LAMBRECHT
METEOROLOGICAL INSTRUMENTS GERMANY

Mercury Barometer acc. to LAMBRECHT (604)

1. General remarks

The LAMBRECHT Mercury Barometer is a cistern barometer with adjustable scale.

Measuring the length of the mercury column, which holds the balance to the air pressure above the point of observation as against the vacuum, makes the measurement of the air pressure. For this reason the zero of the scale has to be adjusted to the level in the low cistern before each reading. The nonius and the scale can determine the length of the mercury column. After checking in our plant every barometer is locked and equipped with a seal.

ATTENTION: It is important to attend to item 3!

2. Choosing a proper place

The barometer should be hung up in a cold room which shows to the north, but not too close to the window. It has to be protected against rapid changes of temperature, direct heat radiation, e. g. sun or stove, and vibrations.

The read position above and the mercury level below must be sufficiently illuminated. When hanging up the instrument, the upper part of the scale should be at eye-level. By means of the plummet the instrument has to be aligned vertically.

3. Initial operation

The placing into operation has to be made very carefully. When the mercury barometer is not mounted in strict accordance to the following instructions, there will not be any guarantee.

During transport the barometer tube is completely with mercury. A Special seal prevents the departure of the mercury, as well as the penetration of air.

After erection of the barometer (in vertical position) the instrument can be unlocked after approx. 5 hours assimilation time.

- Removing of the seal.
- Opening of the stopper by clockwise rotation of the great knurling wheel (until limit). Then the mercury is sinking to the corresponding level.

As the smallest portion of air in the vacuum gauge decreases the barometer level, there is an air trap fused in the barometer (Bunten's peak). When there is air below the air trap in the tube, this has no influence to the measuring accuracy, provided that the whole mercury column is not interrupted (see fig. 1).

Fig.1

It is advisable, 3 - 4 hours before the first reading, to satisfy oneself that there is no air in the vacuum tube. For this reason the barometer must be inclined slowly from the vertical position (up to max. 40°) until the mercury fills the whole tube.

ATTENTION
The instrument in unlocked position must not be inclined for more than 40° or in horizontal position and must not be turned upside down!

When the mercury meets with a slight sound the upper part of the tube the space is a vacuum. This inspection should be made very carefully and should be repeated from time to time. If it is not possible to remove air blisters, which are beyond the air trap, or if there is air in the vacuum, it is necessary to return the instrument to LAMBRECHT for repair!

4. Transport

If the place of the barometer has to be changed, the lower end of the instrument must be moved to one side until the whole tube is filled with mercury.

The tube must then be locked by left-hand rotation of the knurled screw, whereat a small pressure to the screw at the same time, thus ensuring that the tube is firmly closed. The barometer may now be taken off the wall and packed.

5. Maintenance

Due to the unimpeded access of air, the mercury level in the lower cistern oxidizes in the course of the time. If the oxidation has reached that state where the point of the scale can no more be adjusted with security to the lower mercury level, it is recommended to remove the mercury from the cistern and to clean it.

The mercury cleaning has to be carried out by skilled staff only!

6. Measurement

A scale at the right side of the tube measures the length of the mercury column, which holds the balance to the present air pressure. The zero of the division coincides exactly with the point of the scale. Before each reading this point has to be adjusted to the mercury level in the cistern, so that the point and its reflected image will form a cross (X) (see fig. 2).

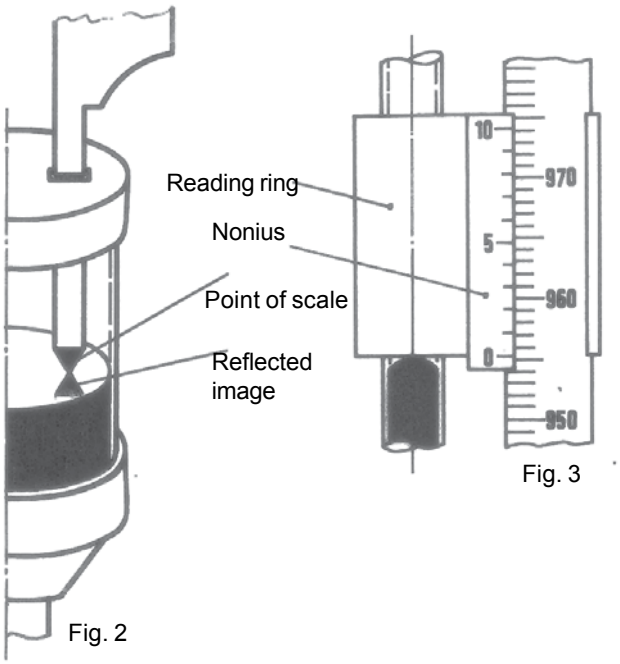

Fig. 2

Fig. 3

The knurled screw at the lower end of the scale makes the adjustment. The reading ring at the nonius, which surrounds the tube, is adjusted by the small knurled screw at the upper part of the scale in such a way that its lower edge is situated immediately above the meniscus of the mercury column.

The eye must then be in the same height with the reading ring and the meniscus of the mercury. The adjustment is correct when the edges of the metal ring before and behind the tube coincide touching the meniscus of the mercury tangentially (see fig. 3).

The last graduation line on the scale below the zero of the nonius division indicates the entire 1/1 mbar. For the reading of the 1/10 mbar serves the nonius. That graduation line of the nonius, which coincides with a graduation line of the main division, indicates the 1/10 mbar. They must be added to the entire 1/1 mbar lead on the main scale. The barometric reading in fig. 3 is 955.3 mbar.

For the determination of the height of the meniscus a second adjustment is necessary. The lower edge of the reading ring has to coincide with the line, at which the mercury touches the tube. The difference of the two readings is the height of the meniscus.

7. Correction of the raw barometric reading

The length of the mercury column ascertained in the above mentioned way depends apart from the air pressure on other influences, which do not admit a direct comparison of the individual measuring result. Therefore, various corrections have to be made for the raw barometric reading, which are described as follows:

7.1 Correction of temperature (table I)

The length of the mercury column depends on the density of the mercury and thus on its temperature. The temperature also influences the length of the scale. For this reason barometric readings are converted to a reference temperature of 0°C, i. e. the length must be determined, which the mercury column would have at a temperature of 0°C.

The following formula has teen taken as a basis for table I:

$$K_t = -b_t \cdot \frac{182 \cdot 10^{-6} \cdot t - 11 \cdot 10^{-6}(t-20)}{1 + \left[182 \cdot 10^{-6} \cdot t - 11 \cdot 10^{-6}(t-20)\right]}$$

Where: K_t = temperature correction

b_t = barometric reading at the temperature t [°C]

7.2 Correction of gravity (table IIa and IIb)

The length of the mercury column also depends on the acceleration due to gravity, which changes with the geographical latitude (table IIa) and the height above sea level (table IIb). Therefore the barometric reading is converted to the normal gravity.

(At sea level below 45° of latitude the gravitational acceleration amounts to 9.80616 m/s². The normal gravity or the standard value of the gravitational acceleration is 9.80665 m/s², which is reached at sea level at approx. 45°33').

The following formula has been taken as a basis for table IIa:

$$K_g\varphi = \left[\frac{9{,}80616}{9{,}80665}(1 - 0{,}002637\cos 2\varphi) - 1\right] \cdot b_0$$

Where:

$K_g\varphi$ = correction of gravity due to the geographical latitude $\varphi°$

b_0 = barometric reading reduced to 0°C

The following formula has been taken as a basis for table IIb:

$$K_{gH} = -0{,}195 \cdot 10^{-6} \cdot H \cdot b_0$$

Where:

K_{gH} = correction of gravity due to the height H

b_0 = barometric reading reduced to °C

When using the barometer stationary it is recommended to register the interpolated values of the table for latitude φ and the height H in the top column of the individual barometric readings b_0.

7.3 Correction of the capillary depression (table III)

Mercury does not moistened glass normally, a convex meniscus is formed in the barometric tube. Thereby the mercury height will be reduced. The correction values depend on the inside diameter of the tube and on the height of the meniscus. They are ascertained empirically by comparing them with a barometer free of depression.

The corresponding correction values for the mercury barometer of LAMBRECHT type are listed in table III.

7.4 Example of correction

For scale in mbar

Barometric reading b_t		1000.00 mbar
Temperature t at the barometer: 20°C *(acc. to table I)*	-	3.63 mbar
b_0	=	996.37 mbar
Geographical latitude of the place of observation: 55° *(acc. to table IIa)*	+	0.85 mbar
Height H of the place of observation: 200 m *(acc. to table IIb)*	-	0.04 mbar
Depression, height of the top: 1 mbar *(acc. to table III)*	+	0.57 mbar
Real barometric reading at a height of 200 m	=	997.75 mbar

For scale mmHg

Barometric reading b_t		750.00 mmHg
Temperature t at the barometer: 20°C *(acc. to table I)*	-	2. 72 mmHg
b_0	=	747.28 mmHg
Geographical latitude of the place of observation: 55° *(acc. to table IIa)*		+ 0.64 mmHg
Height H of the place of observation: 200 m *(acc. to table IIb)*		- 0.03 mmHg
Depression, height of the top: 1 mm *(acc. to table III)*		+ 0.56 mmHg
Real barometric reading at a height of 200 m	=	748.45 mmHg

8. Reduction of the pressure

from actual height to sea level, see table of reduction (table 4).

(604) Mercury Barometer acc. to LAMBRECHT

Id-No.	**00.06040.100 000**
Measuring elements:	Mercury column • liquid thermometer
Measuring ranges:	840...1050 hPa • -15…+50°C
Accuracy:	± 0.25 hPa at 20°C • ± 1°C
Resolution:	0.1 hPa with vernier • 0.5°C
Scale:	1 hPa • 1°C
Range of application:	Altitudes 0…1200 m • Temperatures -15…+50°C
Housing:	Aluminium · lacquer RAL 5009 (azure)
Dimensions:	1030 x 105 x 75 mm inside Ø of the tube is 8 mm
Weight:	Approx. 5.5 kg

Varieties:

00.06040.100 002	**(604) Mercury Barometer acc. to LAMBRECHT** officially calibrated
00.06070.100 000	**(607) Mercury Baro-Vacuum Gauge** (on request)

Enclosures:

- Correction tables I; IIa; IIb; III for mercury barometer according to LAMBRECHT
- Table 4 (reduction of atmospheric pressure)

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