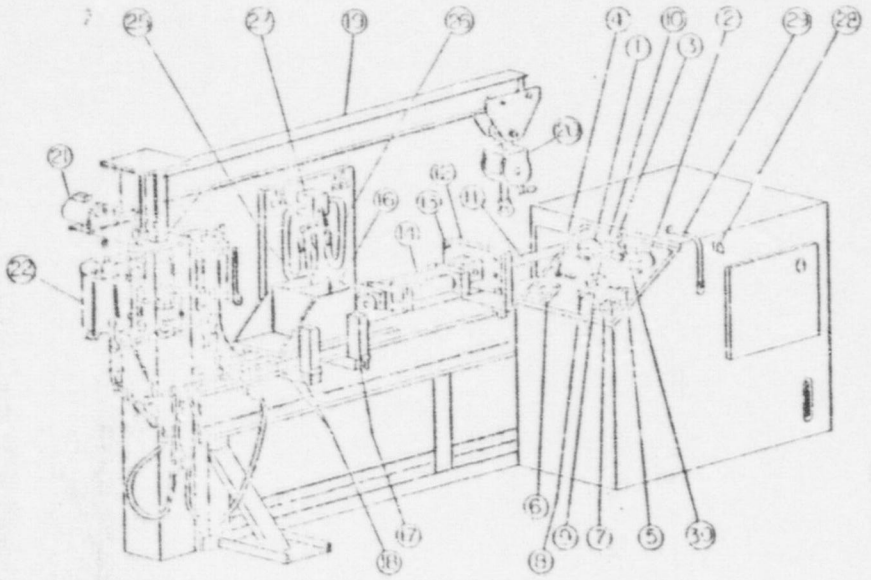


FIGURE 1

FILL, PURGE & TEST SEQUENCE

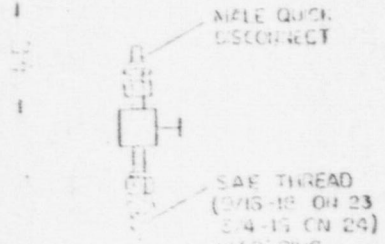


DETAIL-A
ADAPTER CLEVIS



LIST OF PARTS - TEST MACHINE

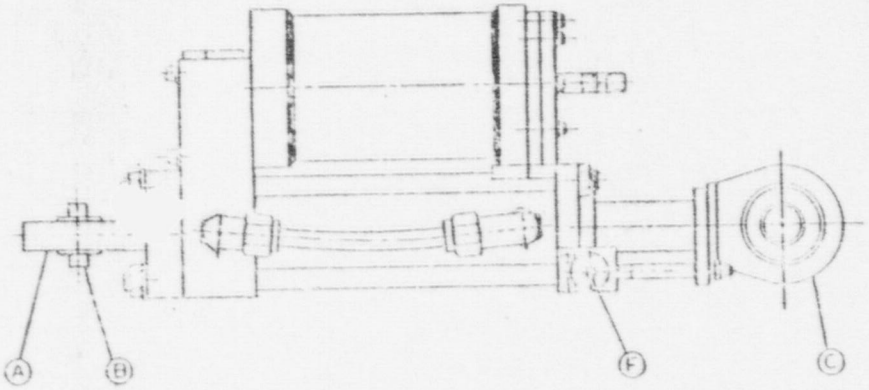
ITEM NO.	PART	PART NO.
1		COMPRESSION PRESSURE GAGE
2		TENSION PRESSURE GAGE
3		VELOCITY METER
4		COMPRESSION PRESS REGULATOR
5		TENSION PRESS REGULATOR
6		COMP VELOCITY CONTROL VALVE
7		TENS VELOCITY CONTROL VALVE
8		DIRECTION SELECTOR
9		STOP BUTTON
10		START BUTTON
11		TESTER DRIVE RAM
12		RAM MOUNTING PLATE
13		ADAPTER CLEVIS
14		SNUBBER - SEE DETAIL B
15		ADAPTER BUSHING
16		REAR UPRIGHT
17		SOCKET HEAD BOLTS
18		GEAR RACK
19		JIB BOOM
20		HOIST
21		VACUUM PUMP MOTOR
22		VACUUM PURGE SYSTEM
23		ADAPTER - 9/16-18
24		ADAPTER - 7/8-16
25		Y CONNECTOR
26		RESERVOIR HOSE
27		PURGE VALVE
28		CONNECTOR SOCKET
29		SHOOTING PLUG
30		DIR SELECTION ENABLE LIGHT



(23) (24) ADAPTERS

LIST OF PARTS - SNUBBER

ITEM LET	DESCRIPTION
A	PIVOT LUG
B	PIVOT PIN
C	[illegible]
D	RESERVOIR FILL PORT PLUG
E	CYLINDER FILL PORT PLUG
F	LOCKING SET SCREW



DETAIL-B
SNUBBER ASS'Y

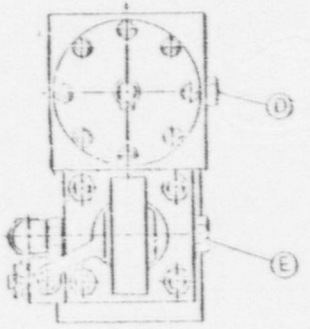
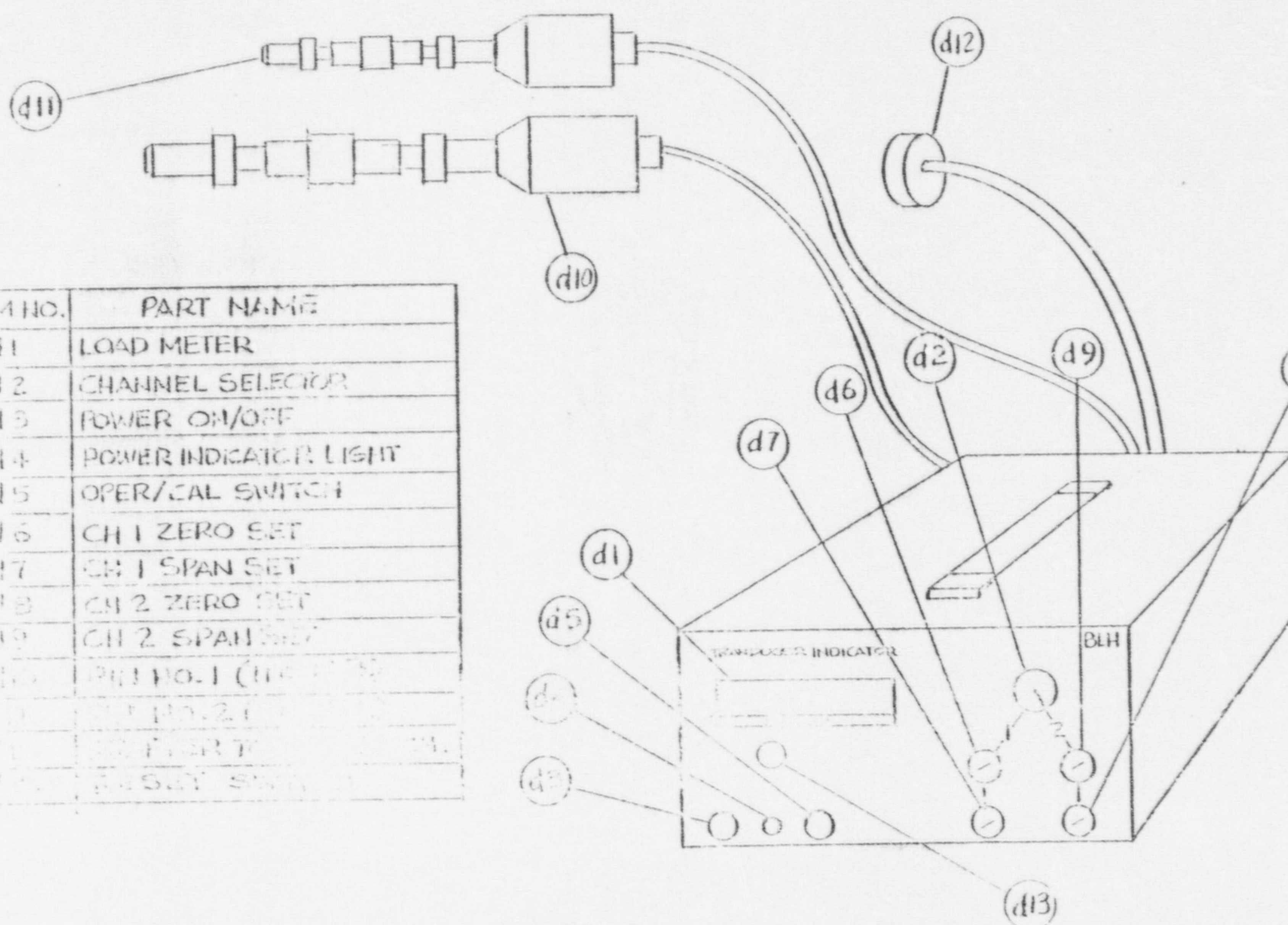


FIGURE 2. SNUBBER DETAILS & TEST MACHINE
MODEL PHD-5434-3

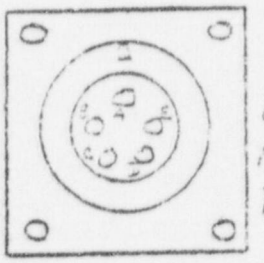


ITEM NO.	PART NAME
d1	LOAD METER
d2	CHANNEL SELECTOR
d3	POWER ON/OFF
d4	POWER INDICATOR LIGHT
d5	OPER/CAL SWITCH
d6	CH 1 ZERO SET
d7	CH 1 SPAN SET
d8	CH 2 ZERO SET
d9	CH 2 SPAN SET
[illegible]	PH NO. 1 (CH [illegible]
[illegible]	[illegible] NO. 2 [illegible]
[illegible]	[illegible] FOR T[illegible]
[illegible]	RESET SW[illegible]

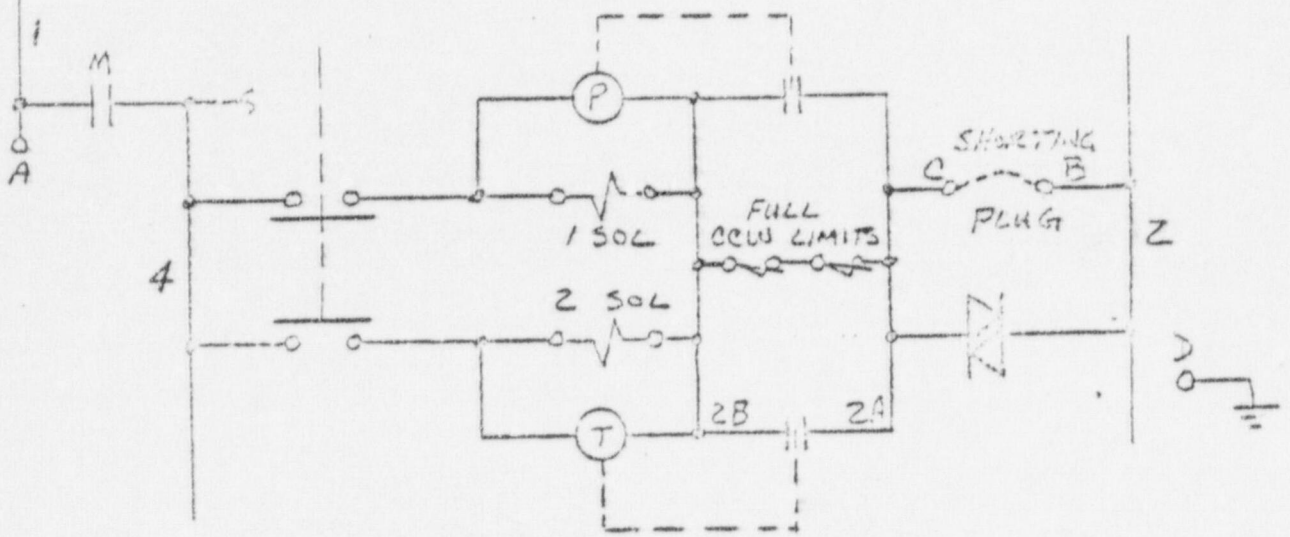
FIG. 3

BLH MODEL 450 TRANSDUCER INDICATOR

NOTE: WHEN BLH DEVICE IS NOT IN USE, SHORTING PLUG MUST BE CONNECTED.



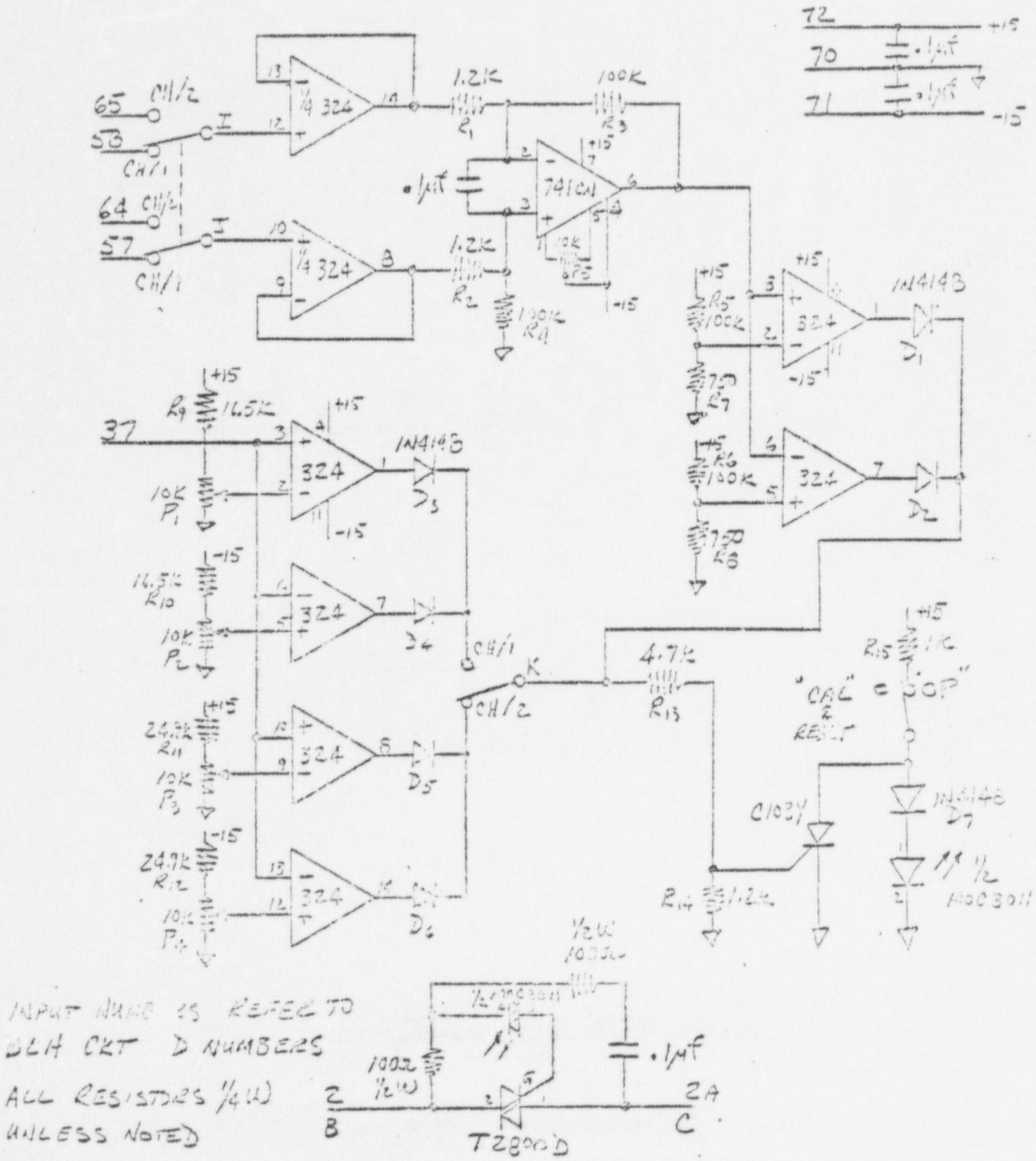
SOCKET & LETTER DESIGNATIONS FOR BLH HOOKUP



NOTE: This diagram shows modifications to test machines to facilitate velocity lever "full CCW to start" interlocks and BLH Model 450 drag test pin safety ckt.

FIGURE 4

TEST MACHINE MODIFICATIONS FOR SAFETY SHUTOFF



INPUT NUMBERS REFER TO BLH CKT D NUMBERS

ALL RESISTORS 1/4W UNLESS NOTED

FIGURE 5

BLH MODEL 450 MODIFICATIONS FOR SAFETY SHUTOFF

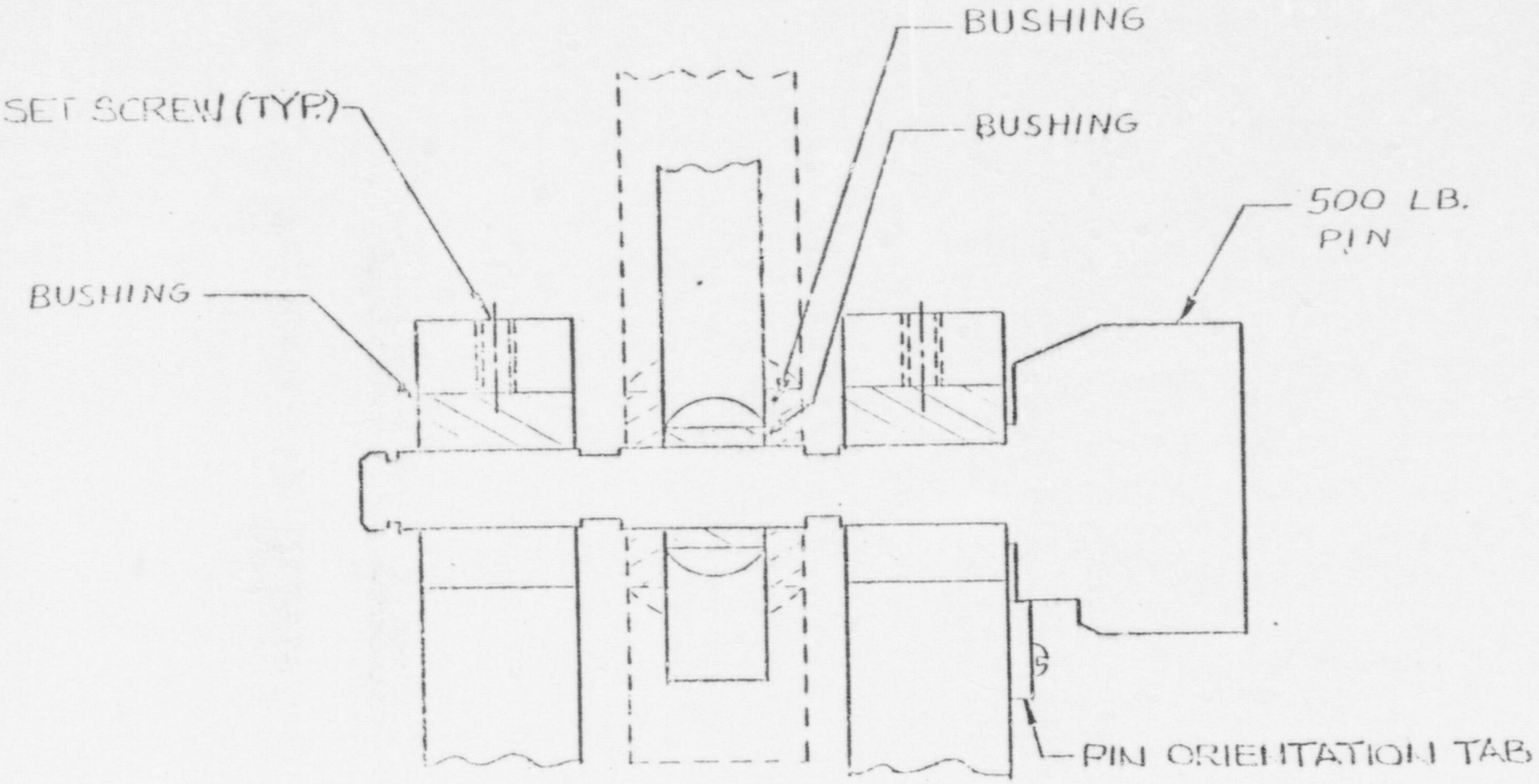


FIGURE 6

1 1/2" - 2 1/2" LOAD PINS

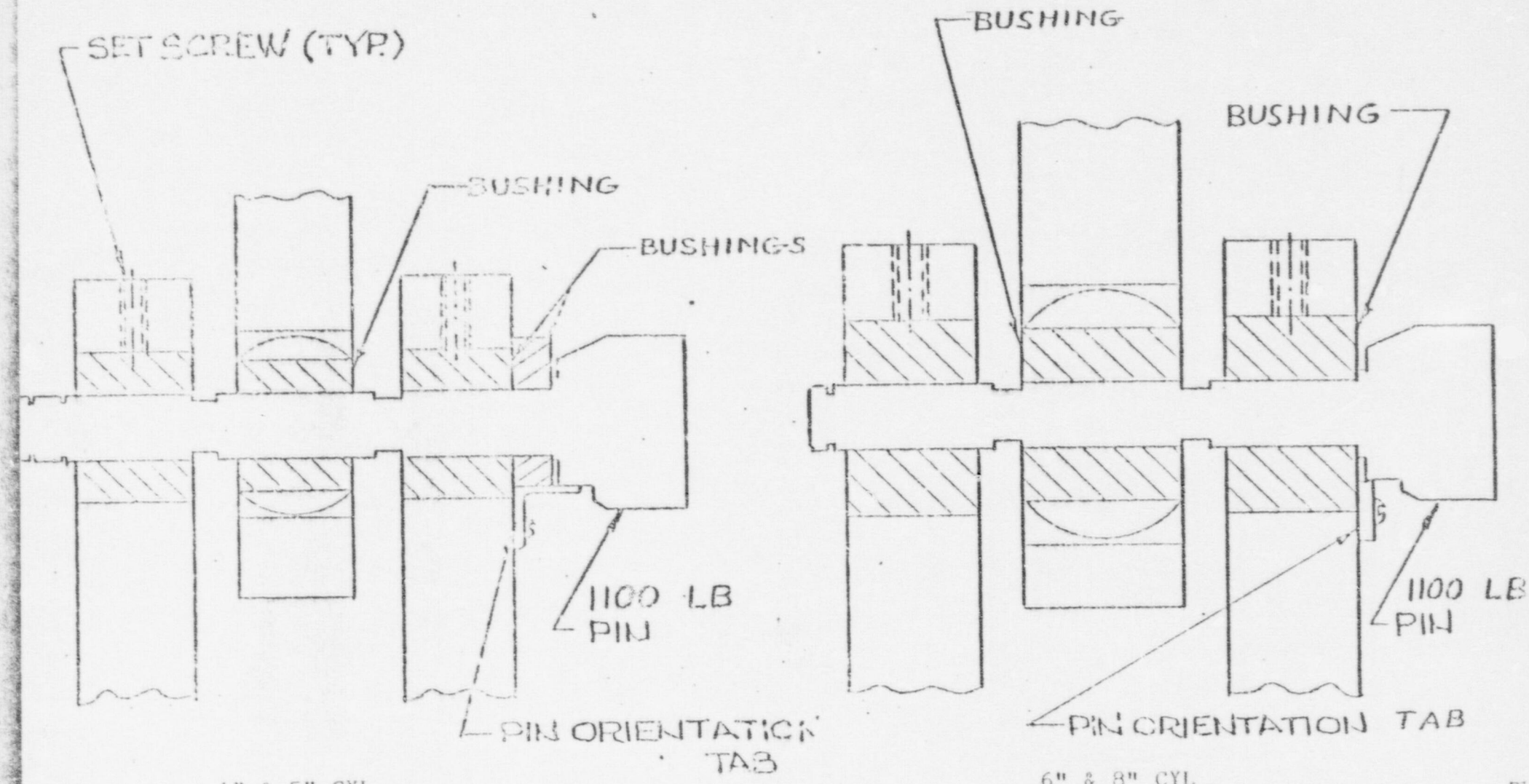


FIGURE 7

4" - 8" LOAD PINS

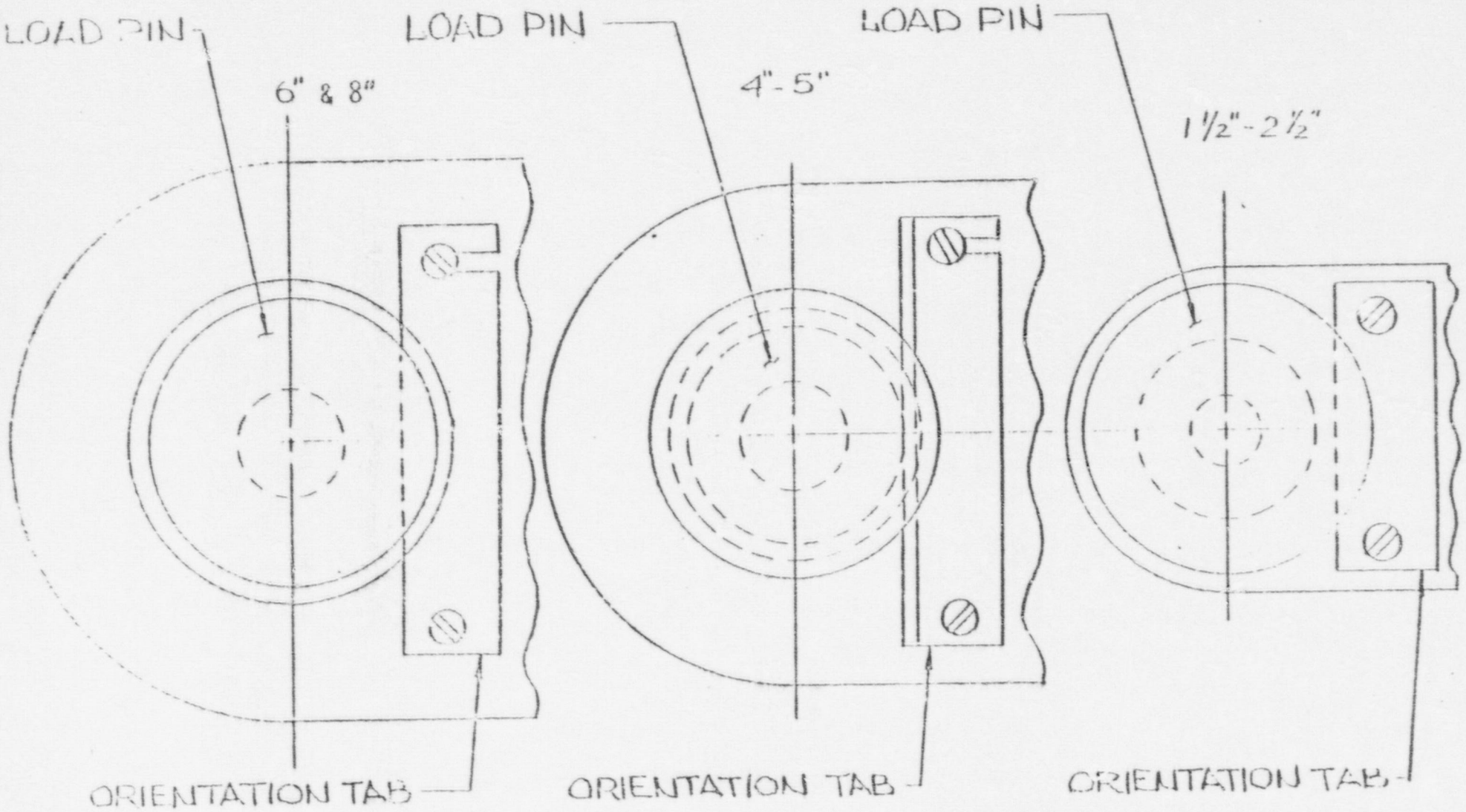
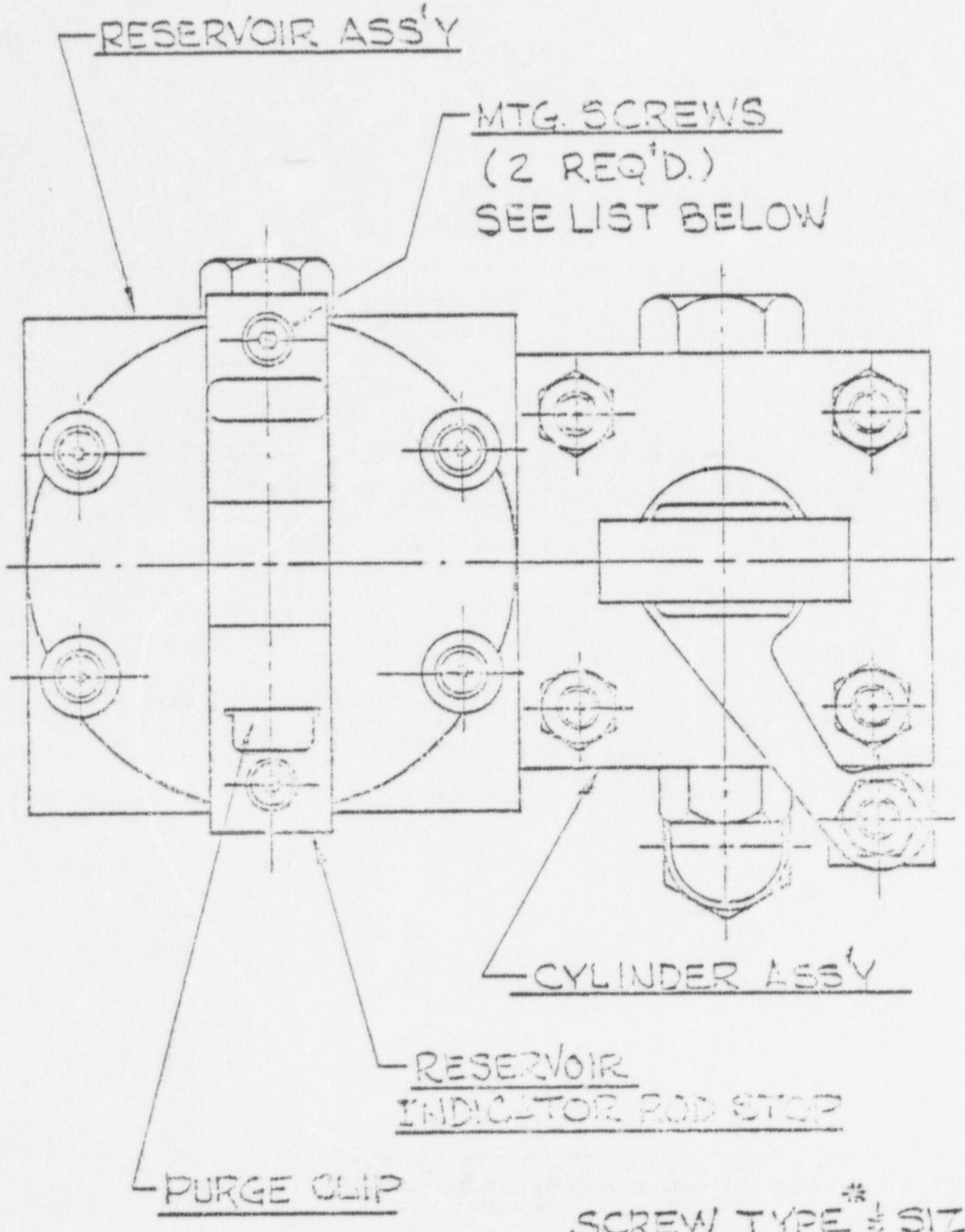


FIGURE 8

PIN ORIENTATION TABS



SCREW TYPE* & SIZE:

1-10 KIP : #10-24 x 3/4" LG.

25 KIP : 1/4-20 x 3/4" LG.

45-110 KIP : 1/4-20 x 15/16 LG.

* ALL SIZES USE SOC. HD. CAP SCR.

FIGURE 9

RESERVOIR INDICATOR ROD STOP INSTALLATION

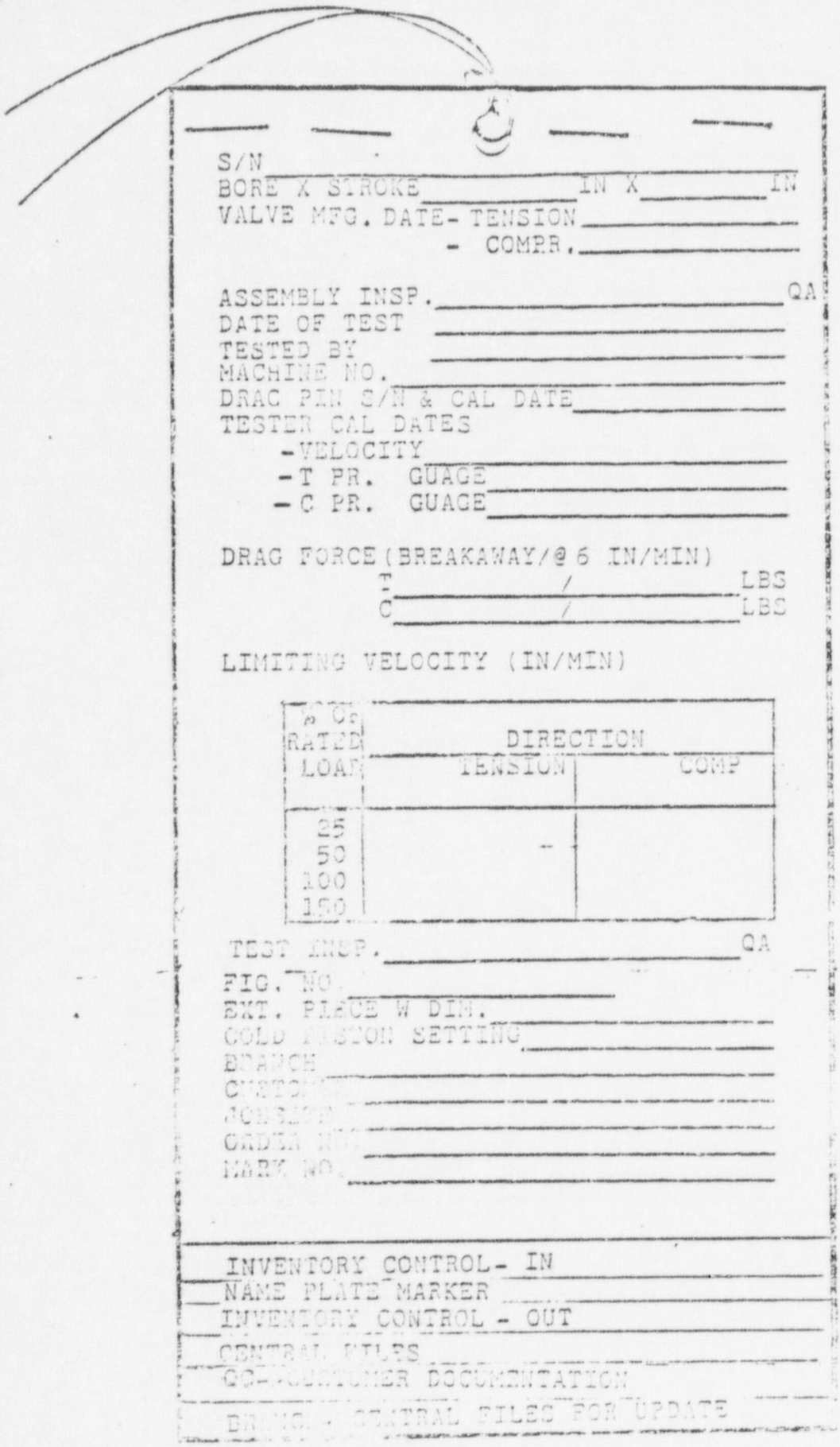


FIG. 10 ID & ROUTING TAG

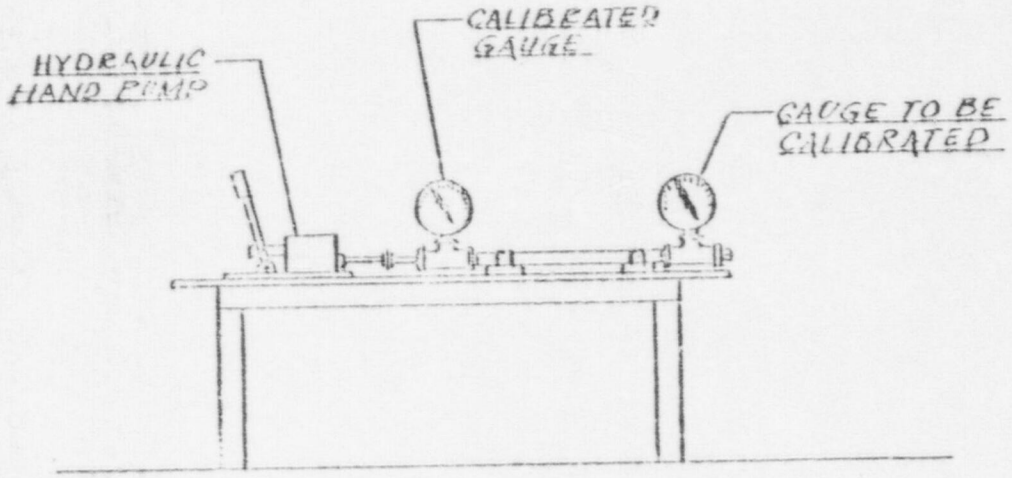


FIGURE 11

PRESSURE GAUGE CALIBRATION SETUP

NOTE: When Disconnected, The Steel Ball (On The Body End) Lays Against The "O" Ring In The Teflon Sleeve.

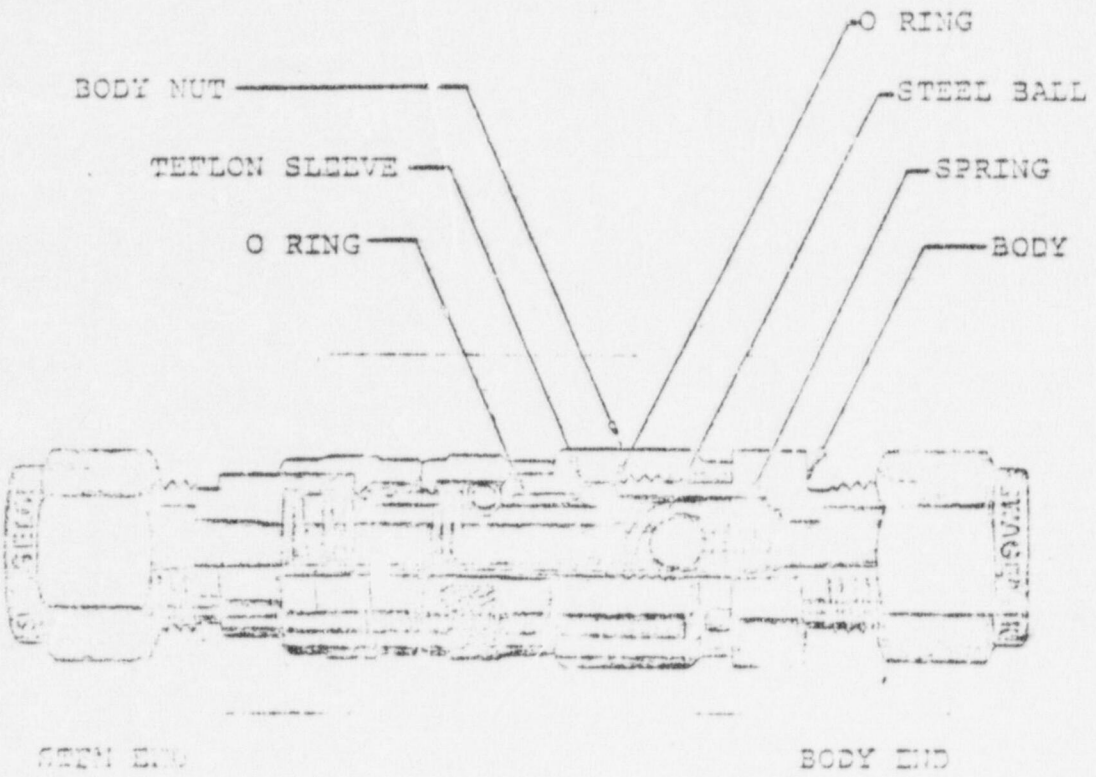


FIGURE 12

SWAGELOK QUICK DISCONNECT

A P P E N D I X A

DRAG FORCE MEASUREMENT EQUIPMENT CALIBRATION FOR FIG. 670 SERIES SNUBBERS

1.0 GENERAL

1.1 System calibration will be performed on a calibrated universal test machine using the adapters and bushings from a Model PHD-5434-3 snubber test machine.

1.2 Pin installation is per Figs. 6, 7 & 8.

CAUTION: The pin orientation tabs must be in place to obtain correct load measurement.

1.3 When calibrating the 1,100 lb. pin, the bushings, rod eyes and adapters for the 6" bore snubber are to be used.

1.4 When calibrating the 500 lb. pin, the bushings, rod eyes and adapters for the 2 1/2" bore snubber are to be used.

2.0 CALIBRATION

2.1 Connect the BLH transducer indicator to the calibration adapter (See Fig. 13) and plug in the AC plug into a grounded 120V AC source.

2.2 Pin No. 1 (1,100 lb. capacity), d10

2.2.1 Span Set

1. Turn on power switch (d3)
2. Switch channel selector (d2) to match pin no.
3. Turn oper/cal switch to oper
4. Adjust zero set (d6) for a zero readout
5. Apply a load of 80% of pin capacity (880 lbs.) in tension.
6. Using the span set (d7) adjust readout to match the applied load
7. Remove the applied load
8. Wait several minutes and check the readout. If the readout is now zero (± 1 lb.), adjust with the zero set.

9. If zero adjustment was required in Step 2.2.1.8, repeat steps 2.2.1.5 thru 2.2.1.8

2.2.2 Full Scale Calibration

1. Apply ten loads in tension, 100, 200, 300, ... 1000 and 1100 lbs. Record both applied load and the indicated load from the load meter (d10) on Table 5.

   NOTE: The safety system within the calibration adapter will shut off the indicator light at approximately 1100 lbs. This has no detrimental effects on this portion of the calibration.

2. Repeat 2.2.2.1 in the compression direction (reset zero if required).
3. Plot a graph of applied load vs. load meter readout with tension and compression on the same graph (see Fig. 14).
4. On the above graph, plot two lines, one plus and one minus 2% of pin capacity (± 22 lbs.) from the actual loads (See Fig.14).
5. The plotted data must fall within the ± 2% lines of this curve; if not, draw a new straight line between zero and passing thru the center of the extreme points, select a new indicated value at 80% of pin capacity, repeat Sections 2.2.1 & 2.2.2 using the new indicated value.
6. The safety system shutoff limits are adjusted as follows:

a) Remove the BLH top cover by unscrewing the two top center cover retaining screws and sliding the cover off to the rear.

b) Apply a load of 1100 lbs in tension. Adjust the appropriate overload trimpot for the 1,100 lb. pin as specified in Fig. I5 The trimpots are located inside the BLH unit and their adjusting screws rotate clockwise to increase the shutoff limit and counterclockwise to decrease. Adjust until the light just goes out.

c) Repeat Step b) for compression

2.3 Pin No. 2 (500 lb. Capacity), dll

2.3.1 Repeat Para. 2.2.1 except the applied load in 2.2.1.5 is 400 lbs.

2.3.2 Repeat Para. 2.2.2 except the loads for 2.2.2.1 will be 50, 100, 150 ... 450 and 500 lbs. and for 2.2.2.6 b) will be 500 Lbs.

2.4 Replace the BLH top cover and retaining screws.

2.5 Disconnect the BLH from the calibration adapter.

2.6 The span for each pin number is to be noted on the calibration sticker for each BLH unit.

TABLE 5

DRAG PIN CALIBRATION DATA SHEET

BLH S/N _____

DATE _____

TESTED BY: _____

REIHLE TEST MACHINE CAL. DUE DATE _____

500 lb. Pin

Pin S/N _____

Actual Load (lbs.)	Indicated Load (Lbs.)	
	Tension	Compr.
100		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
1100		

1100 lb. Pin

Pin S/N _____

Actual Load (lbs.)	Indicated Load (lbs)	
	Tension	Compr.
50		
100		
150		
200		
250		
300		
350		
400		
450		
500		

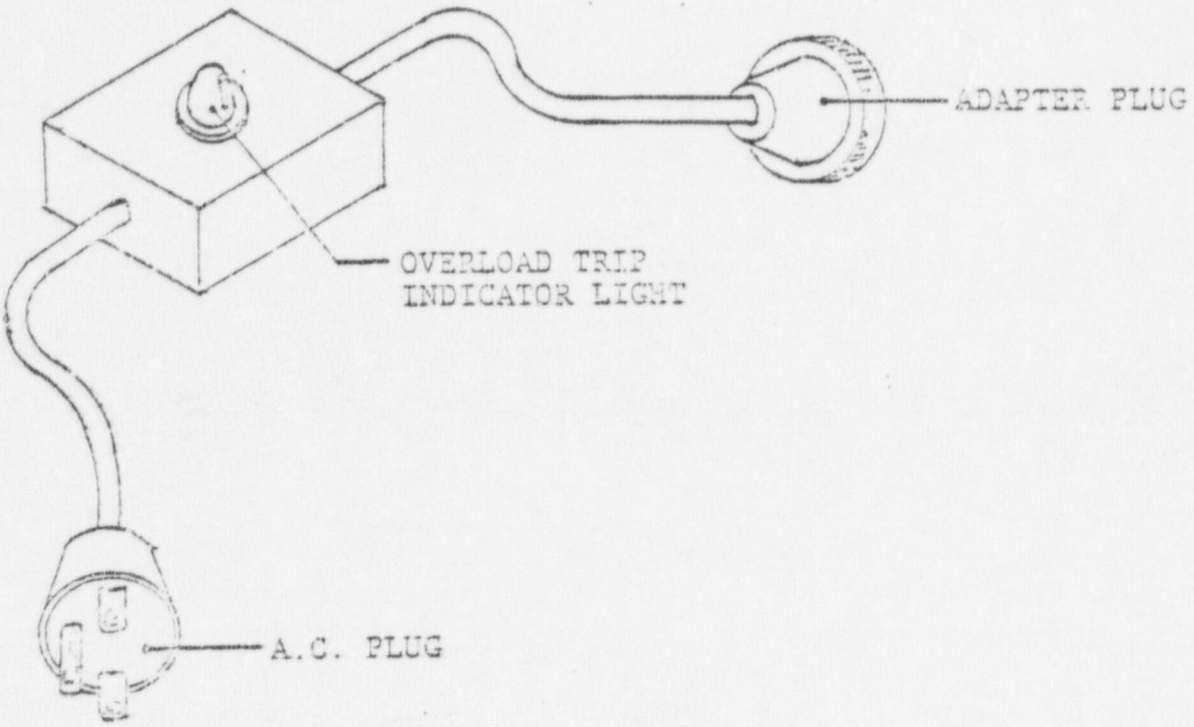
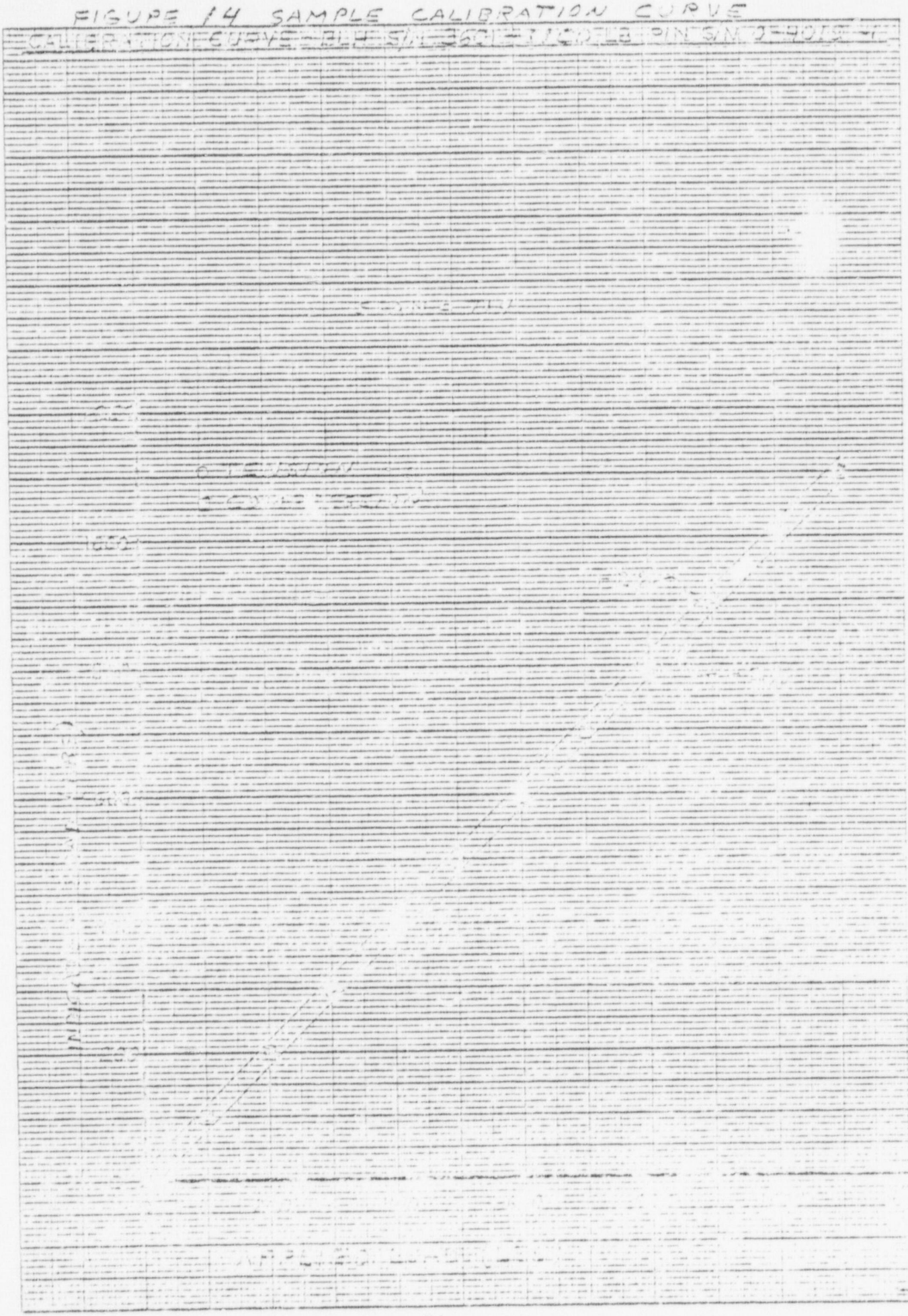


FIG. 13

DRAG FORCE MEASUREMENT SYSTEM
CALIBRATION ADAPTER

FIGURE 14 SAMPLE CALIBRATION CURVE



OVERLOAD TRIMPOT NO.	FUNCTION	
	PIN NO.	LOAD DIRECTION
P1	1 (1000 lb)	TENSION
P2	1 (1000 lb)	COMPRESSION
P3	2 (500 lb)	TENSION
P4	2 (500 lb)	COMPRESSION

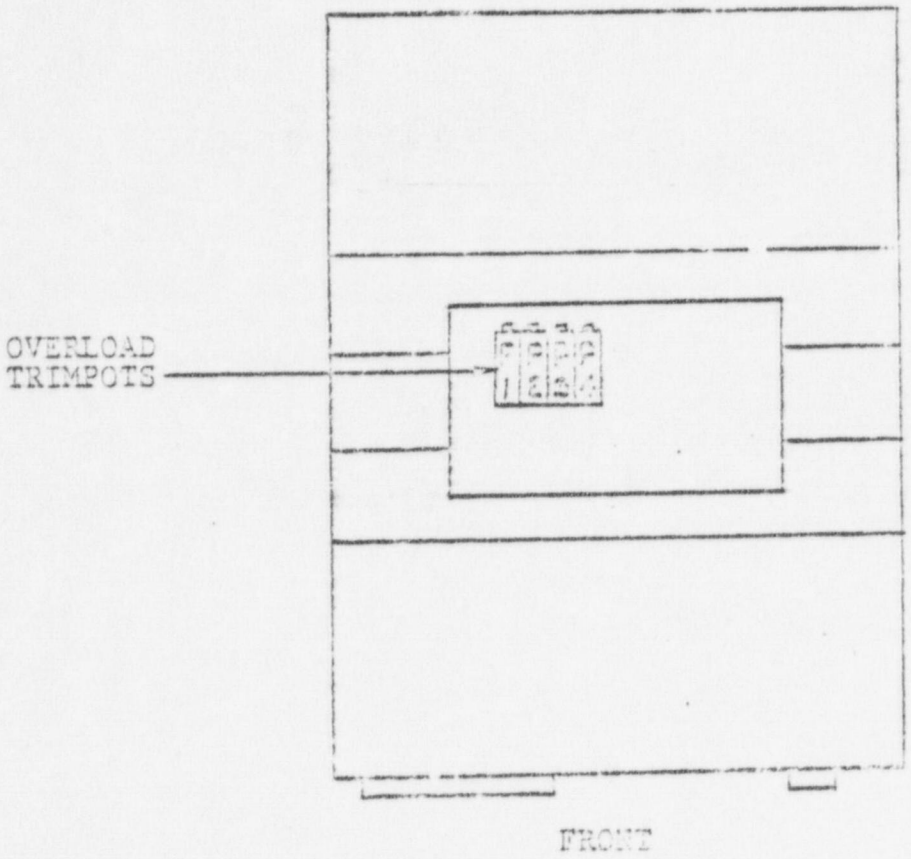


FIG. 15

ELH MODEL 450 TRANSDUCER INDICATOR
TOP VIEW WITH COVER REMOVED

APPENDIX B

OPERATION OF THE LARGE FLUID CONDITIONER MODEL NO. PHD-7556B

TO BE SUPPLIED LATER

(WILL INCLUDE PARTICLE AND AIR CONTENT
MEASUREMENT REQUIREMENTS)