

**INSTRUCTIONS FOR THE USE OF  
CAT. NO. S-4519 MERCURIAL BAROMETER**

**NOTE. READ THESE INSTRUCTIONS THOROUGHLY BEFORE SETTING UP THIS BAROMETER.**

**Description.** Cat. No. S-4519 is a mercury barometer capable of measuring atmospheric pressures encountered at altitudes from 0.3 km (1000 ft) below sea level to about 2.5 km (8000 ft) above sea level. A heavy-walled glass tube of 4-mm bore, filled with mercury, is placed open end down in a cistern of mercury. This barometer is of the Fortin-type, i.e., the cistern has a flexible bottom to adjust the mercury column to changes in pressure.

The barometer comes completely assembled and filled with mercury. The scale has been positioned in our factory to correspond to the correct level of mercury.

Metric and English scales are etched on stainless steel covering pressures from 550 mm (21.5 in.) to 830 mm (32.5 in.) of mercury with a vernier scale to permit reading to 0.1 mm or 0.01 in. of mercury. A milk-white screen provides contrast for viewing the mercury level. Attached is a thermometer reading from  $-10^{\circ}\text{C}$  ( $15^{\circ}\text{F}$ ) to  $55^{\circ}\text{C}$  ( $125^{\circ}\text{F}$ ).

The tube and cistern are supported and protected by a metal frame with a ring on the top for easy hanging. Brackets attached to the frame provide easy mounting on a wall or to either the No. S-4519-10 Barometer Mount (metal) or No. S-4519-20 Barometer Case (wood).

**Setting up the Barometer.** Please remember that the barometer is a very delicate instrument and should be handled with great care. Before attempting to set up the barometer for use, a permanent location for it should be chosen. Ideally, a barometer should be located away from any source of heat or vibration and away from areas of heavy traffic in the laboratory. Adequate lighting must be provided to adjust and read the level of mercury properly.

The barometer should be in an upright position when mounted and be fastened to protect the instrument and prevent movement while adjusting. Suggested mounts are the No. S-4519-10 Metal Barometer Mount or the No. S-4519-20 Wooden Barometer Case. Position the barometer so that the top end of the graduated scale is about eye level to the typical user. This will avoid problems with parallax errors when reading the mercury level.

It is recommended that the shipping carton be saved for future use for storing or transporting the barometer. After mounting in its permanent location, you are ready to adjust the mercury column for use.

The knurled knob on the bottom of the cistern moves a rubber diaphragm. This diaphragm is extended to force the mercury to the top of the tube, thus keeping the liquid from striking against the top of the tube during shipment. To lower the mercury level, turn the knurled knob clockwise about 5 turns or until the level in the tube is about midrange on the scale. To expose the mercury to atmospheric pressure, loosen the screw on top of the cistern. The level of the mercury in the cistern will fall as the air pushes against it. If you are at a high altitude or pressure is unusually low that day, lower the mercury level below midrange before unloosening the screw on top of the cistern. *Do not remove this screw, just loosen it.*

**NOTE.** It is important to lower the level of the mercury before exposing the cistern to atmospheric pressure. Premature loosening of this screw may force mercury out through this vent.

Once the level of the mercury in the cistern has dropped, exposing the pointer, the barometer is ready for use. Proper adjustment of the level will be explained later in these instructions. It is not necessary to raise the level of the mercury when the instrument is not in use. However, it is recommended that the cistern vent screw be tightened between readings. This results in a reduction of mercury vapors into the lab and less oxidation to the mercury inside the cistern.

**Storing or Shipping the Barometer.** If it becomes necessary to store, move, or ship the barometer, the mercury level must be pushed back up to the top of the tube. First, with the cistern screw loose, raise the level until it reaches near the top of the cistern. This will force air out of the chamber. Then tighten the cistern screw and proceed slowly to raise the mercury to the top of the tube. A click will sound when the mercury hits the top. Shake the entire barometer gently up and down. If clicking sounds continue, turn the knurled knob slightly and shake again. When no sound is heard, the mercury is firmly against the top of the tube. The barometer is ready for storage or shipment.

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**Reading the Barometer.** The most reliable readings are obtained when the temperature has remained reasonably constant for several hours. It is good practice to read and record the temperature as the first step. Remember that the prolonged presence of the observer near the barometer or too much contact of the observer's hands on the barometer have a tendency to give an incorrect temperature reading. A check reading of the thermometer after the barometer has been read is good practice.

Before reading the barometer ALWAYS check the level of the mercury in the cistern. The scale has been positioned to read correctly when the mercury level is just making contact with the tip of the pointer that hangs from the top of the cistern. Daily changes in pressure will force the mercury level up or down. Adjust this level before reading the barometer. The height of the meniscus will be greater on a rising barometer than on a falling barometer. Therefore greater accuracy is obtained if, before taking a reading, the meniscus is brought to its approximate average height by lightly tapping the barometer.

When reading the barometer, the observer's eye should be in the same horizontal plane as the top of the mercury meniscus and the lower edge of the vernier. It is good practice to first raise the vernier clearly above the meniscus and then lower it until the lower edge of the vernier and the top of the meniscus are in line. Some illumination of this area may be helpful, but do not have the light source too close to the barometer as heat will adversely affect the readings.

For many purposes this determination of atmospheric pressure is sufficiently accurate, but for a precise determination certain corrections are necessary.

**Correction of Barometer Readings.** Temperature, differences in gravitational acceleration at different latitudes, and altitude will influence the level of the mercury column. To compensate for these effects, it has been agreed internationally to standardize barometric readings to a temperature of  $0^{\circ}\text{C}$ , a latitude of  $45^{\circ}$ , and an altitude of sea level.

- (1) **Temperature correction.** The mercury in the barometer responds like a thermometer. If pressure remains the same but the temperature increases, the level of the mercury will rise. Also, the stainless steel scale will expand slightly. To reduce the reading to  $0^{\circ}\text{C}$ , use the table of temperature corrections found at the end of the instructions. The thermometer attached to the barometer is to be used to determine the correction factor to be applied.

For example, if the temperature were  $24^{\circ}\text{C}$  and the level of mercury when adjusted with reference to the pointer was  $700.9\text{ mm}$ , the table indicates a correction of  $2.86\text{ mm}$  to be subtracted. The corrected height is  $697.14$  or  $697.1$  reduced to  $0^{\circ}\text{C}$ . When using the tables, use interpolation when necessary.

- (2) **Gravity correction.** Acceleration due to gravity varies with changes in altitude and latitude. Only latitude corrections need be considered for the altitudes at which this barometer can be used. Tables can be found in the *Handbook of Chemistry and Physics*.

Using the same example, if the barometer were located at the  $28^{\circ}$  latitude, the tables indicate that  $0.104\text{ mm}$  is to be subtracted from the reading. This results in a corrected height of  $697.036$  or  $697.0\text{ mm}$  at  $45^{\circ}$  latitude. Using both temperature and gravity corrections constitute what meteorologists call a station reading.

- (3) **Altitude correction.** Since the height of the mercury column represents the pressure exerted by the atmosphere from the location of the pointer in the cistern up to the limit of the atmosphere, a difference in elevation (for the same atmospheric conditions) will result in a different station reading because of elevation alone. Therefore to compare reports from cities at various altitudes, each station makes a correction so that the readings are the same as if each barometer were located at sea level. All barometric readings the Weather Bureau releases are reduced to sea level. If you desire to compare your station barometer reading with that of the Weather Bureau, you must reduce your station reading to sea level.

Tables appearing in the *Handbook of Chemistry and Physics* are useful for most applications; refer to the *Smithsonian Meteorological Tables* for more exact work. Using the same example as before, if the station elevation were  $500\text{ m}$ , assume the measured  $24^{\circ}\text{C}$  as the temperature of the air column from  $0$  to  $500\text{ m}$ . Using both the temperature-altitude factor and conversion tables, it is found that approximately  $41.5\text{ mm}$  is to be added to the station reading.

Therefore the station reading reduced to sea level reads  $738.5\text{ mm}$ . It is this figure that can be compared with

data from the Weather Bureau. Remember to consider differences in altitude between your barometer and the local Weather Bureau barometer when comparing data.

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**Temperature Corrections for Barometer Readings  
Stainless Steel Scale  
No. S-4519 Barometer  
Observed Height in Millimetres**

Temp. ° C	640 mm	650 mm	660 mm	670 mm	680 mm	690 mm	700 mm	710 mm	720 mm	730 mm	740 mm	750 mm	760 mm	770 mm
10	1.09	1.11	1.13	1.14	1.16	1.18	1.19	1.21	1.23	1.25	1.26	1.28	1.30	1.31
11	1.20	1.22	1.24	1.26	1.28	1.29	1.31	1.33	1.35	1.37	1.39	1.41	1.43	1.45
12	1.31	1.33	1.35	1.37	1.39	1.41	1.43	1.45	1.47	1.49	1.51	1.54	1.56	1.58
13	1.42	1.44	1.46	1.49	1.51	1.53	1.55	1.57	1.60	1.62	1.64	1.66	1.69	1.71
14	1.53	1.55	1.57	1.60	1.62	1.65	1.67	1.69	1.72	1.74	1.77	1.79	1.81	1.84
15	1.64	1.66	1.69	1.71	1.74	1.76	1.79	1.82	1.84	1.87	1.89	1.92	1.94	1.97
16	1.75	1.77	1.80	1.83	1.85	1.88	1.91	1.94	1.96	1.99	2.02	2.05	2.07	2.10
17	1.85	1.88	1.91	1.94	1.97	2.00	2.03	2.06	2.09	2.12	2.14	2.17	2.20	2.23
18	1.96	1.99	2.02	2.05	2.08	2.12	2.15	2.18	2.21	2.24	2.27	2.30	2.33	2.36
19	2.07	2.10	2.14	2.17	2.20	2.23	2.27	2.30	2.33	2.36	2.40	2.43	2.46	2.49
20	2.18	2.21	2.25	2.28	2.32	2.35	2.38	2.42	2.45	2.49	2.52	2.56	2.59	2.62
21	2.29	2.32	2.36	2.40	2.43	2.47	2.50	2.54	2.58	2.61	2.65	2.68	2.72	2.75
22	2.40	2.43	2.47	2.51	2.55	2.58	2.62	2.66	2.70	2.73	2.77	2.81	2.85	2.88
23	2.51	2.54	2.58	2.62	2.66	2.70	2.74	2.78	2.82	2.86	2.90	2.94	2.98	3.02
24	2.61	2.65	2.70	2.74	2.78	2.82	2.86	2.90	2.94	2.98	3.02	3.06	3.10	3.15
25	2.72	2.77	2.81	2.85	2.89	2.94	2.98	3.02	3.06	3.11	3.15	3.19	3.23	3.28
26	2.83	2.87	2.92	2.96	3.01	3.05	3.10	3.14	3.19	3.23	3.27	3.32	3.36	3.41
27	2.94	2.99	3.03	3.08	3.12	3.17	3.22	3.26	3.31	3.35	3.40	3.45	3.49	3.54
28	3.05	3.10	3.14	3.19	3.24	3.29	3.33	3.38	3.43	3.48	3.52	3.57	3.62	3.67
29	3.16	3.21	3.25	3.30	3.35	3.40	3.45	3.50	3.55	3.60	3.65	3.70	3.75	3.80
30	3.26	3.32	3.37	3.42	3.47	3.52	3.57	3.62	3.67	3.72	3.77	3.83	3.88	3.93
31	3.37	3.42	3.48	3.53	3.58	3.64	3.69	3.74	3.79	3.85	3.90	3.95	4.00	4.06
32	3.48	3.53	3.59	3.64	3.70	3.75	3.81	3.86	3.92	3.97	4.02	4.08	4.13	4.19
33	3.59	3.64	3.70	3.76	3.81	3.87	3.92	3.98	4.04	4.09	4.15	4.21	4.26	4.32
34	3.70	3.75	3.81	3.87	3.93	3.99	4.04	4.10	4.16	4.22	4.27	4.33	4.39	4.45
35	3.80	3.86	3.92	3.98	4.04	4.10	4.16	4.22	4.28	4.34	4.40	4.46	4.52	4.58
36	3.91	3.97	4.04	4.10	4.16	4.22	4.28	4.34	4.40	4.46	4.52	4.59	4.65	4.71
37	4.02	4.08	4.15	4.21	4.27	4.33	4.40	4.46	4.52	4.59	4.65	4.71	4.77	4.84
38	4.13	4.19	4.26	4.32	4.39	4.45	4.52	4.58	4.65	4.71	4.77	4.84	4.90	4.97
39	4.24	4.30	4.37	4.44	4.50	4.57	4.63	4.70	4.77	4.83	4.90	4.97	5.03	5.10
40	4.34	4.41	4.48	4.55	4.62	4.68	4.75	4.82	4.89	4.96	5.02	5.09	5.16	5.23
41	4.45	4.52	4.59	4.66	4.73	4.80	4.87	4.94	5.01	5.08	5.15	5.22	5.29	5.36
42	4.56	4.63	4.70	4.77	4.85	4.92	4.99	5.06	5.13	5.20	5.27	5.34	5.42	5.49
43	4.67	4.74	4.81	4.89	4.96	5.03	5.11	5.18	5.25	5.32	5.40	5.47	5.54	5.62
44	4.78	4.85	4.92	5.00	5.07	5.15	5.22	5.30	5.37	5.45	5.52	5.60	5.67	5.75
45	4.88	4.96	5.04	5.11	5.19	5.26	5.34	5.42	5.49	5.57	5.65	5.72	5.80	5.88