What kind of pressure do you want?

Case I. Barometer on the boat

When you have a barometer in your boat, sitting at sea level, then there is no doubt at all of what type of pressure you want. You want that instrument to read the proper sea level pressure for your location. This is easy. This is unambiguous.

To set the barometer up for that operation, just install it on the boat and then record its pressure with the time and date. We recommend using millibars (same as hecto-pascals) for the units. And maybe do this several times over a period of several hours. It would be simplest to record the data on the even hour, but this is not crucial.

Then next time you have access to the Internet, look up what the correct pressure should have been during the time period you made your recordings. You can find this from the nearest NWS weather station, see Starpath Online Resources. From those pages, you can find a history list to get the pressures you want. Compare what you recorded with what the real pressure was to learn the offset. The values might vary by as much as a millibar, depending on how close the times were and how careful you are to interpolate data from several stations if you are not near one. Just average the differences and that is the offset. Say, for example, that the barometer reading was on average 6.5 mb lower than the NWS reported pressures for sea level.

Then next time back on the boat, read the barometer and then add your correction to it. If it read 1003.3 mb, then after your correction it should read 1009.8 mb. Then you are done. From now on, the pressure you read on the barometer will be the right one and you can start using it to evaluate weather maps compare with radio reports, etc.

Case II. Barometer at home or office

When you read the pressure from a barometer sitting on the shelf or hanging on the wall of your home or office, you have two logical choices for how it should be "calibrated." Do you want it to read sea level pressure or do you want it to read what the actual pressure is at its current elevation, which will always be lower than the sea level pressure. We can call the first choice sea-level pressure and the second we can call true or absolute pressure, we choose true pressure.

Needless to say, if you are at sea level, then these two pressures are the same.

If you want your home barometer to read sea level pressure, then proceed exactly as done above for a barometer on the boat. Then your barometer will then read the proper sea level pressure — so long as you leave it at that elevation. If you move a barometer set up in that manner to another elevation, you will have to do this calibration again. We find this the most convenient for the classroom, so we can immediately compare what the maps and forecasts say with what we read. We must be careful, though, if we take this barometer somewhere else. It will read nonsense at some other elevation. Once it is moved, we have to decide once again what type of pressure we want and set it up.

If you want true pressure, on the other hand, then in a sense it does not matter what elevation you are located at and you can freely move the barometer to any location. Once you get it set right to true pressure, then it will always read true pressure. In that sense, it will also be a true altimeter, since the pressure it reads will have a direct calibrated correlation with the elevation of the instrument (see background notes below). On the other hand, the pressure that you read from the barometer set up in this manner will not correspond to reports on maps or radio for your location. The pressure indicated will always be lower by a fixed amount that depends on your particular elevation.

If you take this true-pressure barometer to sea level, then it will be reading the proper sea level pressure. Which brings up the first method of how to calibrate a barometer to true pressure. Just take it to sea level and proceed as above to set it to the proper sea level pressure. Then when you carry the barometer back up the hills to your home or office, the pressure will drop, but it will indeed be reading true pressure for whatever elevation it is located at.

If you do not have access to a location at sea level, then you are left with a few other choices. One is to use topo maps from online or from your city planning office to discover the actual elevation of your building, and then estimate the elevation above the ground of the barometer installation, and then you have the known elevation of the instrument above sea level for its present location. You should strive to get this correct to within 10 feet or so if you want accurate true pressures. (In principle one can get this elevation from GPS, but even with differential GPS and WAAS enabled GPS, we have found that for the typical hand-held units we tried, the output elevations were not dependable. Perhaps, if we averaged over a long period of time, but we have not tested that.)

Then proceed as in the boat calibration, but when you find the average pressure difference from the list of readings and the list of true sea-level pressures, do not adjust it for that amount, but rather adjust it so the difference matches your elevation. In other words, suppose your elevation was 450 feet, which you look up or compute (see below) to find is equivalent to a pressure drop of 16.4 mb. So, in analogy with the first example, our recorded list of pressure differences between what we read on the barometer on the wall at home and what the real sea level pressure at our location was according to internet records, tells us that our barometer reads on average 6.5 mb below sea level pressure. But for a proper true pressure at 450 feet, we need it to read 16.4 mb below sea level pressure. Hence if at the moment it reads 1013.3, we need to lower it another 9.9 mb (16.4 – 6.5), so that it then reads 1003.4 mb. Then we have a properly calibrated true-pressure barometer. At our location on the wall it will always read 16.4 mb too low as indeed it should, but if we take it to sea level we will read the correct sea level pressure.

The above correction will be as accurate as you know your elevation, but the latter is not always so simple to determine accurately.

Another alternative, is to take your barometer to the nearest air port and see if someone there in some flight office might have a barometer set up and calibrated that you could use to set yours to. You will need to be sure that you know what pressure theirs is set to, etc.

Our general recommendation is to set it to sea level pressure where ever it happens to be, and then just reset it once you get to the boat. After a few trips back and forth you will know what the proper "elevation" of your home is in terms of millibars of pressure.

The barometers we ship from Starpath are usually set to true pressure, meaning what ever the local true pressure minus 5.8 mb to account for our elevation. So in principle you get true pressure when they arrive, but we would strongly recommend going through the above exercises for setting them to proper sea level pressure for the elevation they will be located.

Some customers do not use these for marine weather at all, but indeed care about the absolute pressure. Some gauges depend on exact pressure, some engines do, some high tech air cleaners turn on and off with local pressure, and so forth. In these cases, one needs absolute pressure and the key to that is knowing your elevation so you can compare with published atmospheric pressures at sea level. The instruments will generally be within a few millibars correct when they arrive, but this should be tested by the end user. We have found that on all models that we sell, that once calibrated, they track and are reproducible to well within ± 1 mb.

Background note

As you go up in the atmosphere, the air gets thinner (because gravity gets weaker), so there is progressively less air above you. And since pressure is just the weight of the air above you, as you go up in elevation the pressure goes down. The amount that the pressure drops can be determined from tables or from computers. Generally you will do well enough with the simple rule:

$$\text{Correction} = 3.6 \text{ mb} \times (\text{elevation in feet}) / 100.$$

So 1000 ft = 36 mb, 50 ft = 1.8 mb and so on. The correction for our office wall at an elevation of 160 ft is: 3.6 x 160 / 100 = 5.8 mb.

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