

Directions for Use No. 565 E
for the

THERMOTRON ^(R) TM 11/2	Cat.No. 162 11
with gauge heads TR 111	Cat.No. 162 14
and TR 112	Cat.No. 162 16

1. Technical data

Measuring range of the THERMOTRON TM 11/2 with gauge head TR 111 connected	10^{-2} to 10 Torr
with gauge head TR 112 connected	10^{-3} to 5×10^{-1} Torr
Mains connection	220 V (or 110 V) 50 to 60 c/s
Fuses:- for 220 V, s.ph. mains	0.125 A (slow-blow)
for 110 V, s.ph. mains	0.2 A (slow-blow)
Recorder output	100 mV, $R_{int} = 67$ ohms $R_{ext} \geq 10$ kohms
Dimensions of the control unit	195 x 135 x 140 mm high
Weight of the control unit	1.8 kg
Dimensions of the gauge heads (incl. measuring cell and sensing head)	143 x 48 mm dia.
Weight of a gauge head (incl. measuring cell and sensing head)	140 g (approx. 3 1/4oz.)
Means of connection of gauge head	small flange, NW 10
Length of gauge power cable	2 m

2. Standard equipment

Two gauge power cables are supplied as standard with the control unit THERMOTRON TM 11/2.

3. Principle of operation

Within certain limits the thermal conduction of a gas is related to the pressure of that gas. This phenomenon is exploited in all thermal conductivity vacuum gauges (measuring principle after Pirani, 1906).

The vacuum gauge THERMOTRON TM 11/2 measures the pressure prevailing during thermal conduction of the gas within the gauge head and for this purpose a filament of constant power input is heated. The heat evolved is dissipated in two ways, a) by reflection which is not dependent on pressure and b) by the gas enveloping the filament which is dependent on pressure, reducing with increasing pressure especially in the 10^{-3} to 10 Torr range - the range of the THERMOTRON TM 11/2.

The gauge head's sensing filament heated at constant power forms a branch of a Wheatstone bridge the resistors of which are so compensated that no current flows through the meter at pressures below 10^{-3} Torr.

With increasing pressure the temperature of the sensing filament falls due to the heat dissipation property of the gas. At the same time, the resistance of the filament decreases and the Wheatstone bridge is brought more and more out of tune causing deflection of the meter needle and thus providing a reading of the pressure.

The measuring range of such thermal conductivity vacuum gauges becomes displaced toward the higher pressures as the length of the filament is decreased.

4. Construction of the gauge heads (see Fig. 3)

The sensing elements of THERMOTRON TM 11/2 gauge heads are made of varying lengths of tungsten filament.

Two different LEYBOLD gauge heads are made for the THERMOTRON TM 11/2:

- 1.) The gauge head TR 111 for the measuring range 10^{-2} to 10 Torr, identified by its red spot (15) - 2 short tungsten filaments serve as sensing elements.
- 2.) The gauge head TR 112 for the measuring range 10^{-3} to 5×10^{-1} Torr, identified by its green spot (15) the sensing element of which is a long coiled tungsten filament.

Both gauge heads consist of:-

- a) the measuring cell (18) which may be connected to the vacuum system by a small flange connection NW 10 (17) and
- b) the sensing head (19) which contains the additional and partly variable resistors of the Wheatstone bridge.

The gauge heads (sensing head plus measuring cell) are supplied with the two parts matched and (as whole units) are interchangeable.

Re-compensating or re-calibrating may (if at all) be necessary only after a long period of operation (see section 9).

The measuring cell of a gauge head can be replaced by a new one when necessary. Generally the resistors have to be re-set or calibrated to suit the sensing head (further details under section 9).

5. Control unit and method of connecting the gauge heads to the control unit (see Figs 1 and 2)

One or two gauge heads TR 111 or TR 112 can be connected to the vacuum gauge control unit THERMOTRON TM 11/2. Connecting to measuring points I and II may be in the following combinations:-

connection of one gauge head TR 111 and one gauge head TR 112
or connection of two gauge heads TR 111
or connection of two gauge heads TR 112.

The three scales on the meter are:-

a green scale (3) for the measuring range 10^{-3} to 5×10^{-1} Torr,
a red scale (2) for the measuring range 10^{-2} to 10 Torr,
a black scale (1) 0 ... 10 for reference readings on a recorder
(see section 5.2) or for calibration measurements.

With gauge head TR 111 (red spot) the pressure readings are from the red scale (2) only; the red pilot lamp (5) lights up.

With gauge head TR 112 (green spot) pressure readings are from the green scale (3) only; the green pilot lamp (4) lights up.

5.1) Starting

Connecting the gauge head to the control unit is by means of the gauge power cables supplied as standard with the THERMOTRON TM 11/2. Measuring points I and II will be found at the rear of the unit - any gauge head can be connected to either point.

The control units THERMOTRON TM 11/2 are supplied wired for operating on 220 V, 50 to 60 c/s mains¹⁾.

To start the control unit press the red control button (6).

The pressure reading of the particular measuring point is not given until switch I or II on the meter has been pressed.

If a red-spotted gauge head TR 111 is connected to the selected measuring point I or II the red pilot lamp (5) lights up; if a green-spotted gauge head TR 112 is connected the green pilot lamp (4) lights up. The colour of the pilot lamp in each case matches the colour of the scale (2) or (3).

NB:- Press switch I or switch II only, otherwise false readings result.

5.2) Connection for a recorder

At the rear of the THERMOTRON TM 11/2 there are two ungrounded recorder outputs (0 ... 100 mV), one for each measuring point. The connecting lead of the recorder must be fitted with a 6-pin magnetophone plug obtainable at any radio shop. Solder the cable connections as shown for 100 mV on the rear of the control unit (see Pos. 14).

Amplifiers or compensation recorders may be used provided that the internal resistance is greater than 10 kohms. Low resistance recorders can be connected in which case there would be no registering on the front panel meter of the control unit. For further details consult department HTB.

For simultaneous recording of both measuring points connect a dotted-line recorder - only one measuring point at a time can be recorded by a continuous-line recorder.

Measuring point switch I or II has no influence on the recorder outputs as these give the readings for the relative gauge heads. It is however important to see that the two recorder outputs are connected independent of each other and are ungrounded.

¹⁾ If the unit is to be operated on 110 V, s.p.h., the relative soldered connection in the unit must be melted off and resoldered to the correct point. Unscrew the four corner screws under the chassis, remove chassis from casing and have the modification carried out by an electrician. Our HTI (Technical Information) department will be pleased to supply information.

6. Fitting into a control panel

On removal from the outer casing by unscrewing the four screws in the corners underneath, the unit can be fitted into a control panel and secured to the front panel by four corner screws.

The dimensions of the THERMOTRON TM 11/2 are such that two of the units can be fitted side-by-side in a 19" rack.

7. Meter accuracy and dependency on the nature of the gas

The meter accuracy of the control unit is $\pm 2\%$ of the full scale deflection. The extent of this relatively inaccurate range is clearly indicated at both ends by the widened black base line of the scale. The accuracy as related to pressure is therefore higher in the wide divisions in the middle than it is in the close divisions at the ends of the scale.

The thermal conductivity of gases and vapours varies with the molecular weight and therefore the readings given by thermal conductivity vacuum meters are dependent on the nature of the gas.

Within the margins of error, the pressure readings for gases of similar molecular weight (O_2 , CO, water vapour) can be read off directly. For gases of low molecular weight (H_2 , He) the reading is too high, and for gases of high molecular weight (Xe, Kr, Ar, CO_2) the reading is too low.

If oil or other organic vapours prevail, too high a reading will be obtained at low pressures; especially below 10^{-2} Torr the readings are liable to be most inaccurate in the presence of oil vapours.

8. Cleaning and changing the measuring cell

Contamination of the measuring cell alters the calibration; such contamination could among other things be caused by long periods of operation directly above a rotary pump. The contaminants not removable by solvents should under no circumstances be allowed to enter the gauge heads. In vacuum plant operating under very dirty working conditions this is generally prevented by shields or pipe bends in front of the measuring point.

While it is practical to clean the measuring cells with organic solvents such as petrol, CCl_4 , ether etc. it is not practical to use mechanical cleaners such as brushes because the filaments may be damaged beyond repair. Pour the solvent into the cell and shake well. After emptying rinse well once or twice with distilled water, then place the clean cell under vacuum ($\leq 10^{-2}$ Torr) for at least 2 hours. If the pressure reading does not go back to 0 on the black scale re-calibration is necessary (see section 9).

If the pressure reading of a gauge head, despite re-calibration, cannot be set as described in the following under section 9, or if it is apparent that error occurs, then the measuring cell (18) of the particular gauge head should be replaced by a new one.

To change a measuring cell unscrew screws (16) of the shell casing of the sensing head. The measuring cell is connected to the sensing head by a control contact and this contact must then be removed.

NB:- Measuring cells for gauge heads TR 111 are to be fitted only to sensing heads marked with a red spot; measuring cells for gauge heads TR 112 are to be fitted only to sensing heads marked with a green spot.

9. Re-calibrating the gauge heads

Before commencing to re-calibrate make sure that the measuring cell of the gauge head is not badly contaminated.

After changing the measuring cell the THERMOTRON gauge head must be re-calibrated.

Evacuate the vacuum system, to which the gauge head is connected, to such an extent that the pressure in the gauge head is negligibly low compared with the lower limit of the measuring range. Thus when re-calibrating a gauge head TR 111 the maximum pressure allowable is 10^{-3} Torr; for a TR 112 gauge head the maximum is 10^{-4} Torr.

In the sensing heads of gauge heads TR 111 and TR 112 there are two control potentiometers (20) and (21) which are accessible on removal of the shell casing (22) bearing the name plate.

By means of a small screwdriver set the measuring cell side potentiometer (21) so that meter needle stands at "0" on the black decade scale (1).

Now vent the system, then set the plug side potentiometer (20) so that the meter needle points to "10" on the black decade scale (1). On completion of calibration screw the shell casing (22) back on to the gauge head.

Note:- Re-calibration should be carried out only under even room temperature conditions.

10. Faults - their possible causes and removal

Immediately on switching on the control unit the meter needle deflects sharply hitting the left stop.

Possible causes:- the sensing filament is interrupted
the wrong measuring cell has been connected to the sensing head
the contact between measuring cell and sensing head is faulty.

On switching on, the meter needle deflects steadily but not sharply to the left stop.

Possible cause:- the gauge head is not correctly calibrated.

Removal of the above faults

First check that correct sensing head and correct measuring cell are connected, then check that the contacts between measuring cell and sensing head are clean - to do this remove the shell casing of the sensing head by unscrewing at (16). If faults still persist, re-calibrate (as described under section 9) or change the measuring cell.

11. Circuit diagram

The circuit diagram of the THERMOTRON TM 11/2 will be sent on request.

General notice

Right of alteration of the given data is reserved at all times.
Illustrations are not binding.

Figs 1 to 4
of Directions for Use No. 565 E
for the THERMOTRON TM 11/2 Cat.No. 162 11
with gauge heads TR 111 Cat.No. 162 14
and TR 112 Cat.No. 162 16

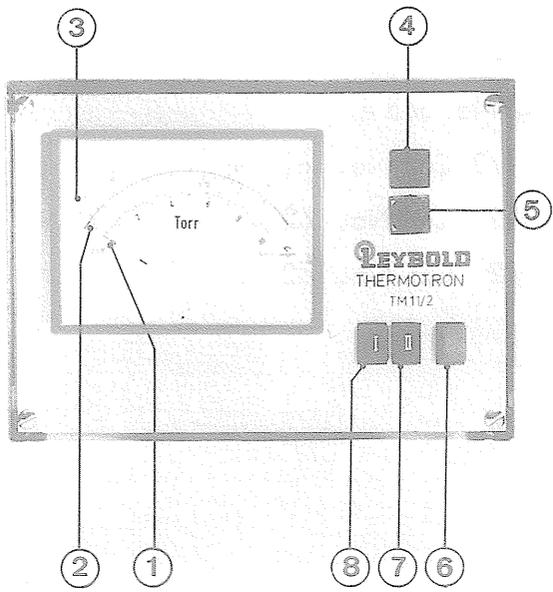


Fig. 1
THERMOTRON TM 11/2, front

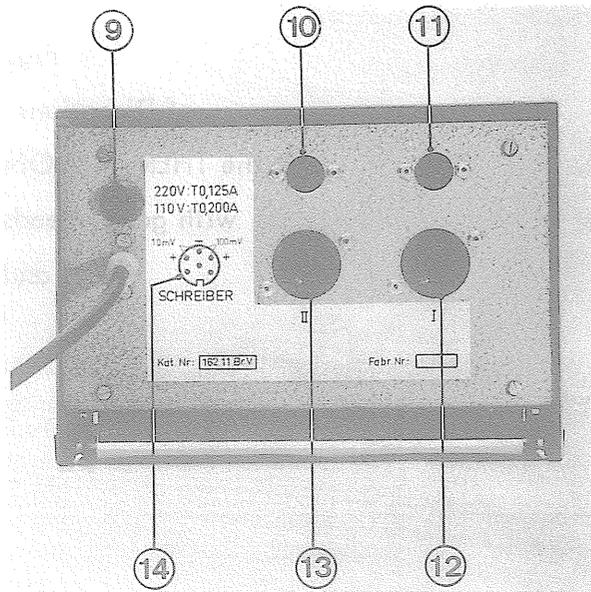


Fig. 2
THERMOTRON TM 11/2, rear



Fig. 3
THERMOTRON gauge head TR 111
(TR 112 similar)

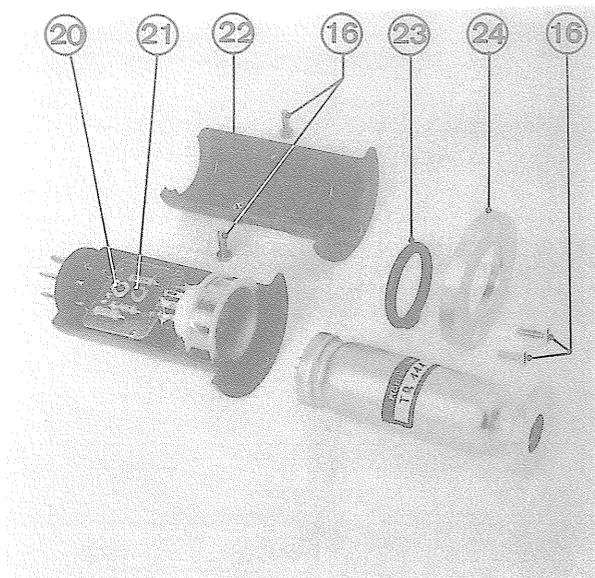


Fig. 4
THERMOTRON gauge head TR 111 opened
(TR 112 similar)

Key to Figs 1 to 4

- 1 Black scale of meter 0 ... 10 for reference readings
- 2 Red scale of meter for pressure measurement with a TR 111 gauge head
- 3 Green scale of meter for pressure measurement with a TR 112 gauge head
- 4 Green pilot lamp for pressure measurement with a TR 112 gauge head
- 5 Red pilot lamp for pressure measurement with a TR 111 gauge head
- 6 Red starter button of the THERMOTRON TM 11/2
- 7 Switch for pressure measurement at measuring point II
- 8 Switch for pressure measurement at measuring point I
- 9 Fuse
- 10 Recorder connection for measuring point II
- 11 Recorder connection for measuring point I
- 12 Gauge power cable connection for measuring point I
- 13 Gauge power cable connection for measuring point II
- 14 Connection diagram for 6 pin magnetophone plug for recorder connection
- 15 Identification spot (red for TR 111; green for TR 112)
- 16 Screws for opening the sensing head
- 17 Small flange connection NW 10
- 18 Measuring cell
- 19 Sensing head
- 20 and 21 Slotted screw potentiometers for calibrating the gauge head
(see text under section 9)
- 22 Shell casing with name plate affixed to exterior (name plate not visible in Fig. 4)
- 23 Sealing ring
- 24 Fixing cap for joining sensing head to measuring cell

