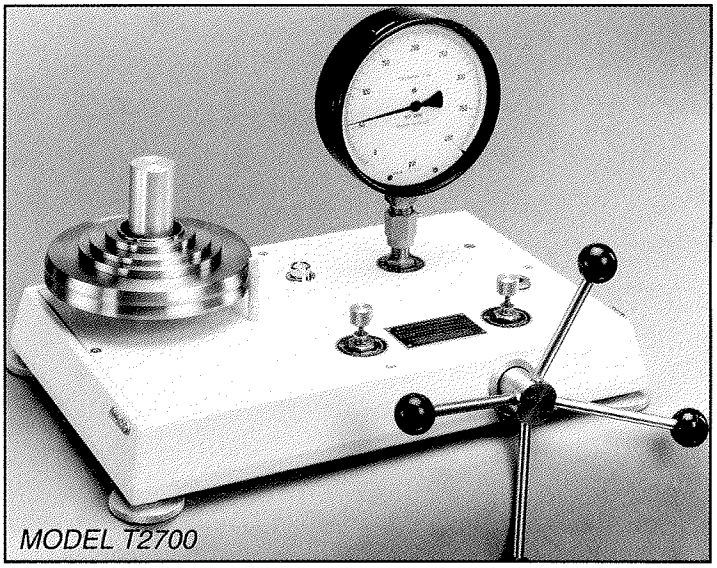
USERS HANDBOOK
High Pressure Pneumatic Deadweight Testers

1.0 General Information

Deadweight Testers are the primary standard for pressure measurement. Utilising the well-proven Piston/Gauge system, consisting of a vertically mounted precision lapped Piston and Cylinder assembly, accurately calibrated weight masses (FORCE) are loaded on the Piston (AREA) which rises freely within its Cylinder. These Weights balance the upward force created by the pressure within the system.

$$\text{PRESSURE} = \frac{\text{FORCE}}{\text{AREA}}$$

Each Weight is marked with the Tester serial number and the pressure measured when placed on a correctly spinning and floating Piston. The total pressure measured is the summation of the Weights plus the Piston Weight Carrier.


MODEL T2700

The Deadweight Tester has been calibrated to the Gravity, Temperature and Air Density stated on the Certificate. Equations and factors are given on the Certificate to adjust for any variations in these environmental conditions. *

Gravity varies greatly with geographic location and so will the Deadweight Tester reading. Due to the significant change in gravity throughout the world (0.5%), ensure that the Tester has either been manufactured to your local gravity or that you have applied the correction from the calibrated gravity.

Example:

Deadweight Tester calibrated gravity : 980.665 cm/s^2
(980.665 cm/s^2 is the International Standard Gravity.)
Gravity at site : 981.235 cm/s^2
Indicated Pressure : 250 psi

$$\text{True Pressure} = \frac{981.235}{980.665} \times 250$$

$$= 1.0005812 \times 250$$

$$= 250.1453 \text{ psi}$$

Temperature and Air Density variations are less significant than Gravity.
Variations should be corrected for when maximum accuracy is required.
Temperature variation example:

Deadweight Tester calibrated temperature	:	20°C
Operating temperature	:	24°C
Percentage change per °C	:	0.002%
Indicated Pressure	:	250 psi

$$\text{True Pressure} = 250 + (20 - 24) \times \frac{0.002}{100} \times 250$$

$$= 250 - \frac{0.008}{100} \times 250$$

$$= 250 - 0.02$$

$$= 249.98 \text{ psi}$$

To ensure that accuracy is maintained, the Piston and Weights must be kept clean and undamaged.

* **See Ancillary Equipment, PDP 101, Section 9, Page 5.**

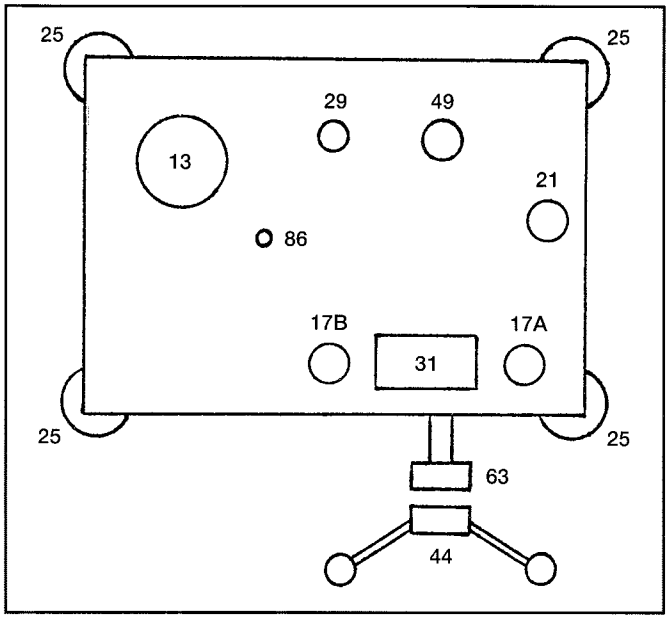
2.0 Supplied As Standard Equipment With Each Instrument:

Calibrated Weight Set in wooden case.
Certificate of Overall Accuracy.
Certificate of Piston Effective Area.
Computer print-out of Weight masses.
Female Adaptors: 1/8", 1/4", 3/8" & 1/2" BSP or NPT.
Cleaning Cloth (89) for Piston.
Spare Seals (53,67).

3.0 Connection To An External Pressure Source

Inlet Port (21) thread: 1/4" BSP or NPT female:
External air supply is connected to the Inlet Port.
Ensure that the supply is both clean and dry.
A compressed gas bottle (nitrogen or dry air) fitted with a pressure regulator is recommended. Factory (compressor) air-lines should only be used if a series of filters are fitted to ensure the air supply is clean and dry.

The Capstan can be used to increase the system pressure if the external source is insufficient. If used for this purpose, then screw Capstan FULLY OUT in Preparation Step 4.4.



IMPORTANT: THE EXTERNAL PRESSURE SOURCE MUST BE REGULATED TO EITHER THE MAXIMUM RANGE OF THE DEADWEIGHT TESTER (Engraved on the Instrument Nameplate (31)) OR 10% ABOVE THE MAXIMUM PRESSURE REQUIRED, WHICHEVER IS THE LOWER. DO NOT OVER-PRESSURISE THE DEADWEIGHT TESTER !

4.0 Preparation

4.1 Find a flat, stable surface.
4.2 Remove Capstan (44) from case lid using Allen Key (37) and fit to Hub (63) on the front of the Tester.
4.3 Level the Tester using the four Adjustable Feet (25) to the Spirit Level (29) mounted on the top plate.
4.4 Screw Capstan half-way out.
4.5 Fit instrument to be tested to Test Station (49).
- 4.5.1 Screw the appropriate Adaptor (52) fully onto the instrument to be tested.
- 4.5.2 Screw assembly down **ANTI-CLOCKWISE** onto the Test Station. **Note: The internal thread in the lower half of the Adaptor is LEFT-HANDED.** Hand-tight is sufficient; ensure that the bottom face of the instrument to be tested contacts the Test Seal (53) on the Test Station.
- 4.5.3 To adjust position to face forward. Hold the Adaptor and unscrew the instrument to be tested **ANTI-CLOCKWISE** so that it faces forward. Hold the instrument to be tested steady whilst turning the Adaptor **ANTI-CLOCKWISE** until it pulls down onto the Test Seal.
- 4.5.4 To calibrate Rear Connection Gauges use a T3700 Angle Adaptor - see Ancillary Equipment, Section 9, Page 5.

IMPORTANT: ENSURE THAT ANY INSTRUMENT FITTED TO THE TEST STATION IS INTERNALLY CLEAN.

5.0 Operation

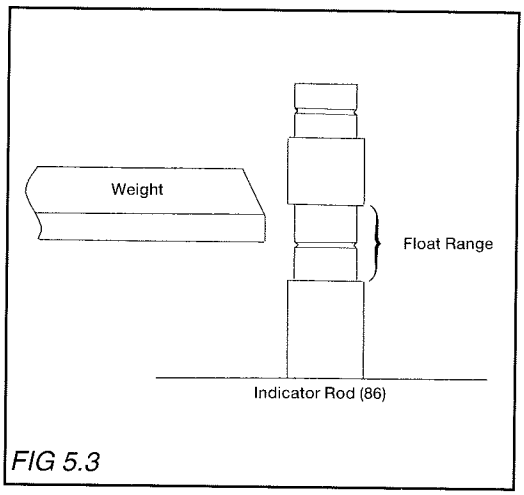


FIG 5.3

5.1 Ensure that both Increase and Decrease Valves (17A & 17B) are closed.
DO NOT OVERTIGHTEN, AS DAMAGE TO VALVE SEAT CAN OCCUR.

5.2 Select required Weights * and stack on the Piston. The pressure measured is the total of the Weights plus the Weight Carrier (13).
(*Fractional Weights: smaller increment Weights are available).

5.3 SLOWLY open and close Increase Valve (17A) until the Piston rises.
Note: Ensure that the bottom face of the lowest weight is aligned within the lower recessed area of the Indicator Rod (86). (See Figure 5.3).
If the system is over-pressurised (Piston against top-stop) then reduce the pressure by SLOWLY opening and closing Decrease Valve (17B) until the Piston floats. Use Capstan (44) for final fine control. Screw in to increase, and out to decrease pressure.

5.4 Rotate the Weight stack clockwise. For optional Motor Drive, see Section 9, Page 5.
DO NOT ROTATE WEIGHTS WHEN THE PISTON IS AGAINST THE TOP OR BOTTOM STOP.
(When Piston is against a stop, a rubbing noise can be heard).

5.5 Observe reading of instrument under test.

5.6 For the next higher pressure point, repeat from 5.2.

5.7 To measure lower pressures, remove the necessary Weights, and slowly open and close the Decrease Valve (17B), reducing the system pressure until the Piston floats. Use Capstan (44) for final adjustment, then rotate the Weight stack clockwise.

5.8 Depressurise by SLOWLY opening and closing Decrease Valve (17B).

5.9 Remove Weight stack.

6.0 Calibration In Different Pressure Units

Conversion Weights can be supplied to measure the existing range in any other pressure unit. The Conversion Weight set is supplied with a special Converting Weight (marked 'CONV') which is placed on the Piston Weight Carrier. This increases the Piston Weight Carrier mass so that it now measures the value stated on this Weight, in the new pressure unit. The Conversion Weight set can now be used in the same way as the Standard Weight set.

Alternative option see PDP101 Section 9, Page 5.

7.0 Storage And Transportation

7.1 Disconnect external pressure source.

7.2 Screw Capstan (44) fully in, disassemble, and store in the case lid.

7.3 For transportation tape down Adaptors (52) in Accessory Block (36).

7.4 Replace Tester case lid, ensuring that the Hinges (35) are properly engaged, and secure with Toggle Clips (33) at sides.

7.5 Place ALL the appropriate Weights on the base of the Wooden Weight Case (74), cover with the lid and secure by screwing Handle (69) fully down. Ensure Handle is tight.

8.0 Piston Care

The Piston and Cylinder Assembly is the most critical and sensitive part of the Tester. To maintain accuracy, the Piston must always slide freely in the Cylinder.

Note: Ensure system is depressurised before attempting Piston removal, by SLOWLY opening Decrease Valve (17B).

8.1 PISTON REMOVAL - (See Drawing, Page 5).

8.1.1 Lift off 'Top Hat' Weight Carrier (13) and unscrew Piston Nut (5). Use dowel hole if nut is tight. Remove assembly.

8.1.2 Using small Allen Key (38) in Accessory Block (36), unscrew Grub Screw (11) in Piston Cap (12), one turn anti-clockwise.
Gently pull off Piston Cap. DO NOT PULL IN SUCH A WAY THAT THE PISTON CAN BEND. The Piston and Cylinder can now be removed.

8.2 PISTON CLEANING

IMPORTANT : NEVER TOUCH THE WORKING AREA OF A CLEAN PISTON WITH BARE FINGERS - THE NATURAL OIL IN YOUR SKIN CAN CAUSE THE PISTON AND CYLINDER ASSEMBLY TO STICK

8.2.1 Use 'non-fluffing', non-abrasive, lint-free tissue or absorbent cloth. Hold the Piston (9) by the larger 'head' end, and rub the tissue back and forth along its length.

8.2.2 To remove all traces of contamination, the Piston must be immersed in a non-filming solvent such as Trichloroethane or Genklene.

8.2.3 Using a NEW tissue, clean the Piston as before, pressing hard between thumb and forefinger along the Piston's length.

8.2.4 Place Piston carefully on a NEW tissue where it will not become dirty or damaged whilst the Cylinder (10) is cleaned.

8.3 CYLINDER CLEANING

8.3.1 Roll a tissue into a tapered rod of appropriate size.Force the tissue through the Cylinder (10) bore by rotating.Ensure the tissue is tight so that dirt is removed. Repeat, inserting a NEW tissue from the opposite end.

8.3.2 To remove all traces of contamination the Cylinder must be immersed in a suitable solvent.

8.3.3 After removal from the solvent, using a NEW tissue, repeat the cleaning process in 8.3.1.

8.4 PISTON RE-ASSEMBLY

GENERAL: The Piston must be carefully introduced into its Cylinder.
If both parts are aligned and correctly cleaned, the Piston will slide freely into the Cylinder.
NEVER FORCE THE PISTON INTO ITS CYLINDER OR DAMAGE MAY RESULT.
If resistance is felt, then re-clean either Piston/Cylinder or both.
If, after repeated cleaning, the Piston still will not slide freely within the Cylinder, then permanent damage may have occurred, in which case the complete assembly will need to be replaced or returned for evaluation.

8.4.1 Hold Piston by larger, 'head' end, and introduce into the larger diameter end of the Cylinder.

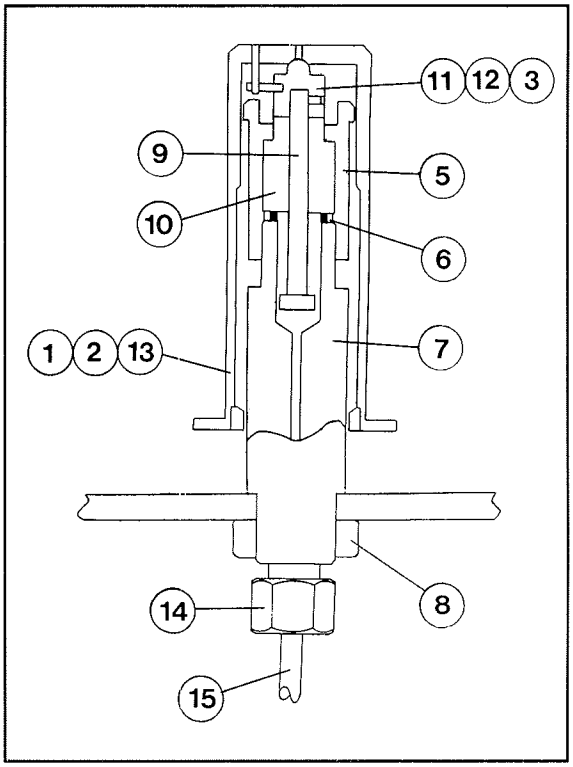
8.4.2 Insert Piston/Cylinder assembly into Piston Nut (5) such that it locates as shown on Page 5. Replace Piston Cap (12), ensuring that it is fully home. Secure Piston Cap to Piston with Grub Screw (11) - DO NOT OVERTIGHTEN.

8.5 REFITTING

Screw assembly onto Piston Body (7), ensuring that the Bonded Seal (6) is clean and refitted. Do not overtighten.

General Arrangement Drawing & Parts List - Piston Assembly

ITEM	PART	DESCRIPTION
1	D4008A	GUIDE BUSH
2	B4013A	PIN
3	B4013B	PIN
4	B4011	SCREW
5	D4103	PISTON NUT
6	B1902	BONDED SEAL
7	D4005	PISTON BODY
8	B4010	LOCKNUT
9	D4001	PISTON
10	D4002	CYLINDER
11	B4011	GRUB SCREW
12	D4004	PISTON CAP
13	D4007A	CARRIER TUBE
14	B1910	NUT/OLIVE COUPLING
15	D4108	PIPE



9.0 Ancillary Equipment

If you require further information on any of the following equipment, please contact your local agent.

PDP 101 PRESSURE DATA PROCESSOR

To reduce human errors and greatly shorten calibration time, the PDP 101 stores and calculates calibration results for direct printing or computer transfer. It enables you to use your Deadweight Tester in 10 different pressure units without the need for additional sets of Conversion Weights or complicated calculations. Changes in Gravity and Temperature can be simply keyed in.

T3700 ANGLE ADAPTOR

To calibrate rear/back Connection Gauges in their correct position, an Angle Adaptor must be used. The Angle Adaptor fits directly onto the Test Station, converting it through 90 degrees, allowing the same Adaptors to be used.

T4600 POINTER REMOVER/PUNCH

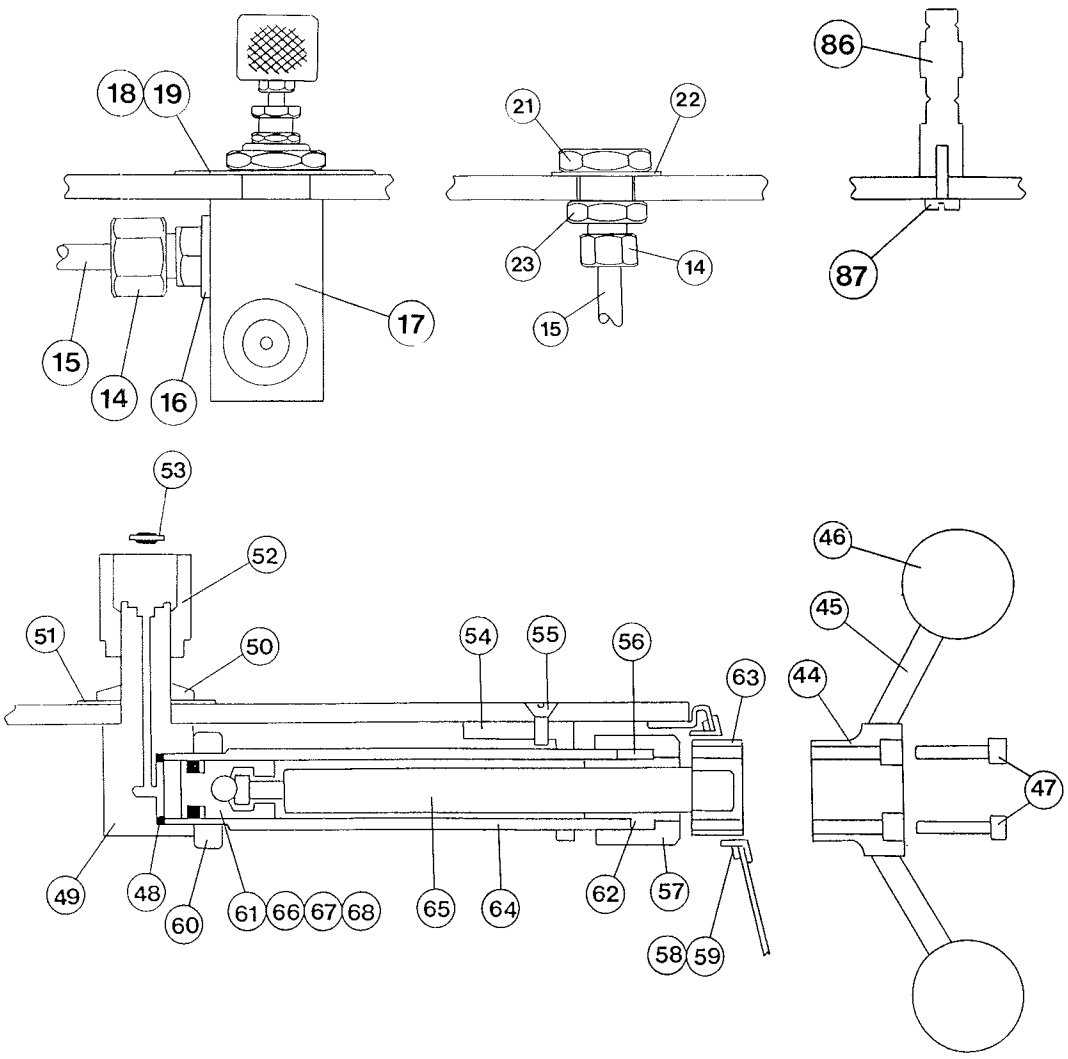
To remove and refit the pointer of a Pressure Gauge. This two-in-one tool has a spring-loaded plunger to quickly and consistently refit the pointer.

OPTIONAL EQUIPMENT:

MOTOR DRIVE

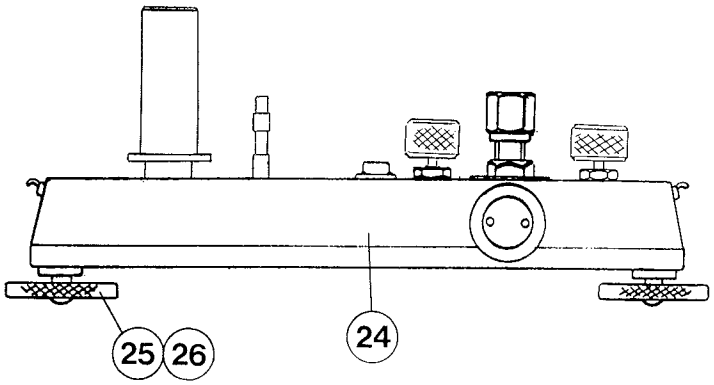
A motor drive can be fitted to rotate the Weights if a continuous pressure is required for long-term testing. This should be specified at the time of order, but can be retro-fitted if necessary.

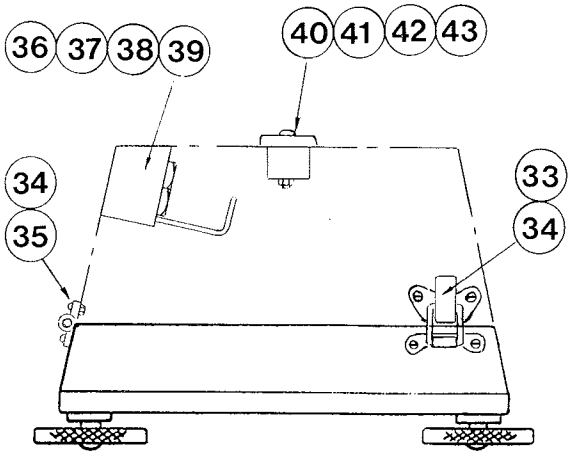
General Arrangement Drawings & Parts List

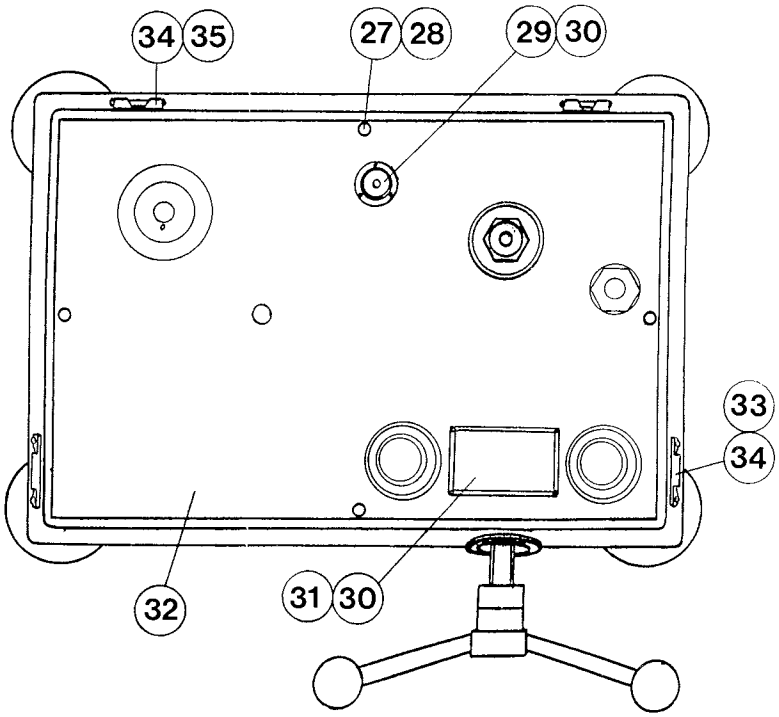


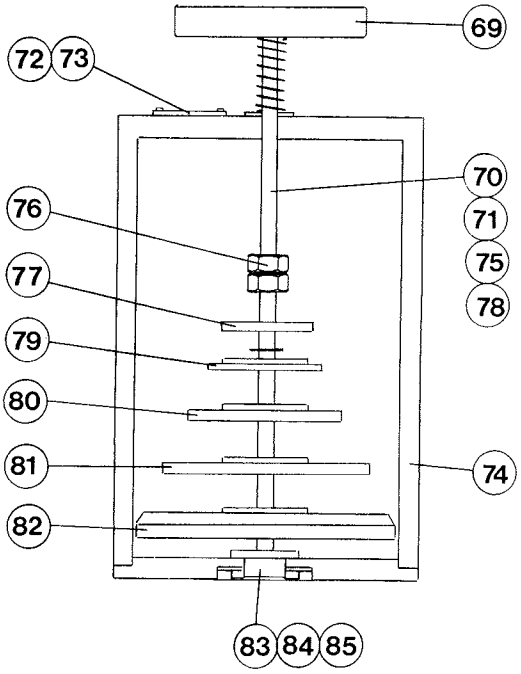
ITEM	PART	DESCRIPTION
14	B1910	NUT/OLIVE COUPLING
15	D4108	PIPE
16	B1033	BONDED SEAL
17	T1700	NEEDLE VALVE
18	D1404	LABEL: INCREASE
19	D1404	LABEL: DECREASE
20	B1822	SCREW
21	D5023	INLET PORT
22	B1407	LOCK WASHER
23	B1807	LOCKNUT
24	D1007E	CASE
25	D1048	FOOT
26	B1047	STUD
27	B1086	SCREW
28	B1082	CAPTIVE NUT
29	B1045	SPIRIT LEVEL
30	B1044	SCREW
31	D1035	NAMEPLATE
32	D1909	TOP PLATE
33	B1076	TOGGLE CLIP
34	B1097	RIVET
35	B1077	HINGE
36	D4113	ACCESSORY BLOCK
37	B1071	ALLEN KEY (LARGE)

ITEM	PART	DESCRIPTION
38	B1070	ALLEN KEY (SMALL)
39	B4114	SPARES BOTTLE
40	D1836	SUPPORT BAR
41	B1078	STRAP HANDLE
42	B1075	SCREW
43	B1081	NUT
44	D1041	OUTER HUB
45	D1020	SPOKE
46	B1021	KNOB
47	B1042	SCREW
48	B1054	'O' RING
49	D1038	TEST STATION
50	D1039	DOME NUT
51	D1098	LABEL: HAND TIGHT ONLY
52	D1018	ADAPTORS
53	B1066	TEST SEAL
54	D1823	SUPPORT BRACKET
55	B1043	SCREW
56	D1053	KEY
57	D1019	BARREL UNION
58	D1087	'C' CLIP
59	D1050	SHROUD
60	B1023	LOCKNUT
61	B1022	BALL









ITEM	PART	DESCRIPTION
62	D1016	RAM NUT
63	D1040	INNER HUB
64	D1013	BARREL
65	D1015	RAM SCREW
66	D1017	RAMBLER
67	B1014	'O' RING
68	B1024	ANTI-EXTRUSION RING
69	D1058	HANDLE
70	B1834	SPRING
71	B1835	WASHER
72	D1036	NAMEPLATE
73	B1044	SCREW
74	D1079	WEIGHT CASE
75	D1060	STUD
76	B1833	LOCKNUT

ITEM	PART	DESCRIPTION
77	D1057	WEIGHT RETAINER
78	B1061	CIRCLIP
79	D1008	WEIGHT
80	D1009	WEIGHT
81	D1010	WEIGHT
82	D1011	WEIGHT
83	D1056	LOCATING STAND
84	B1083	WASHER
85	B1063	LOCKNUT
86	D4110	INDICATOR ROD
87	B1822	SCREW
88	B5034	TEE CONNECTOR (NOT ILLUSTRATED)
89	B2427	CLEANING CLOTH (NOT ILLUSTRATED)

When ordering parts, always quote Tester Serial Number.

11.0 Fault Finding

11.1 POOR PISTON SPIN/SENSITIVITY

IF PISTON IS NOT FREE, DO NOT ROTATE AS DAMAGE MAY OCCUR, DISMANTLE AND CLEAN - SEE SECTION 8, PAGE 4.

11.1.1 If the Piston 'squeaks' when rotated, it must be cleaned.(See Section 8, Page 4).

11.1.2 The Piston (9) and Weight Carrier (13) alone, when floating, should spin for at least 5 seconds. If the spin time is shorter, then clean the Piston (See Section 8, Page 4).

11.1.3 Open Decrease Valve (17B). Lift off 'Top Hat' Weight Carrier (13). Holding the Piston Cap (12), lift gently up and down. The Piston (9) should slide freely within its Cylinder (10), if any resistance or a 'gritty' sensation is detected, then it must be cleaned. (See Section 8, Page 4).

11.1.4 If spin/sensitivity of a cleaned Piston deteriorates quickly then it is likely that the Deadweight Tester system is contaminated and must be completely dismantled, cleaned and rebuilt.

11.2 SYSTEM WILL NOT PRESSURISE

11.2.1 Check that Increase and Decrease Valves (17A & 17B) are closed.

11.2.2 Check for missing/damaged/dirty Test Seal (53) in Test Station (49).

11.2.3 Check that the face of the instrument under test is contacting the Test Seal (53), and the face is not dented or scored.

11.2.4 Check that external source is correctly connected and that it is fully functional.

11.2.5 Check that instrument under test is not leaking.

11.2.6 Check system for leaks by brushing soap solution onto joints and continually pressurising. The soap solution will bubble at the point of leakage. Replace Seal/Part, ensuring that sealing faces are clean and undamaged when re-assembling.

Do not put soap solution on Piston (9), as air will always be leaking between Piston and Cylinder (10). Wipe away ALL traces of soap solution immediately after test. Prolonged soaking may cause certain parts to corrode.

11.3 PISTON DROPS QUICKLY

The Piston will always drop slowly due to a small leak between the Piston and Cylinder. This drop rate will never be so quick that a stable reading cannot be made. If a stable reading cannot be made then check Section 11.2.

12.0 Overhaul And Recertification

The Deadweight Tester's accuracy depends primarily on the effective area of the Piston and the mass of the Weights.

The Deadweight Tester will require periodic recertification, the frequency of which is dependent on use. An approximate guide is as follows:-

(i) High accuracy on-site use, recertify annually or sooner.
(ii) Harsh, rough on-site use, recertify annually or sooner.
(iii) High accuracy careful laboratory use, recertify every 2 to 3 years.
(iv) Low accuracy careful use, recertify every 5 years.

The Deadweight Tester should immediately be overhauled and recertified if either:-

(a) The Piston performance degrades (spin, sensitivity, drop rate).
(Ensure that the instructions in Section 8.0, Page 4, have been correctly carried out).
(b) The Weights are damaged or seriously corroded.

The recalibration frequency must ultimately be specified by the user, with reference to the above comments and any organisational or inspection authority requirements.