

# HANDBOOK

## Operating and Service Instructions Parts Lists

Comparator and Deadweight  
Pressure Determination System

## Mansfield & Green Type “T”

For use with distilled water or other fluids  
compatible with 300 series stainless steel.

FOR REPAIR AND RECALIBRATION  
RETURN TO



TEST AND CALIBRATION INSTRUMENTS DIVISION  
8600 SOMERSET DRIVE, LARGO, FLORIDA 33773

## WARRANTY

This instrument is warranted against defects in workmanship, material and design for one (1) year from date of delivery to the extent that AMETEK will, at its sole option, repair or replace the instrument or any part thereof which is defective, provided, however, that this warranty shall not apply to instruments subjected to tampering or abuse, or exposed to highly corrosive conditions.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED AND AMETEK HEREBY DISCLAIMS ALL OTHER WARRANTIES, INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR MERCHANTABILITY. AMETEK SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO, ANY ANTICIPATED OR LOST PROFITS.

This warranty is voidable if the purchaser fails to follow any and all instructions, warnings, and cautions in the instrument's Instruction Manual.

If a manufacturing defect is found, AMETEK will replace or repair the instrument or replace any defective part thereof without charge; however, AMETEK's obligation hereunder does not include the cost of transportation which must be borne by the customer. AMETEK assumes no responsibility for damage in transit, and any claims for such damage should be presented to the carrier by the purchaser.

### **Deadweight Tester Accuracy**

Guaranteed accuracy of any hydraulic deadweight pressure tester or deadweight gage is  $\pm 0.1\%$  of output pressure, however, limitations due to decreasing sensitivity resulting primarily from friction make it difficult to reproduce accuracy at the low end of the tester range.

Generally, deadweight testers are used only in the upper 90% of the range when best accuracy is required.

Calibration to  $\pm 0.025\%$  is available with data furnished certified traceable to United States, National Institute of Standards & Technology (N.I.S.T.) Calibration data is determined by cross floating against a primary standard certified by N.I.S.T. A common pressure is applied to both units and observed deviations of the tester being calibrated are translated into percent error of output pressure.

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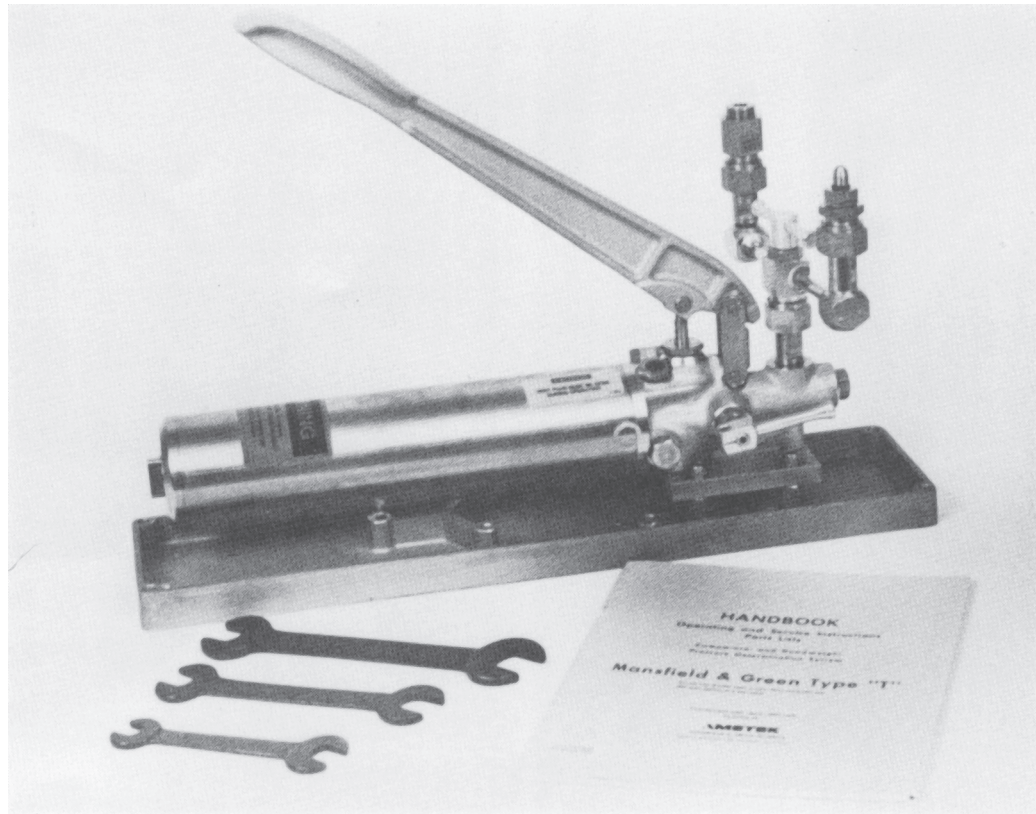


Fig. 1. Assembled View Model T1 Pressure Tester



Fig. 2. Assembled View Models T3 and T3A Pressure Tester

#### 8.4 Packaging Instruction

All parts returned to M & G must be securely packaged to preclude damage in shipping. Pistons and cylinders should be placed within the protective container (T-539) or other secure package. Weights should be packaged individually to prevent damaging each other in transit.

#### 8.5 Certification Options for New and Used Testers

Before ordering a new tester or sending an old tester material back to M & G, specify one of the following certification options and any additional requirements on your purchase order. Contact the distributor if you need any assistance.

##### AMETEK M & G DEADWEIGHT TESTER CERTIFICATION OPTIONS

Option	Description
A	STANDARD CERTIFICATION OF ACCURACY TRACEABLE TO NIST STANDARDS (Item is repaired and calibrated, but no data is provided)
— Options with Additional Cost —	
B	“WITH DATA” - OPTION A PLUS DATA (Item is repaired and calibrated, data is provided)
C	“ISO 9000 REQUIREMENTS” OPTION FOR NEW TESTERS (Option B plus NIST and Working Standards calibration and due dates, accuracy of standards, accuracy ratio statement, copy of ISO certification, and a Certificate of conformance)
D	“AS RECEIVED / AS LEFT” DATA PLUS OPTION A (Item is cleaned and tested with no adjustments or repairs. Then the item is adjusted or repaired and recalibrated if necessary.)
E	“AS RECEIVED / AS LEFT” PER MGP-213 PLUS OPTION A (Same as option C, with additional information pertaining to who and what was used to do the calibration, calibration procedures, and if the device was in tolerance as received and what was done to correct the out-of-tolerance condition)
F	“ISO 9000 REQUIREMENTS” OPTION FOR USED TESTERS (Option D plus NIST and Working Standards calibration and due dates, accuracy of standards, accuracy ratio statement copy of ISO certification, and a Certificate of Conformance)



**SECTION 8**  
**RECOMMENDED RECERTIFICATION PROCEDURES**  
**AMETEK, M & G DEADWEIGHT PRESSURE TESTERS**

**8.1 Introduction**

All deadweight pressure testers produced by AMETEK, M & G are tested and certified in M & G laboratory for accuracy of pressure produced, with results traceable to the National Institute of Standards and Technology. In addition, if .025% or .05% accuracy is required, data is furnished showing nominal and observed pressures within the upper 90% of the range of each piston and cylinder, with results directly traceable to the National Institute of Standards and Technology.

This accuracy can degrade with wear resulting from continued use and/or incidental damage. AMETEK, M & G recommends all instruments be periodically retested for accuracy of pressure produced. Testers returned to AMETEK, M & G will be “tested and (re) certified for accuracy traceable to NIST” or “Tested and (re) certified with data furnished traceable to NIST” if tester is in operable condition.

**8.2 Frequency of Recertification**

The recommended frequency of output pressure recertification is a direct function of the frequency and type of use to which the tester is applied. As a general rule, AMETEK, M & G hydraulic testers (Types T, R, GT, HL) and pneumatic testers (Types PK, RK, HK) should be tested and recertified every 12 months. Testers used frequently, or with dirty fluids, should be tested and certified at more frequent intervals. Master units, used infrequently with clean fluid, will need to be tested and certified less frequently.

**8.3 Material Necessary for Recertification**

- a. Piston / cylinder assemblies: WG-89 (.1 in<sup>2</sup>), WG-90 (.05 in<sup>2</sup>), WG-91 (.02 in<sup>2</sup>), WG-92 (.01 in<sup>2</sup>).
- b. Tube Carrier Assembly (WG-56) and Weight Tube (WG-53)
- c. All weights that have the same serial number as the tester

NOTE – It is not necessary to send in the pump if it is functioning satisfactorily. All pumps sent in will be refurbished at a nominal charge.

– In order to reduce process time and your overall cost, please do not send in any customized fittings, hoses, tools or small miscellaneous parts.

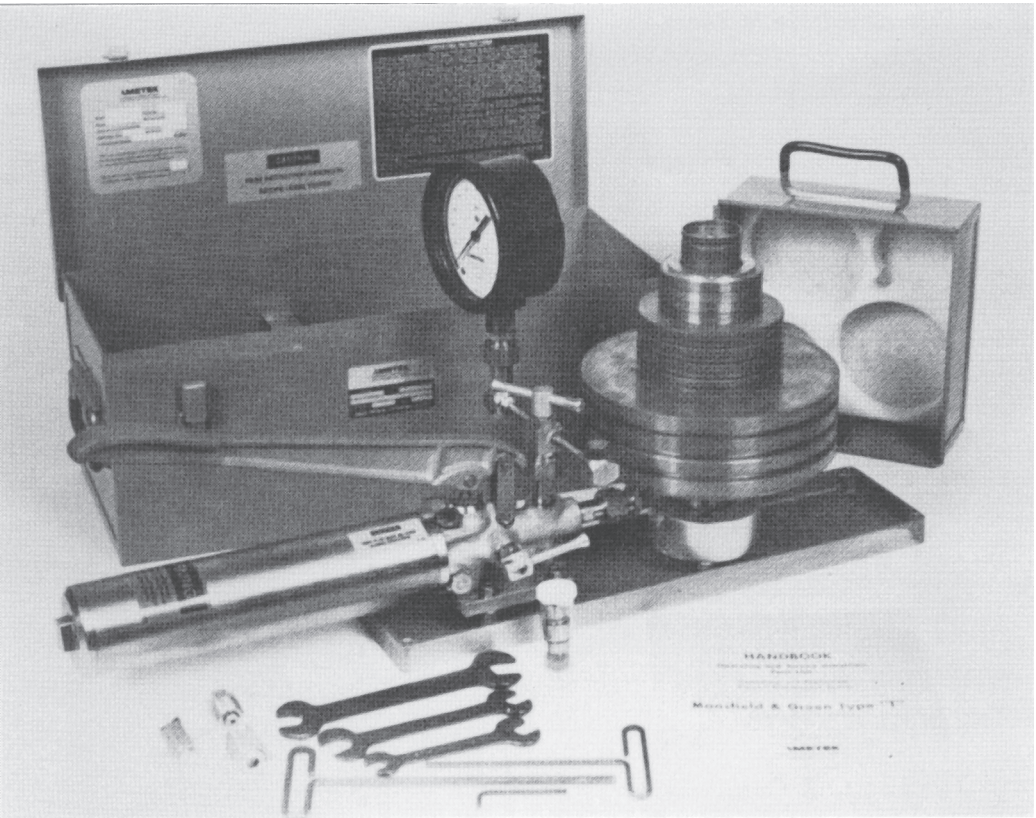


Fig. 3. Assembled View Model T-50 Pressure Tester

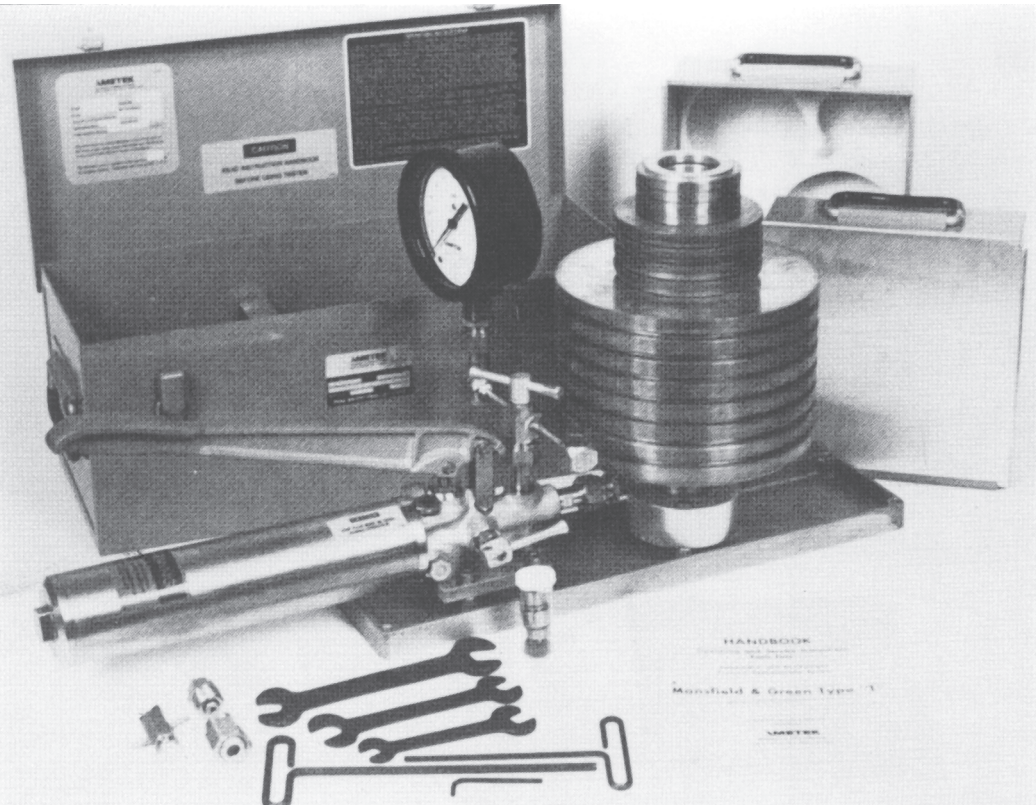


Fig. 4. Assembled View Model T-100 Pressure Tester

SECTION 1: MODEL DESCRIPTION

- 1.0 Pressure Pumps -  
These units are pressure sources designed to provide pressure to test devices external to the pump. The pump can be connected to the device being tested by a high pressure rated tube provided by the user.



The pressure rating of the tubing and fittings used to connect the pump to the test device must exceed the pressure capability of the pump (15,000 psi).  
Never add fluid to the reservoir during a hydraulic test. The volume of oil pumped must never exceed the reservoir volume, or reservoir will overfill when the relief valve is opened.

- 1.1 Model T -  
Hand pump mounted on drip pan with one ¼” pipe thread union body.
- 1.2 Model T-1 -  
Hand pump mounted on drip pan with manifold pipe assembly: (one each) ¼” & ½” pipe thread union bodies: and (one each) 5/8” x ¾”, 1” & 1 1/8" wrenches. See figure 1.
- 1.3 Comparator Testers and Deadweight Testers -  
These units are self-contained pressure sources designed to test instruments that are connected to the offset pipe. They can be used for the calibration of pressure gauges or for setting hydraulic relief valves and pressure switches. These units produce known pressures to test component or systems that are connected to the instrument and are independent of other pressure sources.
- 1.4 Model T-3 -  
Complete kit for comparator testing with metal carrying case: hand pump mounted on drip pan; manifold pipe assembly: pointer puller and hand set: (one each) ¼” & ½” pipe thread, and 7/16”-20 UNF union bodies; 7/16”-20 UNF nipple; (one each) 5/8” x ¾”, 1” & 1 1/8" wrenches; (one each) 5/32” & ¼” hex keys; and (one each) 4 ½” test gauges, with monel element and socket, and with union body mounted on socket, in ranges of 0-160 0-600, 0-5000, and 0-10,000 psig. See figure 2.
- 1.5 Model T-3A -  
Same as model T-3 except with test gauge ranges 0-30, 0-600, 0-3000, and 0-5000 psig.
- 1.6 Models T-5 thru T-155 -  
Complete kit for deadweight testing in various ranges from 10 to 500 thru 100 to 15,000 psig. Includes metal carrying case; hand pump mounted on drip pan; manifold pipe assembly; pointer puller and hand set; (one each) ¼” & ½” pipe thread union body with 7/16”-20 UNF nipple; (one each) 5/8” x ¾”, 1” & 1/8" wrenches; (one each) 5/32”, 3/16” & ¼” hex keys; deadweight column with mounting screws, weight supporting tube; and, from the chart below, the weights and a piston and cylinder assembly.
- 1.7 Type T Deadweight Testers have suspended weights of a hard, non-magnetic die cast alloy. Type TQ Deadweight Testers have suspended weights of forged brass (stainless steel on metric testers) conforming to material requirements of the National Institute of Standards and Technology, Class Q. Weights are calibrated to international gravity 980.665 gals. or customer specified local gravities. Standard accuracy 0.1% of indicated pressure traceable to N.I.S.T. .05 & .025% accuracies available on special order.

SECTION 7

INSTRUCTIONS FOR CLEANING PISTON – CYLINDER ASSEMBLIES  
PRIOR TO PUTTING INTO USE – ALL M & G HYDRAULIC PRESSURE CALIBRATORS

Each M & G piston-cylinder assembly is tested during manufacture for pressure retention (leak rate), for sensitivity and for accuracy of calibration, using very close tolerances for each. Each assembly is then cleaned, identified by a serial number and stored until shipped.

It must be remembered that a piston-cylinder assembly for a deadweight gage or calibrator is of necessity a very closely fitted, lapped and mated assembly. Clearances between the piston and cylinder are on the order of 5 to 20 millionths of an inch, and such clearances require utmost cleanliness for satisfactory operation.

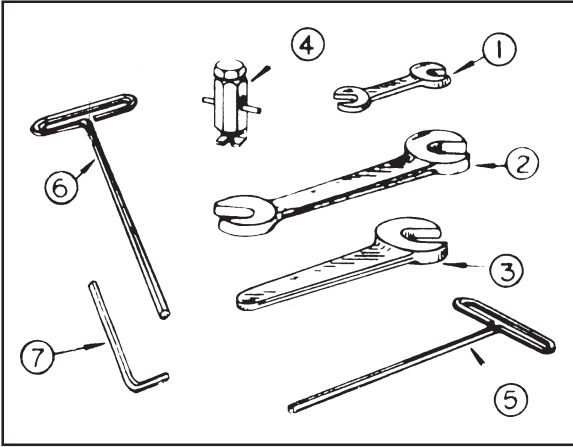
Each assembly which is shipped from here separately, not installed in a column assembly, should be cleaned as follows:

1. Carefully wipe off any visible dirt or foreign matter from the protruding part of the piston and slowly withdraw the piston from the cylinder. Do not use force, but be sure all dirt is removed so that piston will slip out easily.
2. Cylinder bore should be wiped with a small wood handled wiper such as a “Q Tip” to remove all evidence of dirt. Wipe the piston dry and clean with a lint free wiper such as “Kim Wipe”.
3. Rinse piston and cylinder in residual free solvent.
4. Wipe cylinder bore and piston again to remove any dirt.
5. Pick up piston by piston cap and dip it in clean fluid to be used in tester, then carefully insert piston in the cylinder. If any feeling of roughness or what might be grit in the annulus area is suspected, disassemble and repeat cleaning procedure.
6. At the same time, the dead weight column in which the piston is to be mounted on type T, units should be drained and flushed with a solvent such as ethyl alcohol, then cleaned, dried and refilled using clean fluid.
7. The piston-cylinder assembly then can be inserted carefully in the mounting column and secured as described in paragraph 3.2.8 thru 3.2-13.

REMEMBER - Do not touch piston with fingers or other soiled or contaminating surfaces after cleaning.

- Extremely minute particles can cause trouble in a closely fitted assembly such as this. It is not possible to over emphasize the value of cleanliness.

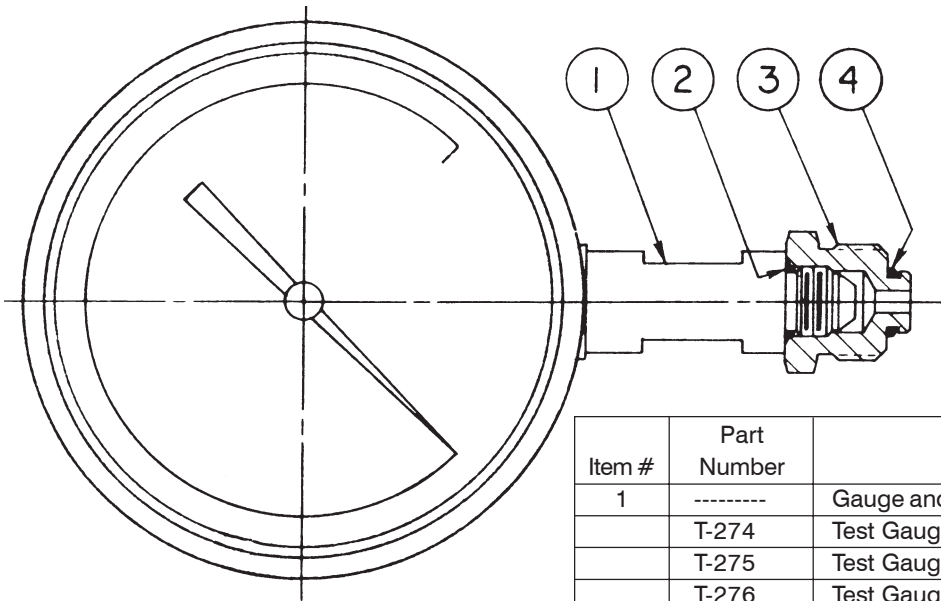




Item #	Part Number	Description
1	T-182	Wrench, Open End, Thin 5/8" x 3/4"
2	1GT-200	Wrench, Open End, Thin 1"
3	T-184	Wrench, Open End, Thin 1 1/8"
4	1GT-99	Puller and Set Assembly, Gauge Pointer
5	T-204	Wrench, 3/16" Hexagon Key, Tee Handle
6	T-239	Wrench, 1/4" Hexagon Key, Tee Handle
7	T-180	Wrench, 5/32" Hexagon Key, Short Series

Quantity of one (1) per tester assembly

**FIG. 10** SERVICE TOOLS



Item #	Part Number	Description	Quantity
1	-----	Gauge and fitting Assembly	4
	T-274	Test Gauge, 4-1/2" - 0-30 PSI	1**
	T-275	Test Gauge, 4-1/2" - 0-160 PSI	1**
	T-276	Test Gauge, 4-1/2" - 0-600 PSI	1**
	T-277	Test Gauge, 4-1/2" - 0-3,000 PSI	1**
	T-278	Test Gauge, 4-1/2" - 0-5,000 PSI	1**
	T-279	Test Gauge, 4-1/2" - 0-10,000 PSI	1**
2	10-90009	O-Ring, Body Union (T-136)	4*
3	T-173	Body, Union	4*
4	10-90027	O-Ring, Body Union	4*

\*Items 2, 3, 4 - one each per gauge assembly, four each per tester assembly.  
 \*\*See Sect. 1.4 & 1.5 for list of gauges supplied with each model.

**FIG. 11** GAGE AND FITTING ASSEMBLY

### 1.8 Optional Equipment for Models T-5 thru T-155

A device called an isolating membrane (see Fig 8b), is available which has the following features:

- Isolates harmful dirt particles, originating in the system being calibrated and/or the pump, from the piston and cylinder. Also see par. 2.4.
- Allows the use of M & G instrument oil in contact with the piston and cylinder assembly which will reduce the rate of fluid leakage thru that assembly. This reduces the frequency of the pumping required to maintain the piston in the referenced calibration plane.

### DEADWEIGHT TESTERS PSIG

Model	Model	Range-psig	Increments	Piston Area	Weight Set
T-5	TQ-5	10-500	5 psig	0.1 sq. in.	#1
T-10	TQ-10	10-1000	5 psig	0.1 sq. in.	#2
T-15	TQ-15	10-1500	5 psig	0.1 sq. in.	#3
T-20	TQ-20	20-2000	10 psig	0.05 sq. in.	#2
T-30	TQ-30	20-3000	10 psig	0.05 sq. in.	#3
T-55	TQ-55	50-5000	25 psig	0.02 sq. in.	#2
T-110	TQ-110	100-10000	50 psig	0.01 sq. in.	#2
T-155	TQ-155	100-15000	50 psig	0.01 sq. in.	#3
T-50	TQ-50	10-500	5 psig	0.1 sq. in.	#1
Dual Range	Dual Range	100-5000	50 psig	0.01 sq. in.	
T-100	TQ-100	10-1000	5 psig	0.1 sq. in.	#2
Dual Range	Dual Range	100-10000	50 psig	0.01 sq. in.	
T-150	TQ-150	10-1500	5 psig	0.1 sq. in.	#3
Dual Range	Dual Range	100-15000	50 psig	0.01 sq. in.	

### WEIGHT SETS FURNISHED WITH T & TQ TESTERS

Weights Furnished Per Nominal Weight					
Weight Set Numbers	0.5 lb. (WG-23)	2.0 lb. (WG-25)	9.5 lb. (WG-26)	10 lb. (WG-27)	Number of Cases
#1	4	4	1	3	1
#2	4	4	1	8	2
#3	4	4	1	13	3

### COMPARATOR TESTERS

Model	Test Gauge Ranges-psig
T-3	0-160, 0-600, 0-5000, 0-10,000
T-3A	0-30, 0-600, 0-3000, 0-5000

### PUMP

Model	Description
T	Hand pump on pan
T-1	Hand pump on pan with dual manifold, fittings & tools
T-2	Hand pump on pan with dual manifold, fittings, tools & carrying case

### PRESSURE PRODUCED ON PISTON (PSI)

PART #	MASS	WG-89 (1/10)	WG-90 (1/20)	WG-91 (1/50)	WG-92 (1/100)
WG-23	.5 Lb.	5	10	25	50
WG-25	2 Lb.	20	40	100	200
WG-26	9.5 Lb.	95	190	475	950
WG-27	10 Lb.	100	200	500	1000

DEADWEIGHT TESTERS METRIC KG/CM²

MODEL	MODEL	RANGE-KG/CM²	INCREMENTS	PISTON AREA	WEIGHT SET
TD-400M Dual Range	TDQ-400M Dual Range	1-40 10-400	0.5 KG/CM² 5.0 KG/CM²	0.1 sq. in. 0.01 sq. in.	#1M
TD-700M Dual Range	TDQ-700M Dual Range	1-70 10-700	0.5 KG/CM² 5.0 KG/CM²	0.1 sq. in. 0.01 sq. in.	#2M
TD-1000M Dual Range	TDQ-100M Dual Range	1-100 10-1000	0.5 KG/CM² 5.0 KG/CM²	0.1 sq. in. 0.01 sq. in.	#3M

WEIGHT SET NUMBERS	WEIGHTS FURNISHED PER NOMINAL WEIGHT					Number of Cases
	Converter WG-201	323g WG-205	1290g WG-204	5806g WG-203	6451g WG-202	
#1M	1	4	4	1	2	1
#2M	1	4	4	1	5	2
#3M	1	4	4	1	8	3

Part WG-201 added to part WG-53, with no other weights added, changes output to:

- 1.0 KG/CM² with WG-89 Piston Assembly
- 2.0 KG/CM² with WG-90 Piston Assembly
- 5.0 KG/CM² with WG-91 Piston Assembly
- 10.0 KG/CM² with WG-92 Piston Assembly

Weights used and pressures produced are:

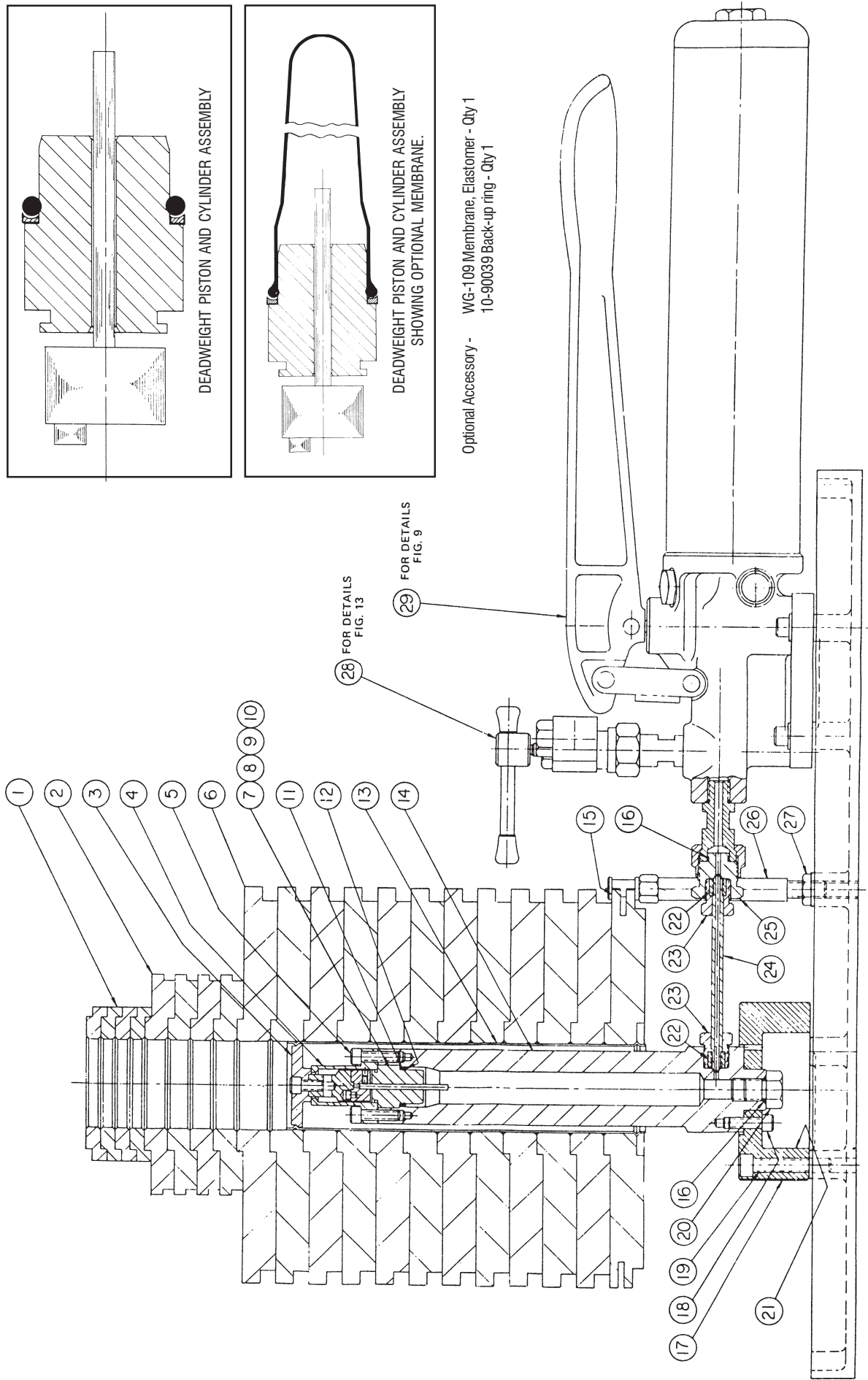
PRESSURE PRODUCED IN KG/CM² ON					
PART NO.	MASS	WG-89	WG-90	WG-91	WG-92
WG-205	0.323KG	.50	1.0	2.5	5.0
WG-204	1.290KG	2.0	4.0	10.0	20.0
WG-203	5.806KG	9.0	18.0	45.0	90.0
WG-202	6.451KG	10.0	20.0	50.0	100.0

DEADWEIGHT PARTS ——— Fig. 9 (pg. 18)

ITEM NUMBER	PART NUMBER	DESCRIPTION	UNITS PER ASSEMBLY
1	WG-23	WEIGHT - 0.5 lb. Kirksite .....	*
1	WG-23Q	WEIGHT - 0.5 lb. Brass .....	*
2	WG-25	WEIGHT - 2 lbs. Kirksite .....	*
2	WG-25Q	WEIGHT - 2 lbs. Brass .....	*
3	WG-56	TUBE CARRIER ASS'Y. ....	1
4	WG-52	CAP, Cylinder .....	1
5	01-90038	SCREW, Cylinder clamping .....	8
6	WG-27	WEIGHT- 10 lbs. Kirksite .....	*
6	WG-27Q	WEIGHT - 10 lbs. Brass .....	*
7	WG-89	PISTON AND CYLINDER ASS'Y. - 1/10 Area .....	*
8	WG-90	PISTON AND CYLINDER ASS'Y. - 1/20 Area .....	*
9	WG-91	PISTON AND CYLINDER ASS'Y. - 1/50 Area .....	*
10	WG-92	PISTON AND CYLINDER ASS'Y. - 1/100 Area .....	*
11	10-90039	BACK-UP RING, Cylinder (WG-108) .....	*
12	10-90015	“O” RING, Cylinder (WG-111) .....	*
13	WG-53	TUBE, Weight .....	1
14	WG-28	BODY, Column .....	1
15	WG-26	WEIGHT - 9 - 1/2 lbs. Kirksite .....	*
15	WG-26Q	WEIGHT - 9- 1/2 lbs. Brass .....	*
16	10-90027	“O” RING (T-154) .....	2
17	T-206	PLATE, Weight.....	1
18	01-90002	SCREW, Column body attaching .....	3
19	01-90016	SCREW, Column base attaching .....	3
20	T-117	PLUG, Column .....	1
21	T-244	BASE, Column .....	1
22	WG-140	COLLAR, Nipple .....	2
23	WG-139	MALE GLAND, Nipple .....	2
24	T-246	NIPPLE, Pump connecting .....	1
25	T-245	BODY, Union .....	1
26	T-137	INDICATOR, Weight position.....	1
27	T-178	NUT, Indicator .....	1
28	T-149	MANIFOLD ASS'Y. (For components see pg. 16) .....	1
29	T-101	HAND PUMP ASS'Y. (For components see pg. 12 & 13) ....	1
	T-177	CASE, Carrying .....	1
	T-222	CASE, Weight carrying .....	*
	WG-67	CASE, Weight carrying .....	*

“ See Chart Sect. 1.





Optional Accessory - WG-109 Membrane, Elastomer - Qty 1  
10-90039 Back-up ring - Qty 1

**FIG. 9** DEADWEIGHT PRESSURE TESTER  
MODEL T-5 THRU T-155 ASSEMBLY

DEADWEIGHT TESTERS METRIC KN/M<sup>2</sup>, BARS, KPA

MODEL	RANGE-KG/CM <sup>2</sup>	INCREMENTS	PISTON AREA	WEIGHT SET
TDQ-40000N	100-4000	50 KN/M <sup>2</sup>	0.1 sq. in.	#1NQ
	1000-40,000	500 KN/M <sup>2</sup>	0.01 sq. in.	
TDQ-70000N	100-7000	50 KN/M <sup>2</sup>	0.1 sq. in.	#2NQ
	1000-70,000	500 KN/M <sup>2</sup>	0.01 sq. in.	
TDQ-100000N	10-10,000	50 KN/M <sup>2</sup>	0.1 sq. in.	#3NQ
	1000-100,000	500 KN/M <sup>2</sup>	0.01 sq. in.	

WEIGHT SET NUMBERS	WEIGHTS FURNISHED PER NOMINAL WEIGHT					Number of Cases
	Converter WG-301	329g WG-305	1316g WG-304	5921g WG-303	6579g WG-302	
#1NQ	1	4	4	1	2	1
#2NQ	1	4	4	1	5	2
#3NQ	1	4	4	1	8	3

Part WG-301 added to part WG-53, with no other weights added, changes output to:  
 100 KPA with WG-89 Piston Assembly  
 200 KPA with WG-90 Piston Assembly  
 500 KPA with WG-91 Piston Assembly  
 1000 KPA with WG-92 Piston Assembly

Weights used and pressures produced are:

PRESSURE PRODUCED IN KPA ON					
PART NO.	MASS	WG-89	WG-90	WG-91	WG-92
WG-305	328.94 GM	50	100	250	500
WG-304	1315.76 GM	200	400	1000	2000
WG-303	5920.919 GM	900	1800	4500	9000
WG-302	6578.799 GM	1000	2000	5000	10000

**K PA = K N/M<sup>2</sup> = BAR (x100)**

CAUTION

DO NOT CONNECT ANY EXTERNAL PRESSURE SOURCE TO THIS INSTRUMENT. THIS UNIT IS DESIGNED TO TEST PRESSURE MEASURING DEVICES CONNECTED TO THE MANIFOLD ONLY. PRESSURE FROM AN EXTERNAL SOURCE CAN RESULT IN EXPLOSION OF THE LIQUID RESERVOIR AND POSSIBLE BODILY INJURY.

SECTION 2: GENERAL INFORMATION

2.1 All wetted parts are stainless steel or monel. All pumps are shipped with a 50-50 mixture of distilled water and isopropyl alcohol in the reservoir. The alcohol is added merely to prevent freezing during shipment and the mixture keeps the O-rings moist during storage. This pump can also be used with other fluids compatible with 300 series stainless steel.

CAUTION

2.2 Do not operate hand pump without fluid in the reservoir - piston O-rings require lubrication. Deadweight Testers should be bolted to bench to prevent tipping. Do not operate above 15,000 PSIG. Vent plug **must be open** when operating this instrument. Vernier Valve will not operate above 3500 PSIG. Never add fluid to reservoir during a hydraulic test. The volume of fluid pumped must never exceed the reservoir volume, or reservoir will over-fill when relief valve is opened.

2.3 (DEADWEIGHT COLUMN) PISTON CYLINDER ASSEMBLY - The piston is hardened, plated, ground and lapped. The cylinder is honed and polished. Total piston travel is 0.5 inch. Piston driver WG-56 moves vertically inside the cylinder cap WG-52 which acts as a stop. Excess pressure cannot force the piston out of the cylinder.

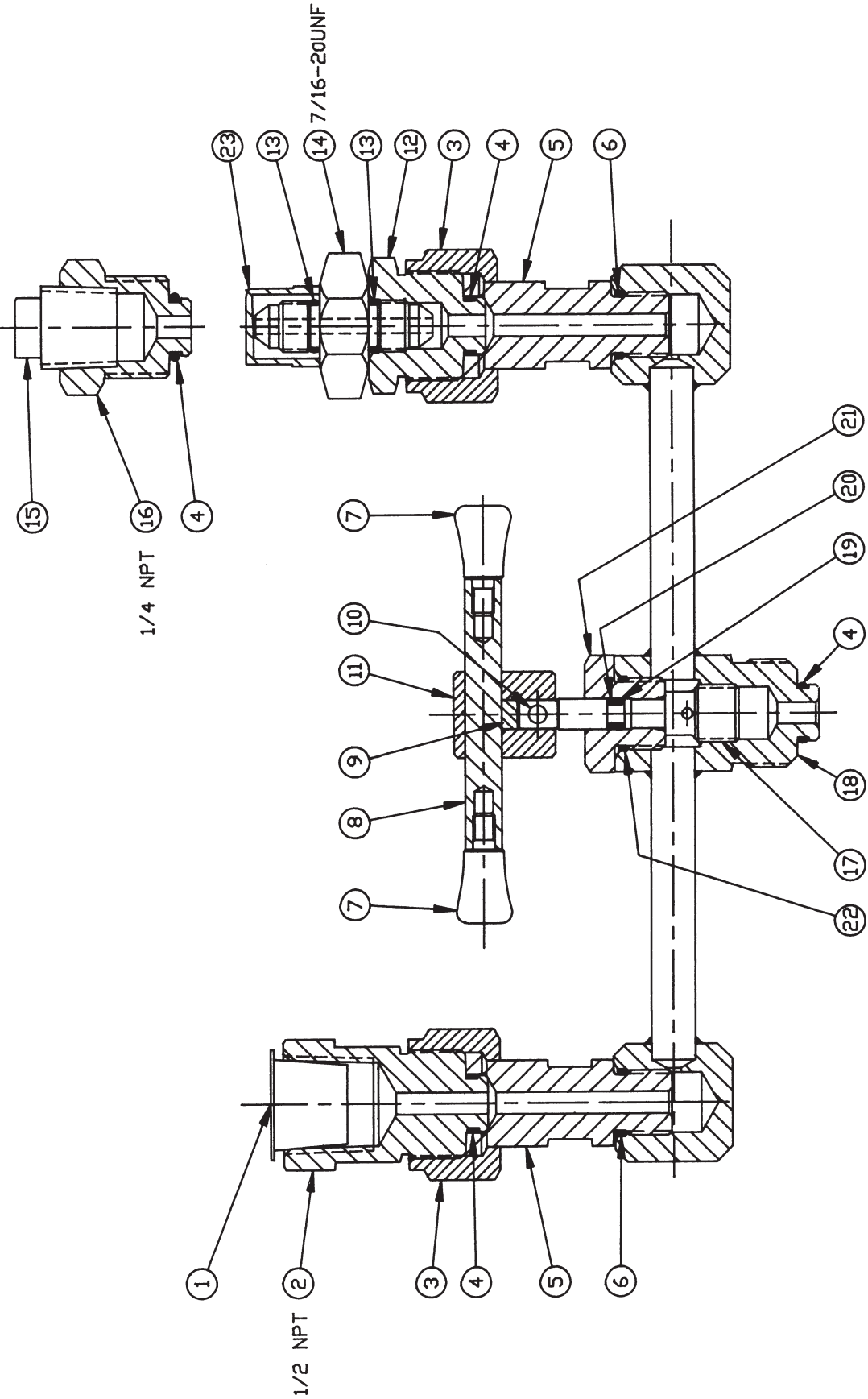
2.4 NECESSITY FOR CLEANLINESS - Clearances between the piston and cylinder are on the order of a few millionths of an inch. This necessitates extreme cleanliness and care as follows:

- a). HANDLING. Handle and install so as not to introduce scratches or nicks. Do not touch the working surfaces (O.D. of piston & I.D. of cylinder) with your hands or with dirty fabrics or fibers.
- b). FLUID CONTAMINATION - Since the pump fluid (possibly from the system being calibrated) flows through the annulus space between the piston and cylinder, any foreign particles in the fluid system which can enter the annulus space can cause severe damage to the piston and cylinder. In severe cases, "binding" or "freezing" can occur.
- c). See par. 6.6 for cleaning procedure.

2.5 Keep weights clean and stored in cases when not in use. Do not allow them to be scratched or dropped.

2.6 The weight tube WG-53 has a calibration reference line on it which is an indication of the bottom of the piston. This is for use in calculating the oil head which exists when calibrating a system which is at a different level than that of the instrument.

2.7 The vent plug may be equipped with a relief valve to avoid pressure build-up in the reservoir. However, the vent plug must be opened during use to allow proper operation of pump.



MANIFOLD ASSEMBLY

FIG. 8

SECTION 6: SERVICE INSTRUCTIONS AND PARTS BREAKDOWN

- 6.1

CHANGING O-RINGS: Always lubricate the O-rings and all contacting metal parts before attempting assembly. For a lubricant, use the same fluid as will be used in the system.
- 6.2

OUTLET CHECK VALVE: To re-assemble, thread-in the retaining plug until all parts are solid, then backoff about 3½ turns. This provides sufficient travel for the poppet.
- 6.3

The valve rod is held in place by items 25, 26 and 27 (fig. 9). Access to these three items is gained by removing the reservoir. Be sure to drain fluid before removing reservoir.
- 6.4

HAND LEVER & PISTON: These can be removed as an assembly for inspection of the piston O-rings and back-up rings. Merely unscrew cylinder retain plug and pull straight up.

At the end of the pressure stroke, the piston should bottom on the body plate insert before the lever hits the cylinder retaining plug. If it doesn't, or if you would like more finger room between the hand lever and the reservoir, loosen piston pin screw, insert a small rod in the crosshold provided in the piston and backoff the piston (which is threaded into the piston pin) as needed. Be sure
- 6.5

PUMP CYLINDER: This part must be removed and reassembled from the top, otherwise the O-rings will be cut by the angular, intersecting hold in the lower portion of the body casting bore. To remove the cylinder, detach body plate and push out cylinder from bottom. On re-assembly, moisten the O-rings with system fluid and try to rotate the cylinder, as you insert it, to avoid cutting or pinching the O-rings. A tapered piece of wood is helpful to rotate the cylinder.
- 6.6

CLEANING DEADWEIGHT COLUMN, PISTON AND CYLINDER: See par. 3.2-8 for instructions on removal. (See sect. 8 for Cleaning Instructions.)
- 6.7

REPLACING FLUID IN DEADWEIGHT UNITS HAVING ISOLATING MEMBRANE: To operate with the required degree of sensitivity, there must be a controlled clearance between cylinder bore and piston. Therefore, there will be some leakage of fluid through this annulus area. The loss of fluid will depend upon length of test period, range of pressure determinations and test conditions. The amount of fluid in the isolating membrane should be checked periodically. To refill, see para. 3.2-9.

SECTION 3: ASSEMBLY & SET-UP INSTRUCTIONS

COMPARATOR TESTING

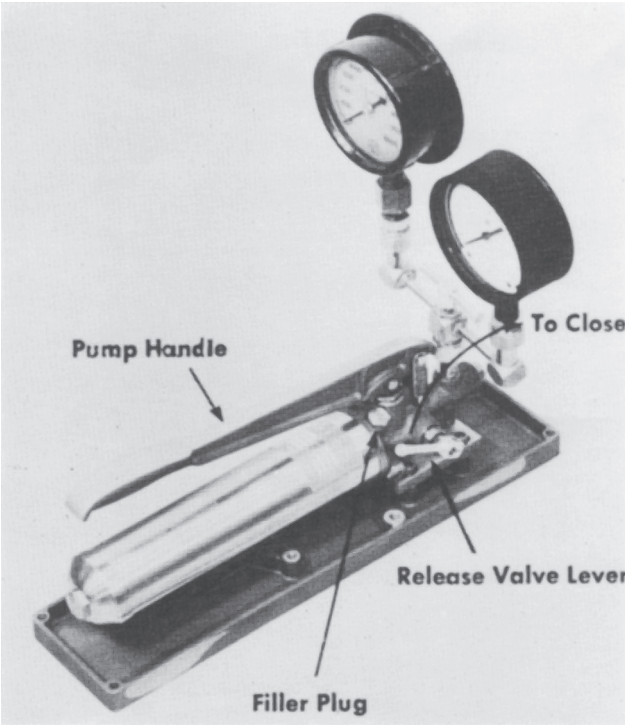


Fig. 5. Comparator Testing

- 3.1-1 Attach T-403 manifold assembly to pump body.
- 3.1-2 Attach test gauge to manifold.
- 3.1-3 Attach instrument to be calibrated to manifold.

DEADWEIGHT TESTING

- 3.1-1 The hand pump, as shipped is assembled to the drip pan in position for comparator testing. Remove the 4 pump attaching screws, turn pump 180°, and reassemble pump to drip pan. Do not tighten bolts.
- 3.2-2 Remove the plug and O-Ring (T-103 and 10-90009) from the front of the plug body.
- 3.2-3 Remove the nipple and nut (T-126, 10-90009 & T-146) from the manifold assembly. Replace these with the plug and O-Ring removed from the pump body.
- 3.2-4 Assemble nipple & nut into the end of the pump body.

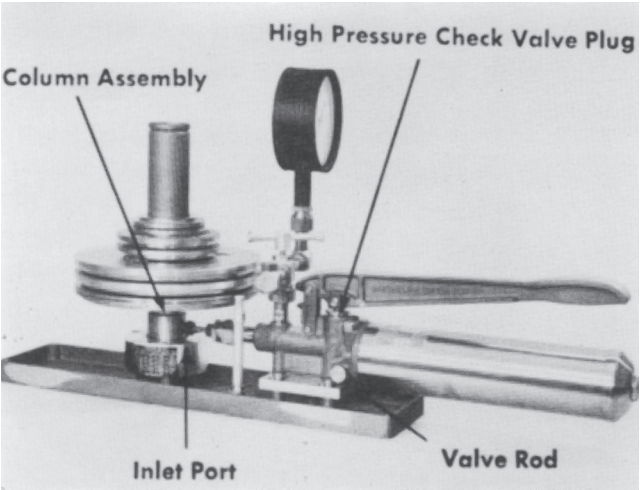


Fig. 6. Deadweight Testing

- 3.2-5 Connect the column assembly to the nipple and nut, then fasten the column to the drip pan.
- 3.2-6 Tighten the screws to secure the pump to the drip pan.

NOTE: Clean piston & cylinder per Section 8 before installing. (Save the plastic vial for future shipping).

- 3.2-7 Dual range models: Select the correct piston and cylinder to suit the required pressure range. Use the table at the end of section 1 or the decal attached to the column assembly base as a guide.
- 3.2-8 Installing or changing piston and cylinder assemblies: Remove the eight (8) socket head cap screws which hold the cylinder cap to the body. Remove the piston and cylinder assembly(figures 8a & 8b). If necessary, use blunt edged screw driver under groove on top of cylinder and pry gently upwards. Refer to figures 8a & 8b for proper assembly of back-up ring & O-Ring or membrane. Wet the outer surface of the O-ring before working the assembly into the column body. After installing the cylinder, replace the cylinder cap and tighten 4 screws. This will set the cylinder into place. Remove screws and cap. Pump fluid to top of cylinder.
- 3.2-9 Filling procedure for units with optional isolating membrane: a special oil, M & G “AAA” oil, is provided in the plastic bottle. To dispense the

MANIFOLD PARTS ----- Fig. 8 (pg. 17)

ITEM NUMBER	PART NUMBER	DESCRIPTION	UNITS PER ASSEMBLY
1	T-149	ASSEMBLY, TYPE “T” MANIFOLD .....	—
2	T-135	THREAD PROTECTOR ½ NPT .....	1
3	T-146	BODY, Union - ½ NPT .....	1
4	T-146	NUT, Union .....	2
5	10-90027	“O” RING (T-154) .....	3
6	T-126	NIPPLE, Union .....	2
7	10-90009	“O” RING, Union nipple (T-136) .....	2
8	T-102	KNOB, Handle .....	2
9	T-119	HANDLE, Vernier .....	1
10	T-190	PLUG, Friction .....	1
11	T-174	SCREW, Hub .....	1
12	T-132	HANDLE HUB, Vernier .....	1
13	T-186	BODY, Union - 7/16 - 20 UNF .....	1
14	10-90005	“O” RING, Nipple (T-151) .....	2
15	T-185	NIPPLE, 7/16 - 20 UNF .....	1
16	T-162	PLUG, Pipe .....	1
17	T-134	BODY, Union - ¼ NPT .....	1
18	T-114	PISTON, Vernier .....	1
19	T-125	MANIFOLD, Offset pipe .....	1
20	10-90001	“O” RING, Vernier (T-152) .....	1
21	10-90017	BACK UP RING, Vernier (T-179) .....	1
22	T-113	BUSHING, Vernier piston .....	1
23	10-90011	“O” RING, Vernier (T-157) .....	1
	99-90001	CAP .....	1



- oil, the capillary tube must be pushed down into the cylinder bore and gently squeeze the bottle to fill the membrane up to the bottom of the cylinder bore. Using the hand pump, carefully pump fluid into the column so as to compress the membrane and bring its fluid level to the top of the cylinder bore.

3.2-10 Coat the piston with a light film of the M&G oil and carefully work down into cylinder bore while simultaneously releasing pump pressure so that the piston will enter the cylinder bore without any trapped air.
- 3.2-11 Replace cylinder cap and fasten loosely with four (4) opposing screws. Tighten, alternately to 30 in. lb. Repeat this procedure with the four (4) remaining screws.

3.2-12 Rotate the piston driver until you feel it drop onto the drive pin in the piston cap, see figure 10. Slide the tube onto the tube carrier.

3.2-13 Place a bullseye level on the tube carrier before using to assure that the column is level. Shim the base if necessary.

SECTION 4: OPERATING INSTRUCTIONS



- THE VENT PLUG (1GT-302) MUST BE OPEN WHEN OPERATING THIS INSTRUMENT. SOME MODELS OF THIS TESTER INCLUDE A PRESSURE RELIEF VALVE (13-90025) WITHIN THE VENT PLUG. IF THE RELIEF VALVE IS ACTUATED, THE OPERATOR SHOULD STOP ALL USE OF THIS INSTRUMENT AND REMOVE THE SOURCE OF PRESSURE WITHIN THE RESERVOIR.

4.1 The pressure source for all models is the hand operated, dual volume pump. To develop pressure, the release valve lever must be rotated clockwise until firmly seated. The valve rod controls the output volume (for location, see fig. 6). With the valve rod in the “out” position (away from the pump body), the output volume is at its maximum, although you will only be able to reach about 1000 psi using normal effort on the pump handle. To go beyond 1000 psi, it will be necessary to push the valve rod “in” (toward the body). This reduces the output volume to ease the effort required to operate the pump handle. The valve rod *should only be moved if* the pump handle is stationary or in the suction stroke. The pump has been primed and tested before shipment. If, for any reason it does not function, refer to section 6, Service Instructions.
- and decreasing pressures.

DEADWEIGHT TESTING

4.3 The minimum pressure, which can be calibrated, is the pressure developed by the force of the rotating parts which are the piston, piston driver, tube carrier and tube acting on a piston of a certain area. The values, in psi, for the rotation parts, are listed on a decal affixed to the base (item 21, fig. 9) along with the values for the different weights.  
The following is an example which shows how to select weights for a certain output: To obtain a 145 psi output using a 1/10 square inch area piston you would add onto the weight carrier tube the following: the grooved 9" dia. weight (95 psi), two 6" dia. weights (20 psi each), plus one 3½" dia weight (5 psi). The sum of the (weights) psi values is 140 and adding the 5 psi value of the “rotating” parts brings the total up to the desired 145 psi.

4.4 Build up system pressure with the hand pump until the weights lift. This can be observed by comparing the vertical position to the bottom weight with the indicator. The ideal “float” position is at one half the total vertical travel of the weight stack. Rotate the weights at about 10 to 30 rpm to reduce friction. Use the vernier piston, in the center of the manifold to make the fine pressure adjustments.
- COMPARATOR TESTING

4.2 Always choose a “test gauge” of (ideally) the same range but never less than that of the instrument system to be calibrated. With the “test gauge” and instrument system to be calibrated connected to the manifold, pump up the system pressure close to the calibration point desired. With the vernier handle, adjust the system pressure until the “test gauge” indicates the desired pressure and then “compare” with the indication given by the instrument system being calibrated. Checks should be made at various increasing

ITEM NUMBER	PART NUMBER	DESCRIPTION	UNITS PER ASSEMBLY
40	10-90004	“O” RING, Valve rod (T-155) .....	1
41	T-115	VALVE ROD .....	1
42	10-90005	“O” RING (T-151) .....	2
43	T-111	SEAT, Relief valve .....	1
45	10-90010	“O” RING, Reservoir tube (T-156) .....	2
46	T-130	STUD, Reservoir.....	1
47	T-140	TUBE, Inlet .....	1
49	12-90152	FITTING, Inlet tube .....	1
50	T-408	PLATE, Body .....	1
51	10-90012	“O” RING, Cylinder (T-164) .....	1
52	T-106	PISTON .....	1
53	T-595	LINER, Body Plate .....	1
54	10-90018	BACK-UP RING, Piston (T-159) .....	1
55	T-107	GUIDE ROD .....	1
56	01-90004	SCREW, Body attaching .....	3
57	T-141	PLUG, Retaining .....	1
58	T-103	PLUG .....	1
59	10-90006	“O” RING (T-154) .....	1
60	108-114	SCREW .....	1
61	01-90058	SCREW .....	1
62	T-754	CAUTION LABEL .....	1
63	T-755	WARNING LABEL .....	1

SECTION 5: TROUBLE SHOOTING

PUMP PARTS ----- Fig. 7 (pg. 12 & 13)

ITEM NUMBER	PART NUMBER	UNITS PER DESCRIPTION	ASSEMBLY
1	T-328	CAP, Reservoir .....	1
2	T-131	TUBE, Reservoir .....	1
3	T-165	HANDLE, Pump .....	1
4	T-118	DRIP PAN .....	1
5	T-199	PLATE, Pump identification .....	1
6	T-120	BODY, Pump .....	1
7	T-160	SCREW, Piston pin .....	1
8	T-161	SHOE, Piston pin .....	1
9	T-142	PIN, Clevis .....	2
10	T-144	HAIR PIN, Cotter .....	2
11	10-90020	BACK-UP RING, Cylinder (T-112) .....	2
12	10-90013	“O” RING (T-153) .....	3
13	T-102	HANDLE KNOB, Relief valve .....	1
14	10-90019	BACK-UP RING, Piston (T-158) .....	1
15	10-90027	“O” RING (T-154) .....	2
16	T-108	PLUG, Cylinder retaining .....	1
17	T-145	PIN, Piston .....	1
18	T-236	CYLINDER, Pump .....	1
19	T-143	CLEVIS .....	1
20	T-773	HANDLE, Relief valve .....	1
21	T-149	MANIFOLD ASS’Y (For components see pg. 16) .....	1
22	T-146	NUT, Union .....	1
23	T-126	NIPPLE, Union .....	1
24	10-90009	“O” RING (T-136) .....	2
25	T-166	SCREW .....	2
26	T-116	SPRING, Valve rod .....	1
27	T-133	DETENT PIN, Valve Rod .....	1
28	T-117	PLUG, Pump body .....	2
29	10-90001	“O” RING (T-152) .....	3
30	IGT-302	PLUG, Fill and Vent Relief Assembly .....	1
31	T-127	SPACER, Check valve .....	2
32	CV-1-5	SPRING, Check valve .....	3
33	T-147	POPPET, High pressure valve .....	2
34	01-90007	SCREW, Drip pan attaching .....	4
35	T-167	WASHER, Drip pan attaching .....	4
36	T-110	STEM, Relief valve .....	1
37	T-109	BODY, Relief valve .....	1
38	T-194	POPPET, Valve .....	1
39	10-90002	“O” RING, Relief valve (T-175) .....	1

5.1 All pumps are thoroughly tested at the factory before shipment. One of the most common difficulties encountered with the pump is the loss of prime, which is evidenced by an inability to build pressure. See figures 5 & 6 for identification of components mentioned below.

For priming purposes, PUMP VIGOROUSLY with full strokes of the hand lever.

Make sure the pump reservoir has sufficient fluid, then pull the valve rod out and pump about ten full strokes with the relief valve open. Close relief valve and continue pumping to be certain the “low pressure” is operating and holding pressure. Open relief valve and pump about ten more strokes.

**CAUTION:** Remember that the gauges and/or systems on the manifold will be subject to any pressures developed during the priming sequence. Therefore, they should have at least a 5000 psi range or be removed from the manifold and the manifold plugged.

Remove “high pressure” check valve plug and slowly pump two and one-half strokes to position hand lever about half way up 45 degrees. With the plug removed system fluid will flow out of the high pressure check valve, flushing the entrapped air. Examine for air bubbles which may adhere to the threads or parts. Replace the plug and when almost tight use slight pressure on the hand lever to cause leakage at the plug to insure complete purging of valve port. Then secure plug. All of the above with valve rod **out** (“low pressure - large volume”).

Operate the pump handle with relief valve closed until sufficient pressure develops to make pumping difficult. Stop pumping, raise the pump handle, push the valve rod in and resume pumping. The “high pressure - small volume” mode should then be operating properly.

If the “high pressure-small volume” does not operate or operates only partially, more air is in the “high pressure” check valve and the priming procedure must be repeated.

Generally when once primed the pump will continue to operate without further attention. It is possible that entrained air in the reservoir may collect in the “high pressure” check valve. If that happens the pump will not develop pressure with the valve rod **in**, (“high pressure-low volume”). The above priming procedure will correct the condition.

5.2 In an emergency or when time is not available for the priming operation, the “high-pressure-small volume” can be operated as follows: with the valve rod **out**, operate pump until pumping effort becomes excessive, do not force. For higher pressures raise hand lever (with valve rod **out**) push valve rod **in** for the down stroke of the hand lever and repeat the entire sequence for each stroke of the hand lever.

5.3 **FAILURE TO PUMP:** If the hand lever is operated and the pump fails to develop pressure, be sure relief valve is closed and that there is sufficient fluid in the reservoir. If necessary, add fluid through vent plug (fig. 5) and prime per par. 5.1. If failure continues, one or both of the check valves may be leaking. Replace both O-rings to be sure.

5.4 **FAILURE TO HOLD PRESSURE:** - If the pump operates but the pressure drops, either one or two parts is leaking. As the pressure drops, watch the hand lever, if it raises, the discharge check valve is leaking. Replace O-ring.

If the hand lever does not raise as the pressure drops, then the relief valve is leaking. A foreign particle may be lodged on the seat, but more likely the O-ring has failed and must be replaced.

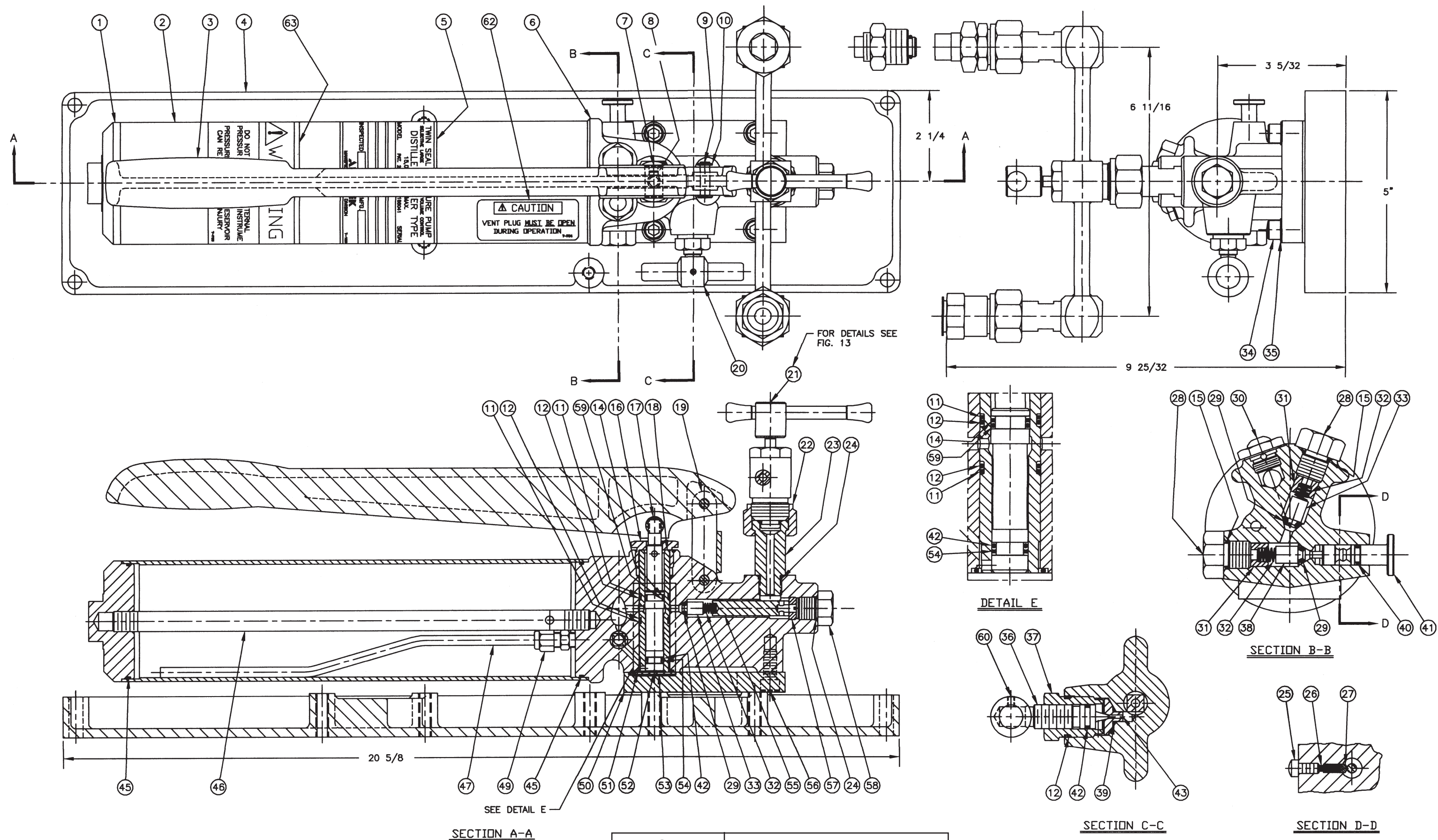


FIG. 7

HYDRAULIC HAND PUMP  
TYPE T ASSEMBLY