NOVALYNX CORPORATION

MODELS
230-7410, 230-7411, 230-7415
230-7420, 230-7421

FORTIN TYPE MERCURIAL BAROMETER

INSTRUCTION MANUAL

Receiving and Unpacking

Carefully unpack all components and compare to the packing list. Notify NovaLynx Corporation immediately concerning any discrepancy. Inspect equipment to detect any damage that may have occurred during shipment. In the event of damage, any claim for loss must be filed immediately with the carrier by the consignee. Damages to equipment sent via Parcel Post or UPS require the consignee to contact NovaLynx Corporation for instructions.

Returns

If equipment is to be returned to the factory for any reason, call NovaLynx between 8:00 a.m. and 4:00 p.m. Pacific Time to request a Return Authorization Number (RA#). Include with the returned equipment a description of the problem and the name, address, and daytime phone number of the sender. Carefully pack the equipment to prevent damage or additional damage during the return shipment. Call NovaLynx for packing instructions in the case of delicate or sensitive items. If packing facilities are not available take the equipment to the nearest Post Office, UPS, or other freight service and obtain assistance with the packaging. Please write the RA# on the outside of the box.

Warranty

NovaLynx Corporation warrants that its products are free from defects in material and workmanship under normal use and service for a period of one year from the date of shipment from the factory. NovaLynx Corporation's obligations under this warranty are limited to, at NovaLynx's option: (i) replacing; or (ii) repairing; any product determined to be defective. In no case shall NovaLynx Corporation's liability exceed product's original purchase price. This warranty does not apply to any equipment that has been repaired or altered, except by NovaLynx Corporation, or that has been subjected to misuse, negligence, or accident. It is expressly agreed that this warranty will be in lieu of all warranties of fitness and in lieu of the warranty of merchantability.

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NovaLynx Corporation

Mercurial Barometers
Instruction Manual

1.0 INTRODUCTION

A Fortin barometer consists of a long glass cylinder sealed at one end and filled with mercury. After being filled with mercury, the cylinder is inverted with the open end submerged into a cistern of mercury. Height of the mercury inside the cylinder is a measure of the atmospheric pressure. Atmospheric pressure acts upon the mercury in the cistern forcing more mercury into the cylinder as pressure increases and releasing mercury into the cistern from the cylinder as pressure decreases. The Fortin barometer features include an adjustable zero pointer inside the cistern and a movable vernier scale near the top of the mercurial column for making precision readings.

1.1 Types of Barometers

NovaLynx provides two types of Fortin mercurial barometers. The first type of barometer is Model 230-7410. This barometer is a high quality precision instrument and is often used by the U.S. National Weather Service. A vernier knob provides movement of the scale through the use of a rack-and-pinion drive that ensures smooth motion and precision setting of the vernier. Three versions of the 230-7410 are available from NovaLynx. Model 230-7410 provides scales for readings in units of inHg and mmHg. Model 230-7411 is the same as the 230-7410 except that the scales are in units of mb and mmHg. Both of these models are suitable for use at elevations between sea level and 3000 feet. There is also a “High Altitude” version, Model 230-7415 that can be used from sea level to an elevation of 12000 feet. The accuracy of these three barometers is ±0.01 inHg, 0.3 mb, or 0.2 mmHg. Temperature and gravitational correction factors must be applied at the time the reading is taken.

The second type of mercurial barometer supplied by NovaLynx is the full range type. The full range barometer is similar to the Fortin barometer. There is no vernier knob and, due to the extended range, the accuracy and resolution of the readings is not as accurate as that of the Fortin barometer. NovaLynx provides two models of the full range barometer, Model 230-7420 and Model 230-7421. Model 230-7420 includes scales for units of inHg and mmHg. Model 230-7421 has scales for mb and mmHg.

For both types of barometers, observations are enhanced by white reflectors located directly behind the cistern zero point and the mercury column. Units of measure are etched into the vernier. Dual scale thermometers are mounted onto each barometer case for the temperature correction readings. Thermometers include scales in degrees Celsius and Fahrenheit.

2.0 SPECIFICATIONS

Range:	
230-7410:	25.5 to 31.7 inHg, 647 to 805 mmHg
230-7411:	861 to 1068 mb, 647 to 805 mmHg
230-7415:	16.7 to 31.7 inHg, 424 to 805 mmHg
230-7420:	20 to 31.1 inHg, 508 to 794 mmHg
230-7421:	677 to 1062 mb, 508 to 794 mmHg
Resolution:	0.01 inHg; 0.1 mmHg; 0.1 mb
Operating elevation:	
230-7410:	0 to 3000 ft
230-7411:	0 to 3000 ft
230-7415:	0 to 12000 ft
230-7420:	0 to 10000 ft
230-7421:	0 to 10000 ft
Thermometer range:	-10 to +120 °F, -25 to +50 °C
Dimensions:	
230-7410:	3.5" W x 42" H (89 x 1067 mm)
230-7411:	3.5" W x 42" H (89 x 1067 mm)
230-7415:	3.5" W x 42" H (89 x 1067 mm)
230-7420:	3.0" W x 40" H (76 x 1016 mm)
230-7421:	3.0" W x 40" H (76 x 1016 mm)
Weight/Shipping:	
230-7410:	7 lbs/15 lbs (3 kg/7 kg)
230-7411:	7 lbs/15 lbs (3 kg/7 kg)
230-7415:	7 lbs/15 lbs (3 kg/7 kg)
230-7420:	5 lbs/11 lbs (2 kg/5 kg)
230-7421:	5 lbs/11 lbs (2 kg/5 kg)

3.0 UNPACKING AND INSTALLING

NovaLynx barometers are shipped completely assembled and filled with mercury. NovaLynx recommends that the barometer be kept in a horizontal position or an upside-down (cistern at the top) position until the barometer is ready for placement into the mounting brackets. By keeping the barometer in one of these two positions, the possibility of any air getting into the barometer tube will be minimized.

Prior to shipment, the barometer is "locked up" by screwing the cistern zero adjusting screw all the way up until mercury fills the cistern and the tube, excluding all air and vacuum spaces . The barometer should remain in the "locked up" mode until the barometer has been secured into its mounting brackets and is ready to be read.

3.1 Mercury Loss

Rough handling and temperature variations during shipment may force small amounts of mercury through cistern seals. Small losses of mercury do not normally result in air seepage into the glass tube and, therefore, will not have any effect on the barometer readings after it is in place. The small losses in mercury can be compensated for by using the cistern adjustment screw. The mercury level is set to the white pointer in the cistern before every reading. If there are indications that a large amount of mercury has been lost or that there is significant damage contact NovaLynx for assistance. Air pockets in the barometer tube will require returning the barometer for repairs.

3.2 Checking for Air

There are three recommended methods for checking the barometer tube for air intrusion:

1. Examine the glass tube. Look for air bubbles that may have adhered to the tube walls.

2. Place the barometer in its normal upright position. Adjust the cistern screw until the mercury fills the cistern but does not come to the top of the small diameter glass barometer tube. Slowly tilt the barometer until the mercury touches the top of the barometer tube (about 30 degrees off the vertical axis). A sharp, high-pitched click that sounds like a small metal hammer tapping glass is an indication of a good vacuum. A lower-pitched clap is an indication of air intrusion into the barometer tube.

3. Compare the readings of the barometer to those of another mercurial barometer that is known to be a good, accurate barometer. The two barometers must be physically next to each other to eliminate effects of temperature, gravity, and elevation. After moving one of the barometers next to the other, allow at least twenty-four hours for the moved barometer to reach thermal equilibrium.

3.3 Location and Mounting

The barometer placement must be carefully selected. The location should provide a sturdy, stable mounting. Use a wall that is as close as possible to vertical level and that is vibration free, temperature stable, and pressure stable. Most often an inside wall offers the best temperature stability. Avoid placement of the barometer next to sources of heat and cold, air compressors and other fluctuating pressure sources. Try to locate an area with adequate overhead lighting to facilitate reading the vernier and setting the zero pointer. Use an artificial light source with a low level of radiant heat. Barometers placed near aisles should be protected from foot traffic.

Mount the barometer support board firmly to the wall and as close to vertical as possible. Try to place the board at an elevation so that the person making the readings will have the barometer scales at eye level. Use a plumb bob or a carpenter’s level to

check the vertical level of the board. A slant in any direction will result in barometer readings that are too high.

After the board has been mounted, the barometer needs to be carefully placed onto the hanger bracket. Slowly and carefully turn the barometer so that it is right-side up. Place the lower cistern end into the barometer centering ring. Slide the upper suspension ring or knob into the hanging bracket .

Slowly turn the cistern screw down about ten full turns (use more turns at elevations above sea level). If the mercury column does not move downward after turning the screw, lightly tap the top of the barometer to dislodge the mercury. With a very high vacuum inside the tube, tapping may be necessary the first time the mercury column is lowered. At first the mercury falls rapidly. As it approaches the pressure at the station altitude, the mercury's fall will abruptly decrease and the levels in the tube and cistern will fall slowly together. Continue turning the cistern screw until the mercury level in the cistern is just touching the white pointer. View the pointer by looking through the side of the cistern glass.

The cistern adjusting screw should always be turned down slowly to avoid sucking air into the cistern by any means other than the normal filtered route through the top of the cistern. The screw may be turned upward rapidly since the slight increase in air pressure will not damage the barometer.

3.4 Relocating the Barometer

Moving the barometer to a new location requires locking of the barometer. The barometer is "locked up" by screwing the cistern adjusting screw all the way up. Mercury will fill the cistern and the barometer tube eliminating all air and vacuum spaces. Failure to "lock up" the barometer will result in air intrusion into the glass tube. Air in the tube will require returning the barometer for repair. The barometer may be taken off its mounting bracket after it has been "locked up."

Carefully rotate the barometer to a horizontal position or, for best results, rotate it to a fully inverted position before transporting to a new location.

Shipping the barometer requires a suitably strong packing box. Use at least four inches of padding on all sides of the barometer. The box must be clearly marked on all sides -

LAY FLAT - DO NOT STAND ON END

4.0 THEORY OF OPERATION

Fortin mercurial barometers are long glass tubes with hollow centers that are sealed at one end and have the other end placed into a reservoir of mercury. The hollow center of the glass tube is filled with mercury before the entire tube is inverted and placed into the reservoir. The reservoir or cistern of mercury is designed so that the level of the

mercury inside the cistern is adjustable. With the barometer installed, there will be a column of mercury that is held in place by the atmospheric pressure. The atmosphere acts upon the surface of the mercury inside the cistern. As pressure increases, the mercury is forced upward and into the glass tube. The height of the column of mercury inside the tube is calibrated to correlate to the atmospheric pressure being exerted on mercury in the cistern.

Air must not be allowed into the glass tube of the Fortin barometer. Bubbles of air inside the tube can cause separation of the mercury column resulting in readings that are too high. Should the air bubble rise to the top of the tube, the air will depress the column of mercury resulting in readings that are too low.

Atmospheric pressure changes that are due to weather changes are relatively small and must be accurately measured. During fair weather the barometric pressure may remain unchanged for several days. As the weather changes from fair to stormy, the barometer will drop markedly. The length of the scales on the barometer are necessary only to allow use of the barometer at different elevations.

The change in the level of the mercury in the small diameter glass barometer tube will be greater than that of the larger diameter cistern. Whenever a reading is to be taken, the mercury level in the cistern is first set to the white zero pointer. Once the mercury level has been set, the height of the mercury column can be measured against the calibrated scale. Accuracy and consistency in setting the zero pointer are both important factors to obtaining good readings.

5.0 READING THE BAROMETER

Whenever a mercurial barometer has been mounted at a new location, readings should not be taken until the barometer has attained thermal equilibrium with its new surroundings. NovaLynx recommends waiting for at least twenty-four hours before taking the first reading. Use the procedure listed below to make an accurate reading.

1. Turn the cistern adjusting screw until the mercury in the cistern just touches the white pointer. The adjusting screw is located on the bottom of the cistern. The white pointer is inside the cistern. Look through the sides of the cistern to see the pointer. The pointer will make a dimple in the mercury's surface as it touches the mercury. Light reflected in the dimple indicate its relative depth. Try to obtain the smallest dimple possible. If there is no dimple, adjust the mercury level upward.

2. Tap the cistern glass and the small diameter glass tube right at the height that the meniscus occurs. Use a light tap of the finger. Remember, a hard tap may break the glass! Tapping should cause the meniscus to settle to an average height. The meniscus is the lowest point of curvature of the liquid or fluid level. Adhesion and surface tension causes the edges of the liquid to rise up the sides of the tube. Readings are always taken at the bottom of the liquid surface point and not at the edges.

3. Check the mercury level and readjust it in the cistern if necessary. See step 1.

4. Raise the vernier scale above the column of mercury. Carefully lower the vernier until the bottom edges appear to be just touching the top of the mercury meniscus. To eliminate parallax, the observer's eye should be at the same level as the front and back, lower edges of the vernier sleeve. When the vernier is properly adjusted, a white light will be visible along both sides of the meniscus but not at the top. There should appear a slight haze over the top of the mercury.

5. Read the barometer scale(s) directly adjacent to the lower edge of the vernier. Estimate as needed between the lines and then use the lines on the vernier to confirm or to refine the estimated last digit. If the sixth line on the vernier is aligned with a line on the main scale, then the estimated last digit should be a six.

6. The barometer reading must now be corrected to compensate for the effects of temperature and gravity. The barometer also only measures the local station pressure at the local elevation. This measurement is not directly comparable to the reported "barometric pressure" that is always at sea level. To estimate sea level pressure refer to the next section.

5.1 Applied Corrections

Barometer scales are calibrated and factory set by using comparison methods and a certified barometer with traceability to NIST. Local pressures are read without the need for correcting the capillary depression.

The standard temperature for the density of mercury is 0 °C or 32 °F. Mercury becomes less dense with an increase in temperature. The standard temperature for metric scales is 0 °C and for English scales is 62 °F. The barometer barrel is brass. The barometer scale has a coefficient of thermal expansion essentially equal to that of brass. The effect of the expansion of mercury is about ten times as great as that of the expansion of brass. Since the barometer will rarely be at 0 °C or 32 °F, it is very important to apply a temperature correction to reduce the reading to mercury at standard temperature. Because standard materials are used, standard combined temperature correction tables and equations may be used. Refer to Tables 1 and 2.

The barometer reading is also affected by the gravity at the instrument's location. Gravity varies according to the earth's latitude. Gravity correction is generally smaller than the temperature correction. At a given location, it will always be the same for the same barometer reading. Standard gravity corrections are given in Table 3. The correction may also be calculated for a given latitude using the equation provided.

A temperature and gravity corrected barometer reading gives the local station pressure at the level of the free surface of the mercury in the cistern. Pressure decreases substantially with elevation. To determine the sea level pressure, the elevation of the barometer's cistern must be known. Elevation may be determined by using a topographical map or by performing a site survey. Once the elevation has been determined, it should be recorded and posted next to the barometer. Use the elevation to interpolate from the table or to use the equation to obtain an estimate of the sea level

differential. This value will be a constant number and should be recorded as well. Add the sea level differential to the local station pressure. Notice that Table 4 and the equation presented are based upon hypothetical standard atmospheric conditions. The actual differential used by the National Weather Service varies with the atmospheric temperature and humidity profiles. Ref. 3.

Table 5.1.A shows examples of corrections applied to inch, millimeter, and millibar scale readings. The readings assume a barometer at 20 °C/68 °F, located at 40 degrees north latitude, and at an elevation of 152.4 meters/500 feet. Whenever values fall between the values listed in either axis of the tables, interpolate both horizontally and/or vertically, as required. Whenever conversion is made from metric to English, or vice versa, always apply the temperature correction in the proper system before making the conversion.

TABLE 5.1.A
EXAMPLES OF BAROMETER CORRECTIONS
at 20 °C/68 °F, 40 degrees north latitude, 152.4 m/500 ft elevation

	Inch		Millimeter		Millibar	
1. Observed Barometer Reading	29.5	inHg@ 68 °F	749.1	mmHg @ 20 °C	998.7	mb @ 20 °C
2. Temperature Correction	- .105	in	- 2.44	mm	- 3.25	mb
3. Temp. Corrected Reading	29.395	inHg @ 32 °F	746.66	mmHg @ 0 °C	995.45	mb @ 0 °C
4. Gravity Correction	- .015	in	- .38	mm	- .51	mb
5. Local Station Pressure	29.38	inHg @ 32 °F	746.28	mmHg @ 0 °C	994.94	mb @ 0 °C
6. Sea Level Differential	+ .537	in	+ 13.63	mm	+ 18.17	mb
7. Estimated Sea Level Pressure	29.917	inHg @ 32 °F	759.91	mm @ 0 °C	1013.1	mb @ 0 °C

TABLE 5.1.B
EQUATIONS FOR CALCULATING BAROMETER CORRECTIONS

1. TEMPERATURE CORRECTION

$$C_t \equiv p_t - p_r = p_r \left[\frac{1+L(t-t_s)}{1+ M(t-t_m)} - 1 \right]$$

2. GRAVITY CORRECTION [REF 1,3]

$$C_g \equiv p_l - p_t = p_t \left\{ \frac{980.616}{980.665} [1-0.0026373\cos(2Ø) + 0.0000059\cos^2(2Ø)] - 1 \right\}$$

3. SEA LEVEL DIFFERENTIAL FOR STANDARD CONDITIONS [REF 3]

$$\Delta p_s = p_o \left[1-\left(1- \frac{0.0065}{288.16} H \right)^{5.2561} \right]$$

WHERE:
H = Geopotential, meters (use elevation above sea level in meters)
p_l = Local Station Pressure
p_o = Standard Pressure at Sea Level, 29.921 in, 760 mm, 1013.25 mb
p_r = Uncorrected Barometer Reading
p_t = Temperature Corrected Barometer Reading
t = Temperature, °C in metric, °F in English system
$Ø$ = Latitude, degrees north or south

		METRIC [REF 1,2,3]	ENGLISH [REF 2,3]
L	=	0.0000184 m/m °C	0.0000102 in/in °F
M	=	0.0001818 m^3/m^3 °C	0.0001010 in^3/in^3 °F
tm	=	0 °C	32 °F
ts	=	0 °C	62 °F

REFERENCES

1. Letestu, S., "International Meteorological Tables", World Meteorological Organization, WMO-No. 118.TP.94, Geneva, Switzerland, 1966; with amendments thru July 1973

2. List, Robert J., "Smithsonian Meteorological Tables", Smithsonian Miscellaneous Collections, Vol. 114, Publication 4014, Smithsonian Institution Press, 6th revised edition 1949, 5th reprint 1971

3. "Manual of Barometry", (WBAN), Vol 1, First Edition, U.S. Dept of Commerce, Weather Bureau, Washington, D.C., 1963

Table 1. TEMPERATURE CORRECTION, English Units [Ref. 2, 3]

To reduce the reading of the barometer to standard temperature

Temperature °F	Multiplier for Correction [a]	Observed Barometer Reading in Inches														
		16″	18″	20″	21″	22″	23″	24″	25″	26″	27″	28″	29″	30″	31″	32″
		ALL CORRECTIONS SUBTRACTIVE														
30	-.000124	.002	.002	.002	.003	.003	.003	.003	.003	.003	.003	.003	.004	.004	.004	.004
32	.000306	.005	.006	.006	.006	.007	.007	.007	.008	.008	.008	.009	.009	.009	.009	.010
34	.000488	.008	.009	.010	.010	.011	.011	.012	.012	.013	.013	.014	.014	.015	.015	.016
36	.000669	.011	.012	.013	.014	.015	.015	.016	.017	.017	.018	.019	.019	.020	.021	.021
38	.000850	.014	.015	.017	.018	.019	.020	.020	.021	.022	.023	.024	.025	.026	.026	.027
40	-.001032	.017	.019	.021	.022	.023	.024	.025	.026	.027	.028	.029	.030	.031	.032	.033
42	.001213	.019	.022	.024	.025	.027	.028	.029	.030	.032	.033	.034	.035	.036	.038	.039
44	.001394	.022	.025	.028	.029	.031	.032	.033	.035	.036	.038	.039	.040	.042	.043	.045
46	.001575	.025	.028	.031	.033	.035	.036	.038	.039	.041	.043	.044	.046	.047	.049	.050
48	.001756	.028	.032	.035	.037	.039	.040	.042	.044	.046	.047	.049	.051	.053	.054	.056
50	-.001937	.031	.035	.039	.041	.043	.045	.046	.048	.050	.052	.054	.056	.058	.060	.062
52	.002118	.034	.038	.042	.044	.047	.049	.051	.053	.055	.057	.059	.061	.064	.066	.068
54	.002298	.037	.041	.046	.048	.051	.053	.055	.057	.060	.062	.064	.067	.069	.071	.074
56	.002479	.040	.045	.050	.052	.055	.057	.060	.062	.064	.067	.069	.072	.074	.077	.079
58	.002660	.043	.048	.053	.056	.059	.061	.064	.066	.069	.072	.074	.077	.080	.082	.085
60	-.002840	.045	.051	.057	.060	.062	.065	.068	.071	.074	.077	.080	.082	.085	.088	.091
62	.003021	.048	.054	.060	.063	.066	.069	.073	.076	.079	.082	.085	.088	.091	.094	.097
64	.003201	.051	.058	.064	.067	.070	.074	.077	.080	.083	.086	.090	.093	.096	.099	.102
66	.003382	.054	.061	.068	.071	.074	.078	.081	.085	.088	.091	.095	.098	.101	.105	.108
68	.003562	.057	.064	.071	.075	.078	.082	.085	.089	.093	.096	.100	.103	.107	.110	.114
70	-.003742	.060	.067	.075	.079	.082	.086	.090	.094	.097	.101	.105	.109	.112	.116	.120
72	.003922	.063	.071	.078	.082	.086	.090	.094	.098	.102	.106	.110	.114	.118	.122	.126
74	.004102	.066	.074	.082	.086	.090	.094	.098	.103	.107	.111	.115	.119	.123	.127	.131
76	.004282	.069	.077	.086	.090	.094	.098	.103	.107	.111	.116	.120	.124	.128	.133	.137
78	.004462	.071	.080	.089	.094	.098	.103	.107	.112	.116	.120	.125	.129	.134	.138	.143
80	-.004642	.074	.084	.093	.097	.102	.107	.111	.116	.121	.125	.130	.135	.139	.144	.149
82	.004822	.077	.087	.096	.101	.106	.111	.116	.121	.125	.130	.135	.140	.145	.149	.154
84	.005001	.080	.090	.100	.105	.110	.115	.120	.125	.130	.135	.140	.145	.150	.155	.160
86	.005181	.083	.093	.104	.109	.114	.119	.124	.130	.135	.140	.145	.150	.155	.161	.166
88	.005360	.086	.096	.107	.113	.118	.123	.129	.134	.139	.145	.150	.155	.161	.166	.172
90	-.005540	.089	.100	.111	.116	.122	.127	.133	.138	.144	.150	.155	.161	.166	.172	.177
92	.005719	.092	.103	.114	.120	.126	.132	.137	.143	.149	.154	.160	.166	.172	.177	.183
94	.005899	.094	.106	.118	.124	.130	.136	.142	.147	.153	.159	.165	.171	.177	.183	.189
96	.006078	.097	.109	.122	.128	.134	.140	.146	.152	.158	.164	.170	.176	.182	.188	.194
98	.006257	.100	.113	.125	.131	.138	.144	.150	.156	.163	.169	.175	.181	.188	.194	.200
100	-.006436	.103	.116	.129	.135	.142	.148	.154	.161	.167	.174	.180	.187	.193	.200	.206
102	.006615	.106	.119	.132	.139	.146	.152	.159	.165	.172	.179	.185	.192	.198	.205	.212
104	.006794	.109	.122	.136	.143	.149	.156	.163	.170	.177	.183	.190	.197	.204	.211	.217
106	.006973	.112	.126	.139	.146	.153	.160	.167	.174	.181	.188	.195	.202	.209	.216	.223
108	.007152	.114	.129	.143	.150	.157	.164	.172	.179	.186	.193	.200	.207	.215	.222	.229
110	-.007331	.117	.132	.147	.154	.161	.169	.176	.183	.191	.198	.205	.213	.220	.227	.235
112	.007509	.120	.135	.150	.158	.165	.173	.180	.188	.195	.203	.210	.218	.225	.233	.240
114	.007688	.123	.138	.154	.161	.169	.177	.185	.192	.200	.208	.215	.223	.231	.238	.246
116	.007866	.126	.142	.157	.165	.173	.181	.189	.197	.205	.212	.220	.228	.236	.244	.252
118	.008045	.129	.145	.161	.169	.177	.185	.193	.201	.209	.217	.225	.233	.241	.249	.257

a. Multiply the observed barometer reading by the appropriate multiplier, interpolated vertically as required, to obtain the temperature correction in the English system accurately, without horizontal interpolation in the tables.

Table 2. TEMPERATURE CORRECTION, Metric Units [Ref. 1, 2, 3]

To reduce the reading of the barometer to standard temperature

Temperature °C	Multiplier for Correction [b]	Observed Barometer Reading in Millimetres or Millibars [c]												
		400	450	500	550	600	620	640	660	680	700	720	740	760
		ALL CORRECTIONS SUBTRACTIVE												
0	-.000000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	.000163	.07	.07	.08	.09	.10	.10	.10	.11	.11	.11	.12	.12	.12
2	.000327	.13	.15	.16	.18	.20	.20	.21	.22	.22	.23	.24	.24	.25
3	.000490	.20	.22	.24	.27	.29	.30	.31	.32	.33	.34	.35	.36	.37
4	.000653	.26	.29	.33	.36	.39	.40	.42	.43	.44	.46	.47	.48	.50
5	-.000816	0.33	0.37	0.41	0.45	0.49	0.51	0.52	0.54	0.56	0.57	0.59	0.60	0.62
6	.000979	.39	.44	.49	.54	.59	.61	.63	.65	.67	.69	.71	.72	.74
7	.001142	.46	.51	.57	.63	.69	.71	.73	.75	.78	.80	.82	.85	.87
8	.001305	.52	.59	.65	.72	.78	.81	.84	.86	.89	.91	.94	.97	.99
9	.001468	.59	.66	.73	.81	.88	.91	.94	.97	1.00	1.03	1.06	1.09	1.12
10	-.001631	0.65	0.73	0.82	0.90	0.98	1.01	1.04	1.08	1.11	1.14	1.17	1.21	1.24
11	.001794	.72	.81	.90	.99	1.08	1.11	1.15	1.18	1.22	1.26	1.29	1.33	1.36
12	.001957	.78	.88	.98	1.08	1.17	1.21	1.25	1.29	1.33	1.37	1.41	1.45	1.49
13	.002119	.85	.95	1.06	1.17	1.27	1.31	1.36	1.40	1.44	1.48	1.53	1.57	1.61
14	.002282	.91	1.03	1.14	1.25	1.37	1.41	1.46	1.51	1.55	1.60	1.64	1.69	1.73
15	-.002444	0.98	1.10	1.22	1.34	1.47	1.52	1.56	1.61	1.66	1.71	1.76	1.81	1.86
16	.002607	1.04	1.17	1.30	1.43	1.56	1.62	1.67	1.72	1.77	1.82	1.88	1.93	1.98
17	.002769	1.11	1.25	1.38	1.52	1.66	1.72	1.77	1.83	1.88	1.94	1.99	2.05	2.10
18	.002932	1.17	1.32	1.47	1.61	1.76	1.82	1.88	1.93	1.99	2.05	2.11	2.17	2.23
19	.003094	1.24	1.39	1.55	1.70	1.86	1.92	1.98	2.04	2.10	2.17	2.23	2.29	2.35
20	-.003256	1.30	1.47	1.63	1.79	1.95	2.02	2.08	2.15	2.21	2.28	2.34	2.41	2.47
21	.003418	1.37	1.54	1.71	1.88	2.05	2.12	2.19	2.26	2.32	2.39	2.46	2.53	2.60
22	.003580	1.43	1.61	1.79	1.97	2.15	2.22	2.29	2.36	2.43	2.51	2.58	2.65	2.72
23	.003743	1.50	1.68	1.87	2.06	2.25	2.32	2.40	2.47	2.54	2.62	2.69	2.77	2.84
24	.003905	1.56	1.76	1.95	2.15	2.34	2.42	2.50	2.58	2.66	2.73	2.81	2.89	2.97
25	-.004067	1.63	1.83	2.03	2.24	2.44	2.52	2.60	2.68	2.77	2.85	2.93	3.01	3.09
26	.004228	1.69	1.90	2.11	2.33	2.54	2.62	2.71	2.79	2.88	2.96	3.04	3.13	3.21
27	.004390	1.76	1.98	2.20	2.41	2.63	2.72	2.81	2.90	2.99	3.07	3.16	3.25	3.34
28	.004552	1.82	2.05	2.28	2.50	2.73	2.82	2.91	3.00	3.10	3.19	3.28	3.37	3.46
29	.004714	1.89	2.12	2.36	2.59	2.83	2.92	3.02	3.11	3.21	3.30	3.39	3.49	3.58
30	-.004875	1.95	2.19	2.44	2.68	2.93	3.02	3.12	3.22	3.32	3.41	3.51	3.61	3.71
31	.005037	2.01	2.27	2.52	2.77	3.02	3.12	3.22	3.32	3.43	3.53	3.63	3.73	3.83
32	.005199	2.08	2.34	2.60	2.86	3.12	3.22	3.33	3.43	3.54	3.64	3.74	3.85	3.95
33	.005360	2.14	2.41	2.68	2.95	3.22	3.32	3.43	3.54	3.64	3.75	3.86	3.97	4.07
34	.005521	2.21	2.48	2.76	3.04	3.31	3.42	3.53	3.64	3.75	3.87	3.98	4.09	4.20
35	-.005683	2.27	2.56	2.84	3.13	3.41	3.52	3.64	3.75	3.86	3.98	4.09	4.21	4.32
36	.005844	2.34	2.63	2.92	3.21	3.51	3.62	3.74	3.86	3.97	4.09	4.21	4.32	4.44
37	.006005	2.40	2.70	3.00	3.30	3.60	3.72	3.84	3.96	4.08	4.20	4.32	4.44	4.56
38	.006167	2.47	2.77	3.08	3.39	3.70	3.82	3.95	4.07	4.19	4.32	4.44	4.56	4.69
39	.006328	2.53	2.85	3.16	3.48	3.80	3.92	4.05	4.18	4.30	4.43	4.56	4.68	4.81
40	-.006489	2.60	2.92	3.24	3.57	3.89	4.02	4.15	4.28	4.41	4.54	4.67	4.80	4.93
41	.006650	2.66	2.99	3.32	3.66	3.99	4.12	4.26	4.39	4.52	4.65	4.79	4.92	5.05
42	.006811	2.72	3.06	3.41	3.75	4.09	4.22	4.36	4.50	4.63	4.77	4.90	5.04	5.18
43	.006972	2.79	3.14	3.49	3.83	4.18	4.32	4.46	4.60	4.74	4.88	5.02	5.16	5.30
44	.007133	2.85	3.21	3.57	3.92	4.28	4.42	4.56	4.71	4.85	4.99	5.14	5.28	5.42
45	.007293	2.92	3.28	3.65	4.01	4.38	4.52	4.67	4.81	4.96	5.11	5.25	5.40	5.54

b. Multiply the observed barometer reading by the appropriate multiplier, interpolated vertically as required, to obtain the temperature correction in the metric system accurately, without horizontal interpolation in the tables.

Table 2 Continued. TEMPERATURE CORRECTION, Metric Units [Ref. 1, 2, 3]

To reduce the reading of the barometer to standard temperature

Temper-ature °C	Observed Barometer Reading in Millimetres or Millibars[c]														
	780	800	820	840	860	880	900	920	940	960	980	1000	1020	1040	1060
	ALL CORRECTIONS SUBTRACTIVE														
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	.13	.13	.13	.14	.14	.14	.15	.15	.15	.16	.16	.16	.17	.17	.17
2	.25	.26	.27	.27	.28	.29	.29	.30	.31	.31	.32	.33	.33	.34	.35
3	.38	.39	.40	.41	.42	.43	.44	.45	.46	.47	.48	.49	.50	.51	.52
4	.51	.52	.54	.55	.56	.57	.59	.60	.61	.63	.64	.65	.67	.68	.69
5	0.64	0.65	0.67	0.69	0.70	0.72	0.73	0.75	0.77	0.78	0.80	0.82	0.83	0.85	0.87
6	.76	.78	.80	.82	.84	.86	.88	.90	.92	.94	.96	.98	1.00	1.02	1.04
7	.89	.91	.94	.96	.98	1.01	1.03	1.05	1.07	1.10	1.12	1.14	1.17	1.19	1.21
8	1.02	1.04	1.07	1.10	1.12	1.15	1.17	1.20	1.23	1.25	1.28	1.31	1.33	1.36	1.38
9	1.15	1.17	1.20	1.23	1.26	1.29	1.32	1.35	1.38	1.41	1.44	1.47	1.50	1.53	1.56
10	1.27	1.30	1.34	1.37	1.40	1.44	1.47	1.50	1.53	1.57	1.60	1.63	1.66	1.70	1.73
11	1.40	1.44	1.47	1.51	1.54	1.58	1.61	1.65	1.69	1.72	1.76	1.79	1.83	1.87	1.90
12	1.53	1.57	1.60	1.64	1.68	1.72	1.76	1.80	1.84	1.88	1.92	1.96	2.00	2.03	2.07
13	1.65	1.70	1.74	1.78	1.82	1.86	1.91	1.95	1.99	2.03	2.08	2.12	2.16	2.20	2.25
14	1.78	1.83	1.87	1.92	1.96	2.01	2.05	2.10	2.14	2.19	2.24	2.28	2.33	2.37	2.42
15	1.91	1.96	2.00	2.05	2.10	2.15	2.20	2.25	2.30	2.35	2.40	2.44	2.49	2.54	2.59
16	2.03	2.09	2.14	2.19	2.24	2.29	2.35	2.40	2.45	2.50	2.55	2.61	2.66	2.71	2.76
17	2.16	2.22	2.27	2.33	2.38	2.44	2.49	2.55	2.60	2.66	2.71	2.77	2.82	2.88	2.94
18	2.29	2.35	2.40	2.46	2.52	2.58	2.64	2.70	2.76	2.81	2.87	2.93	2.99	3.05	3.11
19	2.41	2.48	2.54	2.60	2.66	2.72	2.78	2.85	2.91	2.97	3.03	3.09	3.16	3.22	3.28
20	2.54	2.60	2.67	2.74	2.80	2.87	2.93	3.00	3.06	3.13	3.19	3.26	3.32	3.39	3.45
21	2.67	2.73	2.80	2.87	2.94	3.01	3.08	3.14	3.21	3.28	3.35	3.42	3.49	3.56	3.62
22	2.79	2.86	2.94	3.01	3.08	3.15	3.22	3.29	3.37	3.44	3.51	3.58	3.65	3.72	3.80
23	2.92	2.99	3.07	3.14	3.22	3.29	3.37	3.44	3.52	3.59	3.67	3.74	3.82	3.89	3.97
24	3.05	3.12	3.20	3.28	3.36	3.44	3.51	3.59	3.67	3.75	3.83	3.90	3.98	4.06	4.14
25	3.17	3.25	3.33	3.42	3.50	3.58	3.66	3.74	3.82	3.90	3.99	4.07	4.15	4.23	4.31
26	3.30	3.38	3.47	3.55	3.64	3.72	3.81	3.89	3.97	4.06	4.14	4.23	4.31	4.40	4.48
27	3.42	3.51	3.60	3.69	3.78	3.86	3.95	4.04	4.13	4.21	4.30	4.39	4.48	4.57	4.65
28	3.55	3.64	3.73	3.82	3.91	4.01	4.10	4.19	4.28	4.37	4.46	4.55	4.64	4.73	4.83
29	3.68	3.77	3.87	3.96	4.05	4.15	4.24	4.34	4.43	4.53	4.62	4.71	4.81	4.90	5.00
30	3.80	3.90	4.00	4.10	4.19	4.29	4.39	4.49	4.58	4.68	4.78	4.88	4.97	5.07	5.17
31	3.93	4.03	4.13	4.23	4.33	4.43	4.53	4.63	4.73	4.84	4.94	5.04	5.14	5.24	5.34
32	4.05	4.16	4.26	4.37	4.47	4.57	4.68	4.78	4.89	4.99	5.09	5.20	5.30	5.41	5.81
33	4.18	4.29	4.40	4.50	4.61	4.72	4.82	4.93	5.04	5.15	5.25	5.36	5.47	5.57	5.68
34	4.31	4.42	4.53	4.64	4.75	4.86	4.97	5.08	5.19	5.30	5.41	5.52	5.63	5.74	5.85
35	4.43	4.55	4.66	4.77	4.89	5.00	5.11	5.23	5.34	5.46	5.57	5.68	5.80	5.91	6.02
36	4.56	4.68	4.79	4.91	5.03	5.14	5.26	5.38	5.49	5.61	5.73	5.84	5.96	6.08	6.19
37	4.68	4.80	4.92	5.04	5.16	5.28	5.40	5.52	5.65	5.77	5.89	6.01	6.13	6.25	6.37
38	4.81	4.93	5.06	5.18	5.30	5.43	5.55	5.67	5.80	5.92	6.04	6.17	6.29	6.41	6.54
39	4.94	5.06	5.19	5.32	5.44	5.57	5.69	5.82	5.95	6.07	6.20	6.33	6.45	6.58	6.71
40	5.06	5.19	5.32	5.45	5.58	5.71	5.84	5.97	6.10	6.23	6.36	6.49	6.62	6.75	6.88
41	5.19	5.32	5.45	5.59	5.72	5.85	5.98	6.12	6.25	6.38	6.52	6.65	6.78	6.92	7.05
42	5.31	5.45	5.58	5.72	5.86	5.99	6.13	6.27	6.40	6.54	6.67	6.81	6.95	7.08	7.22
43	5.44	5.58	5.72	5.86	6.00	6.14	6.27	6.41	6.55	6.69	6.83	6.97	7.11	7.25	7.39
44	5.56	5.71	5.85	5.99	6.13	6.28	6.42	6.56	6.70	6.85	6.99	7.13	7.28	7.42	7.56
45	5.69	5.83	5.98	6.13	6.27	6.42	6.56	6.71	6.86	7.00	7.15	7.29	7.44	7.59	7.73

c. Centimetre and kiloPascal corrections may be obtained by moving all the decimal points in the column headings, and in the body of the table, one place to the left. The "Multiplier for Correction" does not change as it applies to all four metric units.

Table 3. GRAVITY CORRECTION[Ref. 2, 3]

To reduce the reading of the barometer to standard gravity

Latitude N or S	Multiplier for Correction[d]	Temperature Corrected Barometer Reading											
		Inches				Millimetres or Millibars[c]							
		15	25	30	32	400	500	600	700	800	900	1000	1100
		LATITUDE 0° TO 45° — THE CORRECTION IS TO BE SUBTRACTED LATITUDE 46° TO 90° — THE CORRECTION IS TO BE ADDED											
90°	+.002593	+.039	+.065	+.078	+.083	+1.04	+1.30	+1.56	+1.82	+2.07	+2.33	+2.59	+2.85
85	.002553	.038	.064	.077	.082	1.02	1.28	1.53	1.79	2.04	2.30	2.55	2.81
80	.002433	.037	.061	.073	.078	.97	1.22	1.46	1.70	1.95	2.19	2.43	2.68
75	.002238	.034	.056	.067	.072	.90	1.12	1.34	1.57	1.79	2.01	2.24	2.46
70	+.001974	+.030	+.049	+.059	+.063	+0.79	+0.99	+1.18	+1.38	+1.58	+1.78	+1.97	+2.17
68	.001850	.028	.046	.056	.059	.74	.93	1.11	1.30	1.48	1.67	1.85	2.04
66	.001717	.026	.043	.052	.055	.69	.86	1.03	1.20	1.37	1.55	1.72	1.89
64	.001576	.024	.039	.047	.050	.63	.79	.95	1.10	1.26	1.42	1.58	1.73
62	.001427	.021	.036	.043	.046	.57	.71	.86	1.00	1.14	1.28	1.43	1.57
60	+.001270	+.019	+.032	+.038	+.041	+0.51	+0.64	+0.76	+0.89	+1.02	+1.14	+1.27	+1.40
58	.001107	.017	.028	.033	.035	.44	.55	.66	.78	.89	1.00	1.11	1.22
56	.000939	.014	.023	.028	.030	.38	.47	.56	.66	.75	.84	.94	1.03
54	.000766	.011	.019	.023	.024	.31	.38	.46	.54	.61	.69	.77	.84
52	.000588	.009	.015	.018	.019	.24	.29	.35	.41	.47	.53	.59	.65
50	+.000408	+.006	+.010	+.012	+.013	+0.16	+0.20	+0.24	+0.29	+0.33	+0.37	+0.41	+0.45
49	.000317	.005	.008	.010	.010	.13	.16	.19	.22	.25	.29	.32	.35
48	.000226	.003	.006	.007	.007	.09	.11	.14	.16	.18	.20	.23	.25
47	.000134	.002	.003	.004	.004	.05	.07	.08	.09	.11	.12	.13	.15
46	+.000042	+.001	+.001	+.001	+.001	+0.02	+0.02	+0.03	+0.03	+0.03	+0.04	+0.04	+0.05
45	−.000050	−.001	−.001	−.001	−.002	−0.02	−0.02	−0.03	−0.03	−0.04	−0.04	−0.05	−0.05
44	.000142	.002	.004	.004	.005	.06	.07	.09	.10	.11	.13	.14	.16
43	.000234	.004	.006	.007	.007	.09	.12	.14	.16	.19	.21	.23	.26
42	.000326	.005	.008	.010	.010	.13	.16	.20	.23	.26	.29	.33	.36
41	.000417	.006	.010	.013	.013	.17	.21	.25	.29	.33	.38	.42	.46
40	−.000508	−.008	−.013	−.015	−.016	−0.20	−0.25	−0.30	−0.36	−0.41	−0.46	−0.51	−0.56
39	.000598	.009	.015	.018	.019	.24	.30	.36	.42	.48	.54	.60	.66
38	.000688	.010	.017	.021	.022	.28	.34	.41	.48	.55	.62	.69	.76
37	.000776	.012	.019	.023	.025	.31	.39	.47	.54	.62	.70	.78	.85
36	.000864	.013	.022	.026	.028	.35	.43	.52	.61	.69	.78	.86	.95
35	−.000951	−.014	−.024	−.029	−.030	−0.38	−0.48	−0.57	−0.67	−0.76	−0.86	−0.95	−1.05
34	.001037	.016	.026	.031	.033	.41	.52	.62	.73	.83	.93	1.04	1.14
33	.001122	.017	.028	.034	.036	.45	.56	.67	.79	.90	1.01	1.12	1.23
32	.001205	.018	.030	.036	.039	.48	.60	.72	.84	.96	1.08	1.20	1.33
31	.001287	.019	.032	.039	.041	.51	.64	.77	.90	1.03	1.16	1.29	1.42
30	−.001367	−.021	−.034	−.041	−.044	−0.55	−0.68	−0.82	−0.96	−1.09	−1.23	−1.37	−1.50
28	.001523	.023	.038	.046	.049	.61	.76	.91	1.07	1.22	1.37	1.52	1.68
26	.001671	.025	.042	.050	.053	.67	.84	1.00	1.17	1.34	1.50	1.67	1.84
24	.001812	.027	.045	.054	.058	.72	.91	1.09	1.27	1.45	1.63	1.81	1.99
22	.001944	.029	.049	.058	.062	.78	.97	1.17	1.36	1.56	1.75	1.94	2.14
20	−.002067	−.031	−.052	−.062	−.066	−0.83	−1.03	−1.24	−1.45	−1.65	−1.86	−2.07	−2.27
18	.002180	.033	.054	.065	.070	.87	1.09	1.31	1.53	1.74	1.96	2.18	2.40
16	.002282	.034	.057	.068	.073	.91	1.14	1.37	1.60	1.83	2.05	2.28	2.51
14	.002374	.036	.059	.071	.076	.95	1.19	1.42	1.66	1.90	2.14	2.37	2.61
12	.002454	.037	.061	.074	.079	.98	1.23	1.47	1.72	1.96	2.21	2.45	2.70
10	−.002523	−.038	−.063	−.076	−.081	−1.01	−1.26	−1.51	−1.77	−2.02	−2.27	−2.52	−2.78
5	.002641	.040	.066	.079	.085	1.06	1.32	1.58	1.85	2.11	2.38	2.64	2.91
0	.002681	.040	.067	.080	.086	1.07	1.34	1.61	1.88	2.14	2.41	2.68	2.95

d. Multiply the temperature corrected barometer reading by the appropriate multiplier, interpolated vertically as required, to obtain the gravity correction accurately, without horizontal interpolation in the tables.

Table 4. BAROMETRIC SEA LEVEL DIFFERENTIAL FOR STANDARD CONDITIONS

Based on the ICAO standard atmosphere [Ref. 3]

Geopotential[e] feet	Sea Level Differential in.	mm	mb
	ALL CORRECTIONS ADDITIVE		
0	0.000	0.00	0.00
10	.011	.27	.37
20	.022	.55	.73
30	.032	.82	1.10
40	.043	1.10	1.46
50	.054	1.37	1.83
60	.065	1.65	2.20
70	.076	1.92	2.56
80	.086	2.19	2.93
90	.097	2.47	3.29
100	0.108	2.74	3.66
200	.216	5.48	7.30
300	.323	8.20	10.94
400	.430	10.92	14.56
500	.537	13.63	18.17
600	.643	16.33	21.78
700	.749	19.03	25.37
800	.855	21.72	28.95
900	.960	24.39	32.52
1000	1.066	27.07	36.08
2000	2.100	53.35	71.12
3000	3.105	78.86	105.13
4000	4.079	103.62	138.15
5000	5.025	127.64	170.18
6000	5.943	150.95	201.26
7000	6.833	173.56	231.40
8000	7.696	195.49	260.63
9000	8.533	216.74	288.97
10000	9.344	237.35	316.44
11000	10.130	257.31	343.05
12000	10.892	276.66	368.84

Geopotential[e] metres	Sea Level Differential in.	mm	mb
	ALL CORRECTIONS ADDITIVE		
0	0.000	0.00	0.00
10	.035	.90	1.20
20	.071	1.80	2.40
30	.106	2.70	3.60
40	.142	3.60	4.80
50	.177	4.49	5.99
60	.212	5.39	7.19
70	.247	6.29	8.38
80	.283	7.18	9.57
90	.318	8.07	10.77
100	0.353	8.97	11.96
200	.703	17.85	23.80
300	1.049	26.65	35.52
400	1.392	35.36	47.14
500	1.732	43.99	58.64
600	2.068	52.53	70.03
700	2.401	60.99	81.31
800	2.731	69.37	92.49
900	3.058	77.67	103.55
1000	3.381	85.89	114.51
2000	6.446	163.74	218.30
3000	9.218	234.14	312.17
4000	11.719	297.66	396.85

e. The geopotential of a position in the lower atmosphere is very nearly equal to the elevation above sea level. [Ref. 3]