DH-Budenberg

DH▪Budenberg Model 249T(L) Dead-Weight Gauge

Operating and Maintenance Instructions

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CONTENTS

SAFETY PRECAUTIONS

AIR/GAS SUPPLY

The Model 249T(L) requires a regulated supply of clean dry gas to operate. Any compressed pneumatic source represents a source of considerable potential energy and as with electricity, precautions must be taken to prevent accidents.

Before connecting/disconnecting instruments under test the operator should ensure no pressure is present in the system.

Before connecting/disconnecting the tester from its pressure source the operator should ensure that the pressure source is isolated from the tester. We recommend using a Nitrogen Cylinder as the gas from this is normally dry and clean. Alternatively use compressed air, filtered and dried to remove oil and moisture.

DO NOT USE OXYGEN IN THE SYSTEM, OR CALIBRATE ANY INSTRUMENT THAT MAY COME INTO CONTACT WITH AN OXYGEN SOURCE.

Calibrate only oil-free gauges to avoid contamination of the tester.

Further guidance is available from BRITISH STANDARD B.S.5304: 1988 “Safety of Machinery”. Useful advice can also be found in publications from Health & Safety Executive, including HS (G) 39 “Compressed Air Safety”.

MINERAL OILS HEALTH AND SAFETY (C.O.S.H.H.) INFORMATION

DH▪Budenberg provide hydraulic mineral oil in 500 ml containers labelled "ISO VG 22" for use up to 2600 bar in dead-weight testers. It is no more hazardous than other common lubricating oils.

It is the nature of the way in which this equipment is used, that there could be frequent and/or prolonged skin contact; in a few individuals this could give rise to skin irritation (Keratosis or Dermatitis). The use of an effective barrier cream will greatly reduce this possibility.

DESCRIPTION

Closed flash point:	greater than $120^{O}C$
Storage:	not above $30^{0}C$.
Oral LD 50:	15 g per kg body weight.
Threshold limit value:	5 mg/m^3.
Fire extinguishing media:	carbon dioxide/dry chemical foam or water fog
Spillage:	soak with absorbent clay or proprietary absorbent
Waste disposal:	burn or dump in approved area.

EMERGENCY TREATMENT OF ACUTE EFFECTS

Ingestion	Do not induce vomiting. Administer 250 ml milk or olive oil. The main hazard following accidental ingestion is aspiration of liquid into lungs.
Aspiration	Send to hospital immediately
Inhalation	Remove to fresh air, if nausea persists seek medical attention.
Eye Contact	Wash with copious amounts of water for at least 10 minutes. If irritation results or persists, obtain medical advice.
Skin Contact	Where skin rashes or other abnormalities occur as a result of prolonged or repeated contact, medical advice should be obtained as soon as possible.

OTHER LIQUIDS

For some very particular applications we supply specially constructed liquids.
Copies of manufacturer's data will be sent to users on request.

LIFTING OF WEIGHTS

Care must be taken when lifting the weights for the dead-weight tester.
Each weight must be lifted individually and never attempt to lift stack of weights on or off the tester.

DATA SHEET

1.1 TESTER DIMENSIONS – PRESSURE CABINET ONLY

Width : 570 mm
Depth : 600 mm
Height : 750 mm
Mass : 31 kg (inclusive of oil fill)
Gas Supply : G1/4
Differential Connection: G1/4

1.2 PRESSURE RANGES

249T	:	1/8in² area	:15 to 100 bar (200 to 1,500 lb/in^2)
		1/16in² area	: 30 to 200 bar (400 to 3,000 lb/in^2)
249TL	:	1/8in² area	:3 to 300 bar (45 to 400 lb/in^2)

1.3 LIQUIDS USED

An hydraulic mineral oil viscosity 20 to 37 cSt at 40^{O}C viscosity grade VG20 to VG37 to ISO3448 (BS4231) is used on the 249T base units. Most users will be able to obtain locally suitable oil (see below) as used in hydraulic machinery. However, for the convenience of users we can supply a 500 ml bottle of oil, viscosity grade VG22.

Oils suitable for testers

The following oils are the commercially available oils suitable for use in the dead-weight tester.

ISO 3448 viscosity grade	Approx. SAE viscosity Classification	Shell	Esso	Mobil
VG22		Tellus 22 Tellus R22	Nuto H22	DTE 22
VG32	10W	Tellus V32 DTE 24	Nuto H32	DTE Oil Light
VG37		Tellus 37 Tellus R37 Tellus T37 Tellus V37		

Other liquids

The Model 249T can be used on silicone based liquids, or inert perfluorinatedpolyethers such as Fluorolube, Fomblin, Halocarbon, which are of the viscosity mentioned above and are chemically inert, being suitable for contact with metals and with the nitrile seals which are standard on the tester. The tester can be supplied as standard tested on mineral oil for the user to clean and fill, or alternatively the tester can be supplied cleaned and tested on any suitable liquid readily available in the UK.

DESCRIPTION

2.1 GENERAL

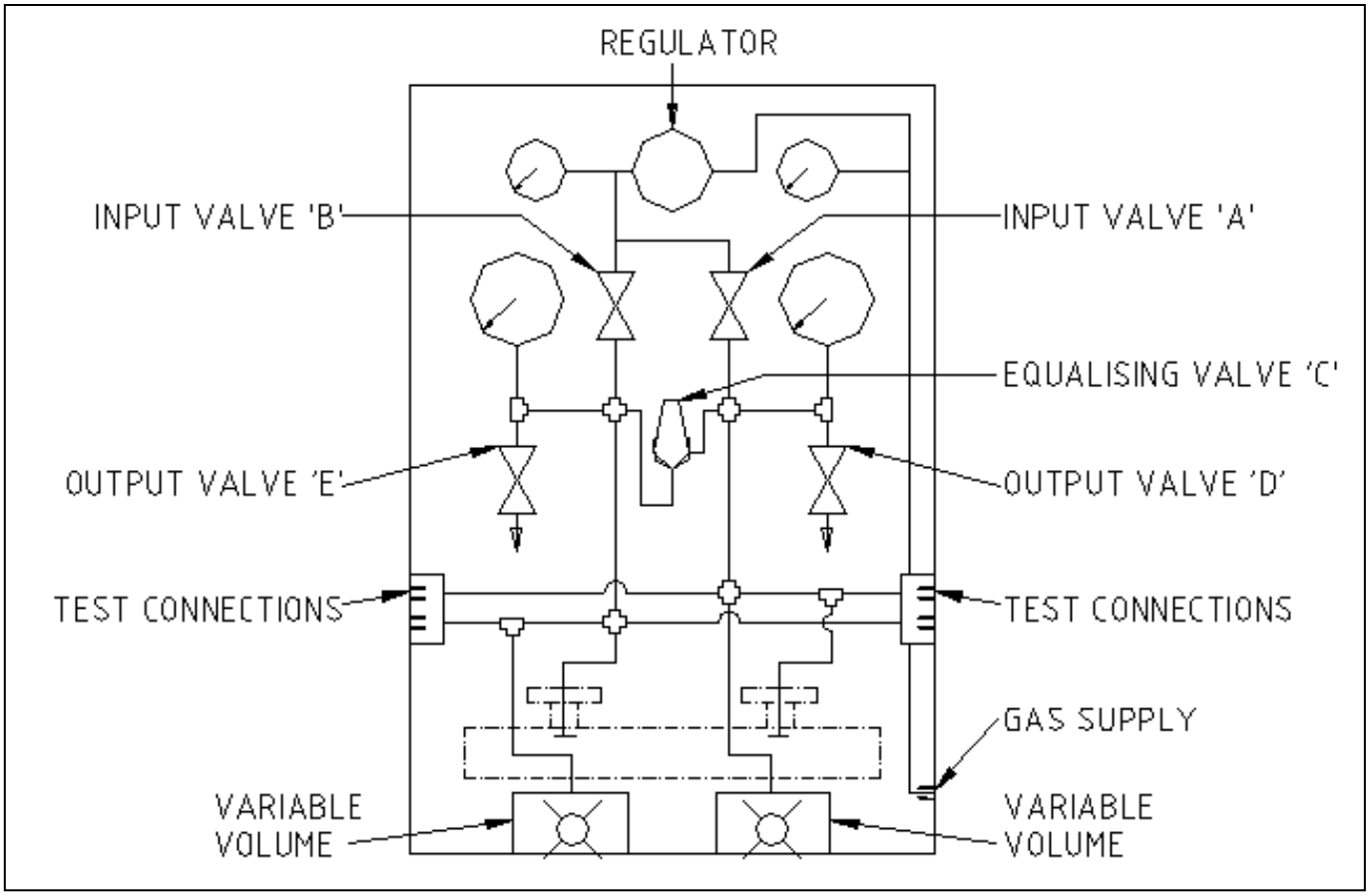
The Model 249T(L) is used for the calibration of differential pressure (DP) cells at high static line pressures on gas. This type of calibration is especially important for fiscal metering of large flows of gas using orifice plates

2.2 PRINCIPAL OF OPERATION

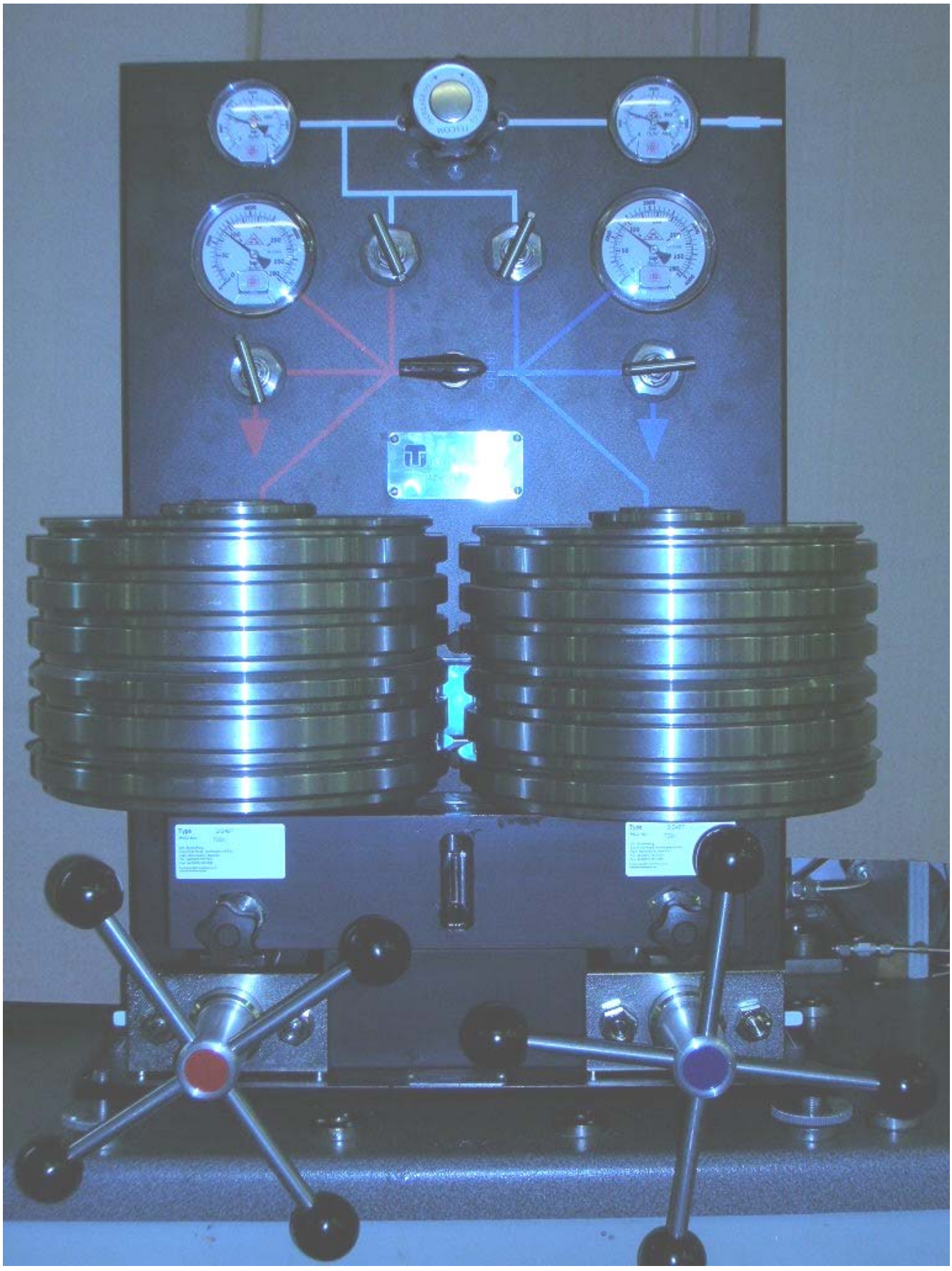
Two piston units (oil lubricated piston units on Model 249T) are connected to each side of a DP cell. These are then balanced at a static gas pressure specified. Once balanced, they are isolated from each other and small weights (in. water or mbar) are added to the piston unit connected to the high side of the DP cell, thus developing a differential pressure across the DP cell.
The differential pressure generated depends only on the effective area of the piston unit and the masses of the small differential pressure weights.

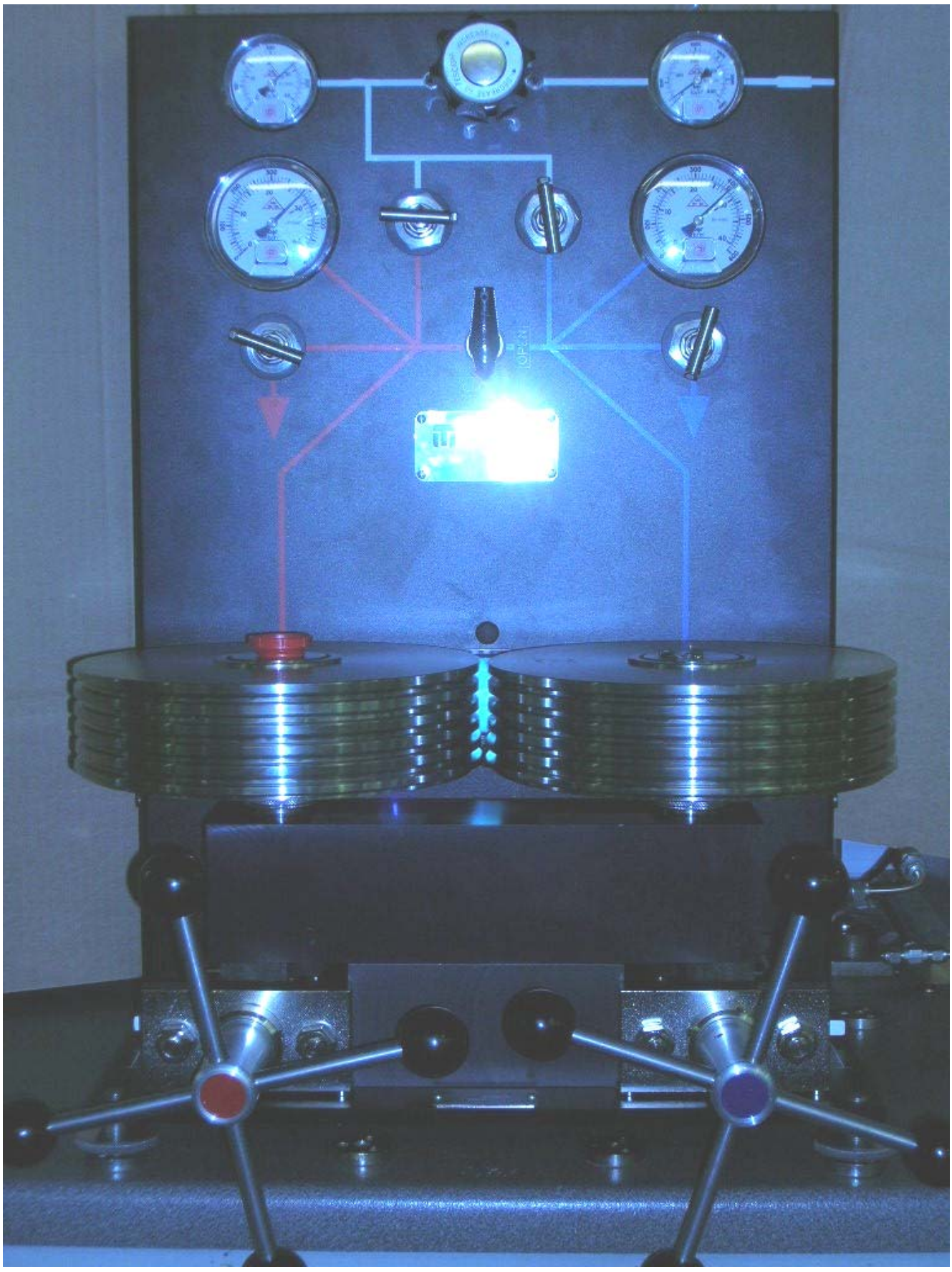
2.3 CIRCUIT

The two piston units are mounted in an aluminium block and loaded with stainless steel weights. Each piston unit is controlled by its own control instrumentation and variable volume adjuster. These are used to help balance the piston units, and also apply the differential pressure.



SCHEMATIC DIAGRAM OF MODEL 249T(TL)




OPEN

INSTALLATION

3.1 UNPACKING THE TESTER

As soon as possible after delivery open the packaging of the system and check that you have all the items detailed in the packing list in section 3.4.

As you are unpacking the items, examine them for signs of damage or breakage during transit.

If any items are missing get in touch immediately with DH▪Budenberg to inform us of the shortage.

3.2 ENVIRONMENTAL REQUIREMENTS

When siting the tester if not in a temperature controlled laboratory look for an area that satisfies the following criteria as much as possible

- a constant temperature area free from draughts and sources of heat or cold
- an area free from noise and vibration if possible an area away from any constantly used pathways
- a clean dry area free from corrosive liquids or vapours.

A strong, stable, level table or workbench with the capability of supporting the system (approx. 250Kg) with sufficient space to operate is required.

3.3 ASSEMBLY OF BASE UNITS

The Model 249T(L) is supplied packaged on a pallet, with two carrying boxes for the weights. The small box contains the differential weights and trim masses to aid the balancing of the PCU.

3.4 PACKING LIST

The system carton should contain: -

1 - copy of the operating and maintenance instructions (this manual).
1 - Model 247T(L) base unit
2 - 1/8in² or 1/16in² Piston units (as ordered).
2 - Main Weight Set (Static Pressure)
1 - Set of differential weights supplied in separate carrying case
1 - 500 ml bottle of oil (Model 249T)
1 - certificate of calibration
1 - spirit level
1 - bag of seals
1 - Allen keys
2 - Tommy bars

SETS OF WEIGHTS SUPPLIED

Model 249T – bar or Kg/cm² MAIN STATIC WEIGHTS

MAIN STATIC WEIGHTS			
ITEM	**QUANTITY**	**1/8in² PRESSURE**	**1/16in² PRESSURE**
PISTON & M.U.W & TRIM MASS HOLDER	2	15	30
TOP LOADING STATIC WEIGHT	10	15	30
TOP LOADING STATIC WEIGHT	4	5	10
DIFFERENTIAL WEIGHTS - mbar			
DIFFERENTIAL WEIGHT	1	1000	2000
DIFFERENTIAL WEIGHT	1	500	1000
DIFFERENTIAL WEIGHT	2	200	400
DIFFERENTIAL WEIGHT	1	100	200
DIFFERENTIAL WEIGHT	1	50	100
DIFFERENTIAL WEIGHT	2	20	40
DIFFERENTIAL WEIGHT	1	10	20
DIFFERENTIAL WEIGHT	1	5	10
DIFFERENTIAL WEIGHT	1	2.5	5

Model 249T – lb/in² MAIN STATIC WEIGHTS

MAIN STATIC WEIGHTS			
ITEM	**QUANTITY**	**1/8in² PRESSURE**	**1/16in² PRESSURE**
PISTON & M.U.W & TRIM MASS HOLDER	2	200	400
TOP LOADING STATIC WEIGHT	12	200	400
TOP LOADING STATIC WEIGHT	2	100	200
DIFFERENTIAL WEIGHTS – in. water			
DIFFERENTIAL WEIGHT	1	400	800
DIFFERENTIAL WEIGHT	1	200	400
DIFFERENTIAL WEIGHT	1	100	200
DIFFERENTIAL WEIGHT	1	50	100
DIFFERENTIAL WEIGHT	2	20	40
DIFFERENTIAL WEIGHT	1	10	20
DIFFERENTIAL WEIGHT	1	5	10
DIFFERENTIAL WEIGHT	2	2	4
DIFFERENTIAL WEIGHT	1	1	2

Model 249TL – bar or Kg/cm² MAIN STATIC WEIGHTS

MAIN STATIC WEIGHTS		
ITEM	**QUANTITY**	**1/8in² PRESSURE**
PISTON & M.U.W & TRIM MASS HOLDER	2	3
TOP LOADING STATIC WEIGHT	10	5
TOP LOADING STATIC WEIGHT	2	2
DIFFERENTIAL WEIGHTS - mbar		
DIFFERENTIAL WEIGHT	1	500
DIFFERENTIAL WEIGHT	2	200
DIFFERENTIAL WEIGHT	1	100
DIFFERENTIAL WEIGHT	1	50
DIFFERENTIAL WEIGHT	2	20
DIFFERENTIAL WEIGHT	1	10
DIFFERENTIAL WEIGHT	1	6
DIFFERENTIAL WEIGHT	2	2

WEIGHT SETS CAN MANUFACTURED FOR ALTERNATIVE PRESSURE UNITS.
WEIGHT SETS CAN MANUFACTURED FOR LOCAL GRAVITY.
CONSULT YOUR LOCAL DISTRIBUTOR FOR ADVICE ON AVAILABILITY.

Assembly of the Model 249T(L)

(1) Obtain a firm bench, on which to mount the tester, capable of withstanding a load of 250kg. It is recommended that the dimensions of the top surface should exceed 1500mm in width x 650mm in depth to provide adequate working area. There should be no obstructions within one metre above the bench surface.

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(2) Position the three level plates onto the bench surface and fix in position The front two plates should be positioned 40mm from the front edge of the bench to allow adequate clearance for the handwheels.

(3) Fit the fixed foot to the rear of the tester base and the two adjustable feet to the front.

(4) Lift tester, at least two people will be required and place on level plates fixed to bench.

(5) Place the spirit level on one of the piston units and set the tester level by adjusting the front two knurled feet. Place spirit level on other piston unit to check level.

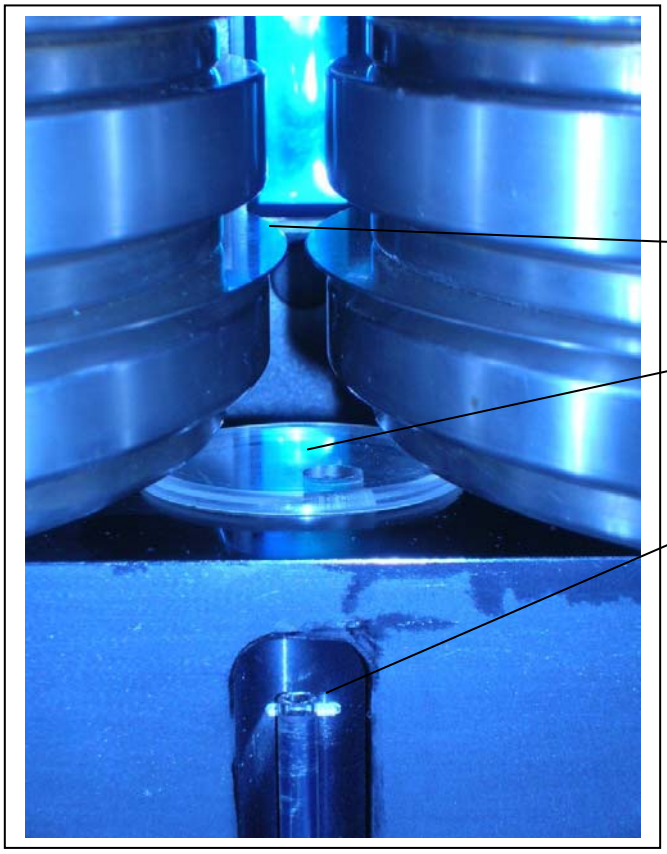
Filling the base unit with liquid – MODEL 249T ONLY

(1) Wind both variable volume handles fully clockwise. Unscrew reservoir spindle on the main aluminium manifold and remove completely with the reservoir cover.

(2) Fill reservoir with appropriate liquid until level with the level indicated on the front face of the aluminium block. Use the oil supplied or an approved substitute for oil systems.

(3) Wind screw pump handle fully anti-clockwise.

(4) Allow 5 minutes for the liquid to level out, then top up reservoir if necessary.



(1) Ensure all valves are closed and regulator is fully turned anti-clockwise.

(2) Remove red cap from connection on right-hand side of tester.

(3) Connect gas supply from either bottle gas (i.e. nitrogen) or a gas booster. Ensure gas is clean and dry. Whilst the tester can accept gas supply pressure of up to 400 bar, it is for ease of use, recommended that the supply pressure be limited to 120% FSD of range being calibrated/verified.

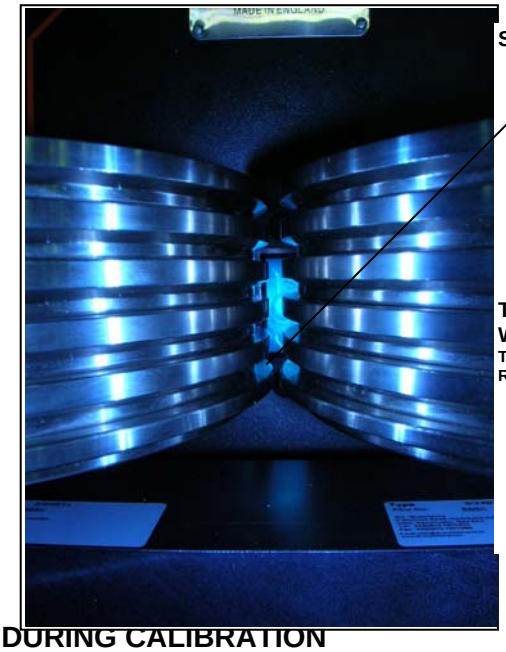
OPERATING INSTRUCTIONS

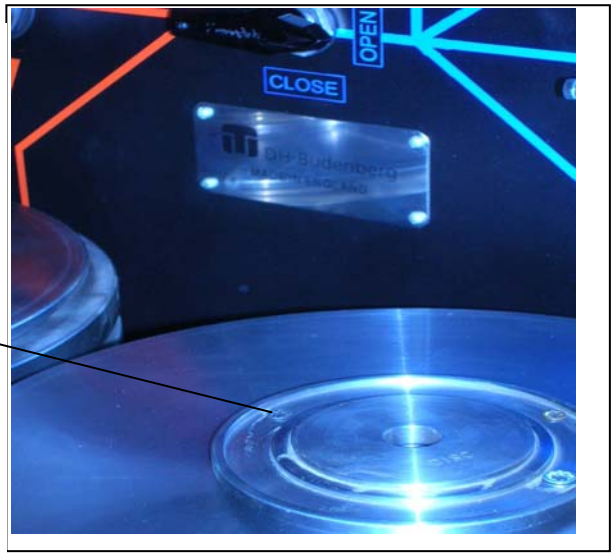
4.1 PROCEDURE

OPERATION

Balancing the Piston Units

4.1.1 Rotate the body of the safety torch that protrudes from the rear of the tester, turning it on and thereby illuminating the sighting panel.
4.1.2 Having pressurised the tester to the approximate working pressure, spin both sets of weights in the same direction.
4.1.3 Rotate the volume adjuster handwheels until one of the piston unit rises.
4.1.4 Add small loose weights into the endcap (Model 249TL) or trim mass holder (Model 249T) of the floating piston unit until it starts to descend.
4.1.5 Repeat operations 4.1.3 and 4.1.4 until both pistons are floating at the same height relative to each other. This may be verified by viewing the sighting edges of the start weights against the illuminated sighting panel.
4.1.6 The tester/PCUs are now in balance. Note reading of D.P. cell and adjust if required.
4.1.7 This operation will take about 10 minutes.





DURING CALIBRATION

When the tester is correctly set up and there are no leaks the piston should “float” for many minutes without it being necessary to touch the screw pump handwheel. If the piston continues to fall, check the connections for leaks.

During calibration, the weights should be rotated by hand. It is desirable that the weights should only be rotated when approximately the correct pressure is obtained. Weights should not be brought to rest by fully releasing the pressure and allowing the piston head to rotate against its stop under the full load of the weight pile.

Stops come into action if the pressure is too high or too low and it is essential that the weights should be spinning freely whilst taking readings. At the lowest pressures the weights will not spin for more than a few seconds unless a very thin oil is used, but providing the weight is rotated by hand before taking a reading and is obviously “floating” an accurate reading will be given.

4.2 CONNECTION OF DIFFERENTIAL PRESSURE CELL

4.2.1 Remove the blanking plugs from either of the differential pressure connections on the side of the tester.
4.2.2 Connect to each port a length of small bore metal tubing keeping the length to the minimum required.
4.2.3 Connect the free end of each length of metal tubing to the ports on the differential pressure cell.
4.2.4 The “red” port on the tester should be connected to the “high” port on the D.P. cell and the “blue” to the “low”.

4.3 LOADING THE TESTER

4.3.1 Place onto each piston unit, its appropriate lead, overhang, endcap and starting weight with sighting edge. These weights MUST always be loaded for any test to be carried out.
4.3.1 Load additional main weight as necessary to achieve the desired working pressure.

4.4 PRESSURISING THE TESTER – MODEL 249TL

4.4.1 Rotate volume adjuster handwheels so that their indicating pointers are in mid-position.
4.4.2 Fully rotate pressure regulator knob anti-clockwise.
4.4.3 Close valves “C” and “D”
4.4.4 Rotate the equalising valve handle anti-clockwise to the horizontal “OPEN” position.
4.4.5 Open valves “A” or “B”.
4.4.6 Turn on, or open gas supply to tester.
4.4.7 Turn regulator control knob clockwise and admit gas to the tester. Continue rotating the control knob until the two 80mm dial gauges indicate the desired working pressure. At this point, depending on the accuracy of the gauges and the tolerances of the P.C.U.’s and weights, one or both pistons may be floating.
4.4.8 Close valve “A” or “B” as appropriate.

4.5 PRESSURISING THE TESTER – MODEL 249T

4.5.1 Rotate volume adjuster handwheels so that their indicating pointers are in mid-position.
4.5.2 Open OIL FILL valves situated on the front face of the PCU manifold.
4.5.3 Remove reservoir cover, and pour in hydraulic mineral oil until it reaches the indicated position on the oil level indicator (situated on front face of PCU manifold).
4.5.4 Close OIL FILL valves situated on the front face of the PCU manifold.
WARNING: These valves should ***NEVER*** be operated when pressure is in the measuring system.
4.5.5 Fully rotate pressure regulator knob anti-clockwise.
4.5.6 Close valves “C” and “D”
4.5.7 Rotate the equalising valve handle anti-clockwise to the horizontal “OPEN” position.
4.5.8 Open valves “A” or “B”.
4.5.9 Turn on, or open gas supply to tester.
4.5.10 Turn regulator control knob clockwise and admit gas to the tester. Continue rotating the control knob until the two 80mm dial gauges indicate the desired working pressure. At this point, depending on the accuracy of the gauges and the tolerances of the P.C.U.’s and weights, one or both pistons may be floating.
4.5.11 Close valve “A” or “B” as appropriate.

4.6 TAKING DIFFERENTIAL PRESSURE READINGS

4.6.1 Shut the equalising valve C to vertical position.
4.6.2 Re-align the sighting edges, if necessary with the volume adjusters, and check that the instrument reading is the same. If the readings are different then the piston units are not

in balance and the equalising valve C should be opened and the piston units re-balanced as previously described. If one piston unit should fall more rapidly that the other then it is likely that there is a leak on that particular side. Carry out tests on pipework to D.P. cell to see where the lead is, correct and then re-balance as previously described.

4.6.3 Add differential weight to value required to H.P. side (red or blue) and level the sighting discs within the marked band on the sighting panel using the volume adjusters, after a setting time no longer than 30 seconds take a reading.

4.6.4 Add next differential weight to value required to the same side and bring back into balance, with each other using the volume adjusters, after a settling time take a reading. Repeat until all readings at that working pressure have been taken.

4.6.5 At the end of the readings check zero reading to see no change has occurred.

NOTE: The ranging and checking of the D.P. cell will vary according to different requirements. Therefore, the above is only a guide to the tests to be carried out.

4.7 CHANGING THE WORKING STATIC PRESSURE

4.7.1 Remove differential weights and small balancing weights.
4.7.2 Open equalising valve (C)
4.7.3 Apply main weights to required working pressure.
4.7.4 Repeat required procedures as described above

4.8 PRESSURE RELEASE

4.8.1 Shut off gas supply
4.8.2 Open equalising valve C and open release valves D and E
4.8.3 Slowly open valves A and B until all gauges read zero.
4.8.4 When tester is not in use close valves A and B, leave valves C, D and E open and remove all weights to a place of safe keeping.

4.9 TEMPERATURE MEASUREMENT OF PISTON UNITS

For many purposes, such as calibrating most type of dial gauges and transducers, accurate knowledge of the temperature of a piston unit is not necessary. However, in order to achieve the utmost accuracy from a dead-weight tester it is important to know the temperature of the piston unit as close as possible to the working part of the unit.

In laboratories where the room temperature is controlled it is most likely that the temperature of the working parts of the unit will not differ from the ambient temperature by more than 0.5°C. When working in uncontrolled temperatures, however, one would have to measure the temperature of the piston unit

A possible way to do this is to use a disc shaped thermistor type probe sensing element taped to the outer surface of the piston unit. The sensing element should be insulated from the ambient temperature by covering the element with a thin strip of polystyrene, or other insulating material, then taping this to the piston unit.

We can supply a suitable instrument. Consult your local distributor for advice on availability

FAULT FINDING

The following chart is an aid to fault finding on your equipment in case of a fault occurring.

Fault	Possible cause	Remedy
Equipment does not provide any output	No air supply connected/leaking	Check supply Check for leaks, replace seals

pressure.	Regulator not set correctly	Adjust so regulated supply gauge (top left-hand corner) register approximately 110% FSD of instrument being calibrated/verified
	Differential pressure connections leaking	Check for leaks, replace seals
	Reservoir Valve is open/Drain valve is open	Close valve and try again.
	Pressure leaking past valves ‘D’ or ‘E’	Ensure valve is fully shut. Open and then close to remove any debris off valve seat
	If unable to locate a cause.	Return tester to DH▪Budenberg for investigation.
Equipment provides pressure but pressure decays to zero	Incorrect operating procedure being used.	Ensure that correct operating procedure is being followed (Refer to section 4)
	Pressure leaking past valves ‘D’ or ‘E’	Ensure valve is fully shut. Open and then close to remove any debris off valve seat
	No liquid in tester (Model 249T ONLY)	Check that tester is filled with liquid. Fill the equipment with fluid as necessary. Refer to section 3 (Filling the equipment with liquid).
	If unable to locate a cause.	Return tester to DH▪Budenberg for investigation.
	Internal damage	Return tester to DH▪Budenberg for investigation.
Equipment provides pressure but pressure increases without operator input	Pressure leaking past valves ‘A’ or ‘B’	Ensure valve is fully shut. Open and then close to remove any debris off valve seat

PERIODIC MAINTENANCE

6.1 CLEANING THE UNIT AND CHECKING THE LIQUID LEVELS.

Cleaning the units and checking the liquid levels (Model 249T) is the only periodic maintenance required. With normal use, no further maintenance should be necessary. If required, the system can be returned to our works for re-conditioning. Accuracy, overhaul and re-certification is also explained in corrective maintenance.

Oil operation

Keep the system clean and free from spilt oil. Do not use any cleansing solvents as they may damage the seals.

Ensure that the reservoir contains sufficient liquid to carry out any calibrations required. If necessary top up the reservoir with the same liquid that is already being used. Do not mix various types or brands of liquid in the tester.

If the oil in the system becomes dirty it should be drained, to prevent contamination and damage to the system.

CORRECTIVE MAINTENANCE

7.1 GENERAL

This section contains details on stripping the unit and replacing the spare parts which are listed in section 8. The component identification numbers in brackets in each procedure refer to the following drawings

7.2 OIL FILL VALVE – MODEL 249T ONLY

The spindles of the valves are sealed with an “O” ring and this can be renewed or the valve cleaned by unscrewing the gland nut and removing the spindle. If removing spindle, the sealing washer at the bottom of the gland nut should be visually inspected for any signs of damage.

ALL OTHER VALVES USED ON MODEL 249TL & 249T ARE SUPPLIED AS A COMPLETE ASSEMBLY

7.3 INDICATING GAUGES

Should a gauge become defective or damaged it should be replaced or returned for repair.

7.4 VOLUME ADJUSTER

To renew the “O” ring seals items 9 and 10, remove the two nuts on either side of the handle and the two set screws on the underside of the base plate that retain the bearing plate. Rotate handwheel clockwise until the bearing plate end disengages from the two pillars then pull the assembly free.

7.5 PISTON/CYLINDER UNIT

As the piston/cylinder unit represents a high proportion of the total value of the tester, it should always be handled with care and every effort made to keep it clean.

The piston/cylinder unit is made to extremely fine limits of accuracy and it is not advisable to dismantle it. If it is necessary to clean it, the piston and cylinder bore must be oiled immediately, in order to protect the high grade finish.

Should the unit become damaged it should be returned complete for replacement or repair. Parts from different units are not interchangeable as they have to be weighed and evaluated as a whole.

The serial number of the piston/cylinder unit appears in the certificate of accuracy and is marked on the body of the unit. This number, as well as the tester serial number should always be quoted in correspondence concerning the piston/cylinder unit.

The piston/cylinder connections should be blanked if it is removed from the tester. If the unit is taken off for any reason it should be stored upside-down, resting on its weight carrier.

TO CHANGE OR INSPECT PISTON UNITS

Ensure pressure has been released as described.
Remove all weights including piston heads.
MODEL 249TL - Grip each piston unit by the knurled portion of the adaptors and unscrew in an anti-clockwise direction from the tester block.
MODEL 249T – Use appropriate 'tommy bar' in drilled side holes of each piston unit and unscrew in an anti-clockwise direction from the tester block.
Cleaning the Piston Unit – see diagrams for construction
The piston must be kept clean and dry. Under normal operating conditions the piston will rotate for approximately ½ minute at any pressure. If the rotation is unsatisfactory or a squealing noise is heard, remove the piston unit from tester. Unscrew the cap until the piston is free. Rub piston and cylinder with a clean, dry fluff-free cloth. Do not finger the working surfaces. If the contamination is very bad a little solvent may be used. In normal use it should only be necessary to clean the unit once or twice a week. If the period is very much shorter and only clean gauges have been used examine the air or gas supply for contamination.
After cleaning a piston unit, re-assembly taking care when re-fitting piston into the cylinder.
Re-fit the new or cleaned piston unit to the tester block in the reverse of above. Ensure seals have not been damaged before re-fitting PCUs
The serial number of the piston unit is marked on the outside of the piston unit. This number, as well as the tester number should always be quoted in correspondence concerning the piston unit.

7.6 FACTORY OVERHAUL AND RE-CERTIFICATION OF DEAD-WEIGHT TESTERS MAINTENANCE OF ACCURACY.

The accuracy of a dead-weight tester depends primarily on the effective area of the piston unit and on the weights applied to the piston. The effective area of the piston unit can be affected by wear of the unit. This is generally caused by contamination of the oil in the tester by foreign matter from instruments being calibrated, by water, or by chemicals from instruments, or by rust or corrosion caused by contaminants.

Weights are made of austenitic stainless steel which are entirely stable. They should be periodically cleaned using a non abrasive method to remove any foreign matter.

NEED FOR OVERHAUL AND RE-CERTIFICATION

We recommend that the tester be returned to us for overhaul and re-certification at any time if when used in accordance with instructions:

(a) The piston does not spin freely.

(b) The rate of fall of the piston is appreciably greater than when new and makes use of the tester difficult.

(c) The weights are damaged.

(d) The tester cannot be made to operate satisfactorily due to wear or damage to pump piping or valves which cannot be rectified by the user.

When high accuracy is required from the tester, it should be returned for overhaul and re-certification more frequently. The actual period will depend on how the tester is used. A tester kept in a laboratory and carefully used might need to be returned every two to three years. A tester carried from site to site and used for calibrating high accuracy gauges or transducers from industrial process plant or for measuring pressures directly might well need to be returned at intervals of less than a year.

The actual period between overhaul and re-certification should be fixed by the user in the light of the above comments taking into account the requirements of any inspection authority, which might be involved.

IDENTIFICATION OF WEIGHTS

All weight sets supplied with a dead-weight tester have allocated, and are marked, with a weight set number. Additionally, if users wish to ensure that only specific weights are used with an individual dead-weight tester or piston and cylinder unit, then the serial number of the tester, and/or piston cylinder unit may also be marked on the main weights. Regrettably due to size, increment weights can only be marked with the serial number of a piston and cylinder unit.

OVERHAUL AND RE-CERTIFICATION

To provide the best possible service, the tester should be returned as complete units comprising the base, the piston and cylinder unit, and all the weights. Users may at their discretion elect to service the base themselves and only return the piston and cylinder unit with weights for overhaul. In such

instances, certification issued after overhaul can only refer to the piston and cylinder and weight set numbers and not to the base to which they were originally fitted.

Tester bases will be stripped, all pipework cleaned, all seals replaced, worn components replaced where desirable, and all reassembled and tested.

The weights will all be checked and brought to within original limits if possible. If one or two weights are missing or beyond economical repair they will be replaced. If more are missing/ beyond economical repair customer instructions will be sought.

The piston unit will be checked for accuracy and sensitivity. If it is not satisfactory for any reason a quotation will be submitted for a replacement unit.

A new certificate of accuracy will be issued for each overhauled tester. Unless otherwise instructed on order when there has been a slight change in area of the piston unit the certificate will reflect this; the accuracy will not be affected by more than 0.03%. For example the certificate of accuracy of an overhauled tester might show that the error does not exceed 0.05% when the original certificate shows that the error did not exceed 0.02%.

We can issue an UKAS certificate of calibration for an overhauled system. Details will be supplied on request.

ORDERING AND PRICING

An open order should be placed to avoid delays and correspondence. No tester will be overhauled if it is not economic to do so. By far the most expensive component likely to need replacement is the system piston unit; this unit will not be replaced unless customer's approval has been obtained.

When customers ordering procedure does not allow an open order to be placed, we quote a basic price for the overhaul and re-certification of that particular model. This assumes that the tester and weights are in good condition and covers stripping, cleaning of pipework, replacement of seals, re-assembly and testing, checking of weights and of piston unit. The basic price covers our certificate of accuracy in the typical form. Customers requiring a more detailed certificate of calibration should state this on their order.

Any additional work required will be carried out and will be quoted separately and will not commence until agreed so by the customer involved.

SPARE PARTS

8.1 SPARE PARTS LIST

This list covers all the items subject to wear. Any enquiries should be addressed to DH▪Budenberg.

Unit	Item No.	Description	Part No.
Piston/cylinder MODEL 249TL	1	MODEL 249TL PCU – QA/1864	3/4110
	2*	Bonded seal 400-023-4490-41	YR1337
	3*	O-Ring 200-210-4470	YR1390
Piston/cylinder MODEL 249T	4A	MODEL 249T PCU – 1/8in² AREA - PA/7089	YC0384
	4B	MODEL 249T PCU – 1/16in² AREA - PA/5870	YC0571
	5*	O-Ring 200-126-4470	YR1386
	6*	O-Ring 200-011-4470	YR1370
	7*	O-Ring 200-021-4470	YR1373
	8*	Valve seat PA/5586/2	YC3534
SCREWPRESS	9*	O-Ring 200-010-4470	YR1365
	10*	O-Ring 200-111-4470	YR1380
	11*	Bonded seal 400-025-4490-41	YR1338

Items marked thus * are contained in the bag of seals supplied with the system which is also available as a spare.

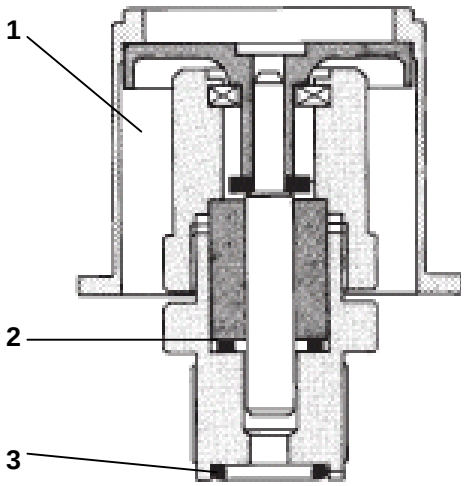
8.2 ORDERING SPARES

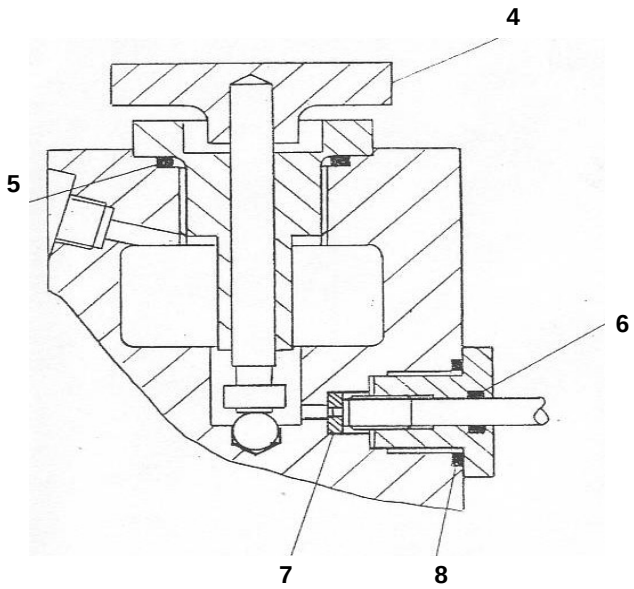
When ordering spares or making enquiries always give:
1) System Model No. (on front of this manual)
2) System serial No. (on nameplate)
3) Description of part. See spare parts list.

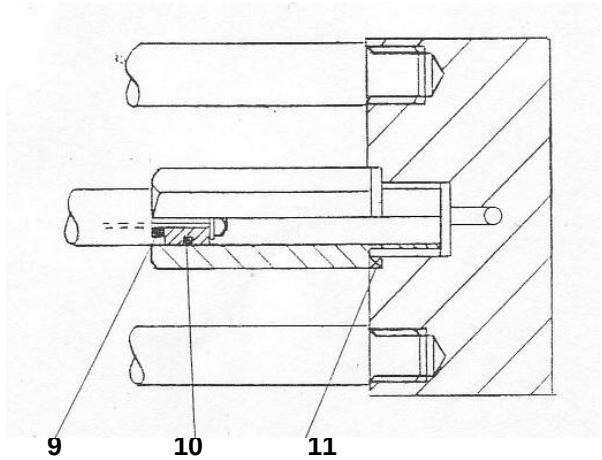
Whilst every effort is made to ensure that the correct parts are supplied, this cannot be guaranteed unless full information is given.

Ordering spares can be carried out from our service department at the following address:

DH.Budenberg Customer Services
2 Gilchrist Road, Northbank Ind. Est.,
Irlam,
Manchester
M44 5AY
UK
Tel: 44 (0)870 7877370
Fax: 44 (0)870 7877369
E-Mail: sales@dh▪budenberg.co.uk







8.3 IDENTIFICATION OF SPARE PARTS OPTIONAL EXTRAS

9.1 UKAS CERTIFICATE OF CALIBRATION

All testers are available with certificates of calibration on pressure, also calibration of effective area and mass of the piston unit, also the mass of the weights.
Consult your local distributor for advice.

Consult your local distributor for advice on any additional equipment required for calibration requirements.

EC DECLARATION OF CONFORMITY

ISSUED IN ACCORDANCE WITH THE

PRESSURE EQUIPMENT DIRECTIVE (PED) 97/23/EC

I hereby declare that in accordance with the above directive, that the

Model 249TL & Model 249T
Differential Dead-weight Tester

has been manufactured and tested in accordance with the conformity assessment:
Module A – 'internal production control'.

Name : D. Beaven

Position : ENGINEERING MANAGER - DH▪Budenberg - UK

Date : 1th December 2007

Signature : _____

EC DECLARATION OF CONFORMITY

ISSUED IN ACCORDANCE WITH THE

PRESSURE EQUIPMENT DIRECTIVE (PED) 97/23/EC

PRODUCT DESCRIPTION	:	PNEUMATIC/HYDRAULIC DIFFERENTIAL DEAD-WEIGHT TESTER
MODEL No	:	MODEL 249TL, MODEL 249T
MANUFACTURE	:	DH▪Budenberg MANCHESTER ENGLAND
MAXIMUM WORKING PRESSURE	:	200bar (3,000lb/in²)
HYDROSTATIC PRESSURE TEST	:	250 bar (3,600lb/in²)
ASSEMBLY DIMENSIONS	:	
SIZE	:	57cm x 60cm x 75cm (WxDxH)
WEIGHT	:	BASE (PISTON/CYLINDER FITTED) : 32Kg (70lbs) – FILLED BASE (PISTON/CYLINDER FITTED) : 31Kg (68lbs) – UNFILLED WEIGHTS - bar : 82Kg (180lbs) - lb/in² : 85Kg (190lbs)
VOLUME	:	RESERVOIR : 0.1 LITRES PRESSURISED VOLUME : 0.1 LITRES
INTENDED USE	:	PRESSURE MEASUREMENT DEVICE.

PRESSURE EQUIPMENT DIRECTIVE DEFINITION : PRESSURE ASSEMBLY
PRESSURE EQUIPMENT DIRECTIVE CLASSIFICATION : SEP
PRESSURE EQUIPMENT DIRECTIVE CONFORMITY ASSESSMENT: MODULE A

CLASSIFICATION OF THE PRESSURE ASSEMBLY IS BASED ON THE PRESSURIZED INTERNAL VOLUME (V) AS DEFINED IN ANNEXE B OF THE PRODUCT CLASSIFICATION CHART IN THE PRESSURE EQUIPMENT DIRECTIVE 97/23/EC.

	GAS		LIQUID	
GROUP	1	2	1	2
PRESSURE <200 bar	SEP	SEP	SEP	SEP
>200 bar	CAT III	SEP	SEP	SEP
>500 bar	CAT III	SEP	CAT 2	SEP
>1000 bar	CAT IV	CAT III	CAT II	CAT I

NOTE: THE ABOVE TABLE IS BASED ON DH▪Budenberg EQUIPMENT THAT HAS A PRESSURISED INTERNAL VOLUME OF LESS THAN ONE LITRE.

DETAILS OF HARMONISED STANDARDS/TECHNICAL STANDARDS/EUROPEAN COMMUNITY DIRECTIVES SPECIFIED/USED:

STANDARD	DESCRIPTION
EN 837-1:1998	Pressure Gauges - Part 1: Bourdon tube pressure gauges – Dimensions, Metrology, Requirements and Testing

DH▪Budenberg QUALITY ASSURANCE SYSTEM : ISO 9001
DH▪Budenberg QUALITY ASSURANCE MONITORS : LLOYD'S REGISTER OF SHIPPING

INSTALLATION DETAILS

DH▪Budenberg provide pressure adaptors to aid the calibration of pressure equipment. The adaptors may be screwed, flanged or hygenic connections that meet relevant international standards. These can be readily fitted to DH▪Budenberg equipment by any qualified instrument technician following recognised international or company guidelines.

TAPER THREADS:

BSPT or N.P.T. are tapered threads, which may require a sealing material, i.e. P.T.F.E. tape or a sealing compound to be applied to the thread form prior to fitting into its mating part. P.T.F.E. tape is the preferred method to be used on a dead-weight tester, as a compound requires a cure time, and there is a slight possibility that the compound may enter the internal pipework, which may affect the P.C.U. operation.

BSP THREADS:

BSP threads are bottom sealing threads, which will require the use of a sealing washer, which should be compatable with the test medium employed. Never attempt to make a seal on the thread.

PRESSURE RATINGS

B.S.P. CONNECTIONS HAVE MAXIMUM PRESSURE RATINGS AS FOLLOWS (BASED ON EN837):

	CONNECTION MATERIAL	
SIZE	**BRASS**	**STAINLESS STEEL**
G1/8	**400 bar**	**400 bar**
G1/4	**600 bar**	**1000 bar**
G3/8	**600 bar**	**1000 bar**
G1/2	**1000 bar**	**1600 bar**

N.P.T. CONNECTIONS HAVE MAXIMUM PRESSURE RATINGS AS FOLLOWS (BASED ON EN837):

	CONNECTION MATERIAL	
SIZE	**BRASS**	**STAINLESS STEEL**
1/8 in	**400 bar**	**400 bar**
1/4 in	**600 bar**	**1000 bar**
3/8 in	**600 bar**	**1000 bar**
1/2 in	**600 bar**	**1000 bar**

METRIC CONNECTIONS HAVE MAXIMUM PRESSURE RATINGS AS FOLLOWS (BASED ON EN837):

	CONNECTION MATERIAL	
SIZE	**BRASS**	**STAINLESS STEEL**
M12 x 1.5	**600 bar**	**1000 bar**
M20 x 1.5	**1000 bar**	**1600 bar**

HIGH PRESSURE FITTINGS:

Lens rings (coned joints) should be used for achieving a safe, effective seal on pressures greater than stated above. The pressure fittings should be periodically inspected to ensure the threads are not damaged. The safety vent hole should be examined to ensure it is not blocked.

SPECIAL APPLICATIONS:

It is the responsibility of the end user to ensure that if the product is used with Category 1 gases or fluids that all precautions are taken to ensure the equipment is used in a safe manner. Group 1 gases and fluids are classified as Explosive; Extremely flammable; Highly flammable; Flammable (where the maximum allowable temperature is above flashpoint); Very toxic; Toxic. International or company guidelines should be followed for sealing arrangements, special cleaning procedures required. Neither DH▪Budenberg, nor its Agents will be liable for any damage incurred due to the end user methods employed.