Check on Pressure Sensor Tool

User Guide

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Update

Rev.1 Change discordance tolerance from ± 0,50 to ± 0,75 hPa for increasing the measure tolerances. Altitude conversion from feet to metre. Wording implementation for cases of airport

1 Preamble

In front of the amount of pressure measures in nonconformity to reality, mainly generated by wrong barometric adjustments and sensors badly calibrated, I have developed a simple solution from a spreadsheet. Its use allows controlling your pressure sensor: no specific knowledge necessary, simple use with help and guidance to the problem encountered.

This tool has three main targets:

To know the Relative Reference Pressure at sea level for your station,
To set up your pressure sensor,
To monitor your sensor and to help you for correction of possible deviations.

To know if your sensor runs well, to know if your sensor is “passing away” or if your console shows a defectiveness.

If you have not set the barometric adjustment for your altitude into your console, check it now.

If your station runs from a certain time, check the value of your barometric adjustment. If the deviation is big, you can always reset the console in order to get a consistency in the calculation of the relative pressure, by introducing a new suitable value.

Method is simple. You have Excel or sCalc; it is enough to **open the spreadsheet**. You have no software; download Open Office, package of excellent quality including sCalc, free GNU running with Linux, Mac and Windows.

The first thing to do is to **define the Relative Reference Pressure**, which will be used to calibrate your weather station. The way uses the METARs, **Met**eorological **A**irport **R**eports. For validating the reference pressure, you have to input at least two airports: name and distance as a crow flies. Then, to calculate the Relative Reference Pressure, it is enough to consult the METARs and keyboard the pressure values of the airports chosen.

For installation, you input 3 values into the spreadsheet. You know the theoretical barometric adjustment to input for setting, at pressure and temperature conditions of the instant.

For monitoring, you input 4 values into the spreadsheet. You immediately know your current barometric adjustment. It is compared with the theoretical barometric adjustment, at pressure and temperature conditions of the moment. Your pressure measure is also compared with the theoretical value of this moment.

You know the deviations instantly. You know if your sensor is correct or if it deflects:

You know the conditions of your sensor and the quality of your records.

Before starting calculation, I strongly advise to read this document completely in order to understand how “works” this tool.

The reading will be always longer than the practice you will do…But necessary to correctly use this tool

For any information suggestion or request, please feel free to sent a mail at mail@meteo-dinan.fr

2 Definition

Before starting, **it is necessary we have the same language**. All of the terms used here are terms applied to meteorology. These same terms have not the same meaning in physic or thermodynamic.

The pressure measure is linked with air masses in movement around Earth, its specific mass, temperature and altitude. The combination of these various variables gives the areas of low pressure or cyclones and the areas of high pressure or anticyclones. The movement of these areas generates the weather we will have. In very short summary: the displacement analysis of the curves with same pressure, called isobars, and these of the temperatures, called isotherms, at different altitudes allows to make weather forecasts.

The absolute pressure is the atmospheric pressure **measured on a given geographical point**, at an elevation given, a temperature given and at a moment given. It **is the pressure measured by your sensor** and originally recorded by your weather station. It is a value of **raw measure non adjustable**.

The pressure varies according to the movement of air mass and decreases with elevation. To define isobars, it is enough to find a simple mean for having an equivalent measure compared to the raw measure. We have to forget altitude and temperature of the point recorded by an adjustment, called barometric adjustment. The solution has been to consider as reference system or frame the sea level. The normal conditions or “zero point” are taken at 1013,25 hPa and 288,15 K[1] (Kelvin), corresponding to 15°C. Therefore, you are in depression if you are below 1013,25 hPa at 15°C and you are in high pressure if you are above of 1013,25 hPa at 15°C. That equivalent measure (reduced) at sea level is called relative or reduced measure.

The Relative Pressure is thus the sum of the Absolute Pressure and the Barometric Adjustment.

If you live at the sea level, the adjustment is null because you are exactly at the sea level pressure and temperature conditions.

If you live above the sea level, the adjustment is positive, you increase the absolute pressure. The relative pressure is higher than the absolute pressure.

If you live below the sea level, for instance the Red Sea, the barometric adjustment is negative. The relative pressure is lower than the absolute pressure.

Only now, the day where you install your weather station, the pressure and temperature conditions are not necessarily of 1013,25 hPa and 15 °C at sea level. You will be too lucky!

At normal conditions, i.e. 1013,25 hPa and 288,15 K or 15°C, the pressure decreases by 1 hPa for each time you take up from 8,327 m. At 1013,25 hPa and 0°C, the pressure decreases by 1 hPa for 7,893 m and at 1013,25 hPa + 30°C this is 8,761 m. The tool takes into account the pressure and temperature conditions at the time where you do your installation or your check. Consequently, you will have a good precision for your settings and possible future corrections.

To correctly define the barometric adjustment, we must know, with the best precision, three variables:

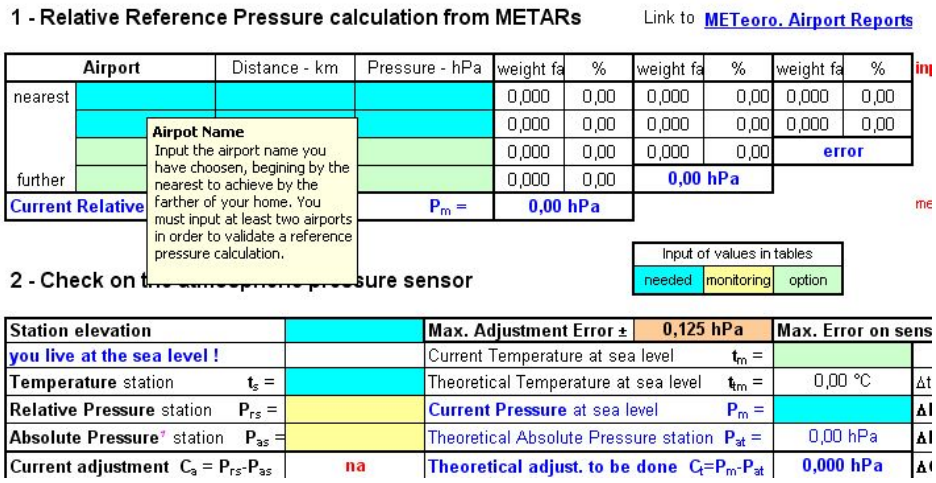
1. **The Relative Pressure at sea level also named Relative Reference Pressure.**
2. **The Outside Temperature.**
3. **The Altitude of your Pressure Sensor.**

[1] The zero Kelvin is at –273,15°C, we have 0°C for 273,15 K, so for 15°C: 273,15+15 = 288,15 K

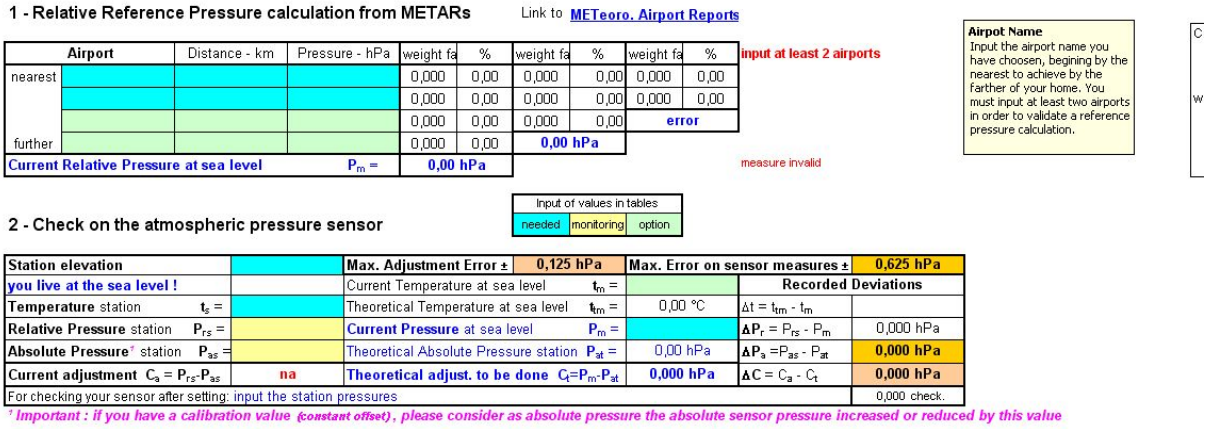
3 General Use

The tool gives you the definitions and actions to undertake with input & information notes, which appear by click on the cells. It also gives you all the necessary messages for corrective actions according to the results you have.

For reading reason and only using Excel, you can move the input notes by click and keep with left button of your mouse. You can slide it to open visually the cells. For instance, you will have this form at the file opening if you click on the first airport name, cell C6

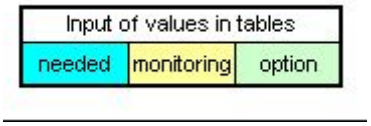


You can move it on the right side as shown:



The fields of all the cells are now clear, all the input or information notes will be opened at this position from now on, here on top right.

Some cells are needed, others are used by monitoring or option. They are differentiated by a colour code. Only these cells are modifiable, all the others are protected.



4 Relative Reference Pressure Calculation for your station

To correctly know the atmospheric pressure at sea level is sometimes difficult if you have no airport or no national meteorological office in your vicinity. However, the solution comes in that. This tool shows a first table allowing defining the Reference Pressure leading to a barometric adjustment sufficiently accurate for your weather station. Without this latter, nothing is possible and the only value set for elevation does not give the results expected necessarily.

The method is based on weight factor application to the METARs pressures (METeorological Airport Report) published at half-hourly or hourly intervals according to the airports. If you live near an airport, you are very lucky to adjust your sensor, but not at all for noise. It is enough to collect the METARs and you must have an accuracy quasi-perfect. The tolerance of your barometric adjustment is lower than ± 0,025 hPa.

You have one two or three airports within a 75 km radius. You are lucky. You will have a good accuracy for your barometric adjustment lower than ± 0,050 hPa. You have one airport within a 75 km radius and others under 100 km; you will have a barometric adjustment accurate between ± 0,075 and ± 0,100 hPa. Over that, it becomes difficult to use this method except to define the future trend; but you must have a national meteorological office being able to give you the information.

Writing convention and airport definition:

Airport of name A at a distance as a crow flies d_A *has a relative pressure at sea level* P_{mA}
Airport of name B at a distance as a crow flies d_B *has a relative pressure at sea level* P_{mB}
Airport of name C at a distance as a crow flies d_C *has a relative pressure at sea level* P_{mC}
Airport of name D at a distance as a crow flies d_D *has a relative pressure at sea level* P_{mD}

***Important Note**: the METARs are published at half-hourly or hourly intervals according to the airports. The pressure is expressed in integer, the pressure varies during the half an hour or hour. For being near the reality, you are advised to check your sensor five or ten minutes after the METARs publication in order to reduce the error or tolerance. It could be around 0,5 up to 0,75 hPa if the trend up or down is fast. We can reduce this deviation taking into account its change. With 3 or 4 airports, we can be consistent to real value and have a relative pressure very close the reality*

This tool takes into account the pressure change of METARs given in integer, your weather station recording with one or more digits. A ***discordance notification*** *of measures and trends is shown* ***if the difference between the relative reference pressure and your station pressure is higher than ± 0,75 hPa.*** *That does not means your tolerance on measure is bad but it is necessary to confirm it by an other check at the next publication of METARs, before replacing anything.*

The calculation of the Relative Reference Pressure is thus based on the weight factors of the various chosen airport pressures and the distance from your home. The Relative Reference Pressure can be done by calculation with one up to four airports.

The altitude is often given in feet, the input value can be precise in metre. For instance, 127 feet is 127 x 0,3048 = 38,7096 # 30,71 m, displayed value 30,7 m, or 55 m is 55 / 0,3048 = 180,446 # 180,4 feet.

Remark: The displaying of cell values is round according to the digits, one, two or three but calculations are done with all decimals. It can appear a figure or a sum given you the feeling is wrong or not exact. For instance, 3,1125 plus 0,8875 is strictly equal to 4. The displaying with three digits will show you 3,113 and 0,888, which should give 4,001. This result is false, it is actually 4.

4.1 Case of one airport

You are living at a distance as a crow flies lower than 10 km from an airport; the considered value is this of the airport. For using the tool, you have to input this airport two times in the first and second lines, corresponding to line 6 and 7 of the spreadsheet.

1 - Relative Reference Pressure calculation from METARs Link to **METeoro. Airport Reports**

	Airport	Distance - km	Pressure - hPa	weight fa	%	weight fa	%	weight fa	%	distance ok
nearest	My Airpot	8,5	1002	0,000	0,00	0,000	0,00	2,000	50,00	ok
	My Airport	8,5	1002	0,000	0,00	0,000	0,00	2,000	50,00	ok
				0,000	0,00	0,000	0,00	**1002,00 hPa**		
further				0,000	0,00	**0,00 hPa**				
Current Relative Pressure at sea level			P_m =	**0,00 hPa**						measure ok

Input of values in tables

The **Relative Reference Pressure** at sea level, which is shown on right side, is **1002,00 hPa** here.

4.2 Case of 2 airports

You are living at more 10 km as a crow flies from an airport and you have a second one within a 75 km radius, you will get this type of result:

1 - Relative Reference Pressure calculation from METARs Link to **METeoro. Airport Reports**

	Airport	Distance - km	Pressure - hPa	weight fa	%	weight fa	%	weight fa	%	distance ok
nearest	Dinard-Pleurtuit	14,2	1002	0,000	0,00	0,000	0,00	3,113	77,81	ok
	Rennes	49,8	1003	0,000	0,00	0,000	0,00	0,888	22,19	ok
				0,000	0,00	0,000	0,00	**1002,22 hPa**		
further				0,000	0,00	**0,00 hPa**				
Current Relative Pressure at sea level			P_m =	**0,00 hPa**						measure ok

Input of values in tables

The **Relative Reference Pressure** at sea level is **1002,22 hPa** with combination of 2 airports.

Rule 1: *The total of the weight factor is always equal to 4 for 2 airports.*

$$k_A + k_B = 4$$

Rule 2: *For two airports at a distance d_A and d_B from your home, the weight factors applied are defined as follows:*

$$k_A = (d_B / d_A) \times k_B \qquad k_B = 4 / (d_B / d_A + 1)$$

*The **formula applied for 2 airports** is thus:*

$$P_m = (k_A \times P_{mA}) + (k_B \times P_{mB}) / 4$$

4.3 Case of 3 airports

Yu are living at a distance as a crow flies upper to 10 km and you are lucky to have other airports within a 75 km radius. **You have to live inside of the triangle based on the 3 airports**, input them. Yu will get this kind of result:

1 - Relative Reference Pressure calculation from METARs Link to **METeoro. Airport Reports**

	Airport	Distance - km	Pressure - hPa	weight fa	%	weight fa	%	weight fa	%	distance ok
nearest	Dinard-Pleurtuit	14,2	1002	0,000	0,00	3,928	65,47	3,113	77,81	ok
	Rennes	49,8	1003	0,000	0,00	1,120	18,67	0,888	22,19	ok
	Saint-Brieuc	58,6	1003	0,000	0,00	0,952	15,86	**1002,22 hPa**		ok
further				0,000	0,00	**1002,35 hPa**				
Current Relative Pressure at sea level			P_m =	**0,00 hPa**						measure ok

Input of values in tables

The **Relative Reference Pressure** at sea level is thus **1002,35 hPa** calculated with the combination of 3 airports. It is obviously 1002,22 hPa for the two first airports.

Rule 3: *The total of the weight factor is always equal to 6 for 3 airports.*

$$k_A + k_B + k_C = 6$$

Rule 4: *For three airports at a distance d_A, d_B and d_C from your home, the weight factors applied are defined as follows:*

$$k_A = (d_C / d_A) \times k_C \qquad k_B = (d_C / d_B) \times k_C \qquad k_C = 6 / (d_C / d_A + d_C / d_B + 1)$$

*The **formula applied for 3 airports** is thus:*

$$P_m = ((k_A \times P_{mA}) + (k_B \times P_{mB}) + (k_C \times P_{mC})) / 6$$

4.4 Case of 4 airports

You are living at a distance as a crow flies above 10 km and you have other airports within a 75 km radius. **You have to live inside of the triangle based on the 3 airports**, keyboard them. You wish to know the trend rising or falling of the atmospheric pressure, input a fourth airport when it is approximately within a maximal 100 km radius. You have also to take into account the major movement of the air masses to get the future situation. You will get the following result:

1 - Relative Reference Pressure calculation from METARs Link to **METeoro. Airport Reports**

	Airport	Distance - km	Pressure - hPa	weight fa	%	weight fa	%	weight fa	%	distance ok
nearest	Dinard-Pleurtuit	14,2	1002	4,802	60,02	3,928	65,47	3,113	77,81	ok
	Rennes	49,8	1003	1,369	17,11	1,120	18,67	0,888	22,19	ok
	Saint-Brieuc	58,6	1003	1,164	14,54	0,952	15,86	**1002,22 hPa**		ok
further	Lannion	102,4	1002	0,666	8,32	**1002,35 hPa**				ok
Current Relative Pressure at sea level			P_m =	**1002,32 hPa**						measure ok

Input of values in tables

The **Relative Reference Pressure** at sea level is **1002,32 hPa**. The trend is falling because the relative pressure of the fourth airport, here 1002,00 hPa is lower than the relative reference pressure calculated by combination of various airports.

If we have 1003 hPa instead of 1002 hPa for the farther airport, the result is:

1 - Relative Reference Pressure calculation from METARs Link to **METeoro. Airport Reports**

	Airport	Distance - km	Pressure - hPa	weight fa	%	weight fa	%	weight fa	%	distance ok
nearest	Dinard-Pleurtuit	14,2	1002	4,802	60,02	3,928	65,47	3,113	77,81	ok
	Rennes	49,8	1003	1,369	17,11	1,120	18,67	0,888	22,19	ok
	Saint-Brieuc	58,6	1003	1,164	14,54	0,952	15,86	**1002,22 hPa**		ok
further	Lannion	102,4	1003	0,666	8,32	**1002,35 hPa**				ok
Current Relative Pressure at sea level			P_m =	**1002,40 hPa**						measure ok

Input of values in tables

The **Relative Reference Pressure** at sea level is **1002,40 hPa**. The trend is rising because the relative pressure of the fourth airport is higher than the relative reference pressure calculated by combination of various airports.

The METARs are on line every half an hour or hour, your pressure is not 1002,22 hPa or 1002,35 hPa. In the first case with a falling trend, it should be below 1002,35 hPa. In the second case with a rising trend, it should be above 1002,35 hPa.

Rule 5: *The total of the weight factor is always equal to 8 for 4 airports.*

$$k_A + k_B + k_C + k_D = 8$$

Rule 6: *For four airports at a distance d_A, d_B, d_C and d_D from your home, the weight factors applied are defined as follows:*

$$k_A = (d_D / d_A) \times k_D \qquad k_B = (d_D / d_B) \times k_D \qquad k_C = (d_D / d_C) \times k_D$$

$$k_D = 8 / (d_D / d_A + d_D / d_B + d_D / d_C + 1)$$

*The **formula applied for 4 airports** is thus:*

$$P_m = ((k_A \times P_{mA}) + (k_B \times P_{mB}) + (k_C \times P_{mC}) + (k_D \times P_{mD})) / 8$$

We just define the relative reference pressure for your weather station. Now, we do the calculation of the barometric adjustment, which must be set up. We have to know two other additional variables: the outside temperature and the elevation of your pressure sensor.

Here, we suppose the outside temperature measure recorded by your weather station is accurate. Therefore, we take it as temperature reference. It is enough to read it on your console.

Finally, we must know the altitude of your sensor with accuracy. The easy method is to use a GPS. The coordinates and elevation are simultaneously shown. Without GPS, you can look on an Ordnance Survey map or look at Google Maps. You have the elevation of your ground linked with your geographical references.

Remark: The pressure sensor is generally integrated inside of your console. If you install it at a floor of your house, do not forget to add the height of this floor. Three meters is more 0,35 hPa at normal conditions. That has an impact on the barometric adjustment for calculating your relative pressure.

5 Barometric Adjustment of your station

It is enough to input three variables into table 2: the altitude, the outside temperature and the relative reference pressure, which has just been calculated. Let empty the two yellow cells, you immediately get the theoretical barometric adjustment of your station, at pressure and temperature conditions of the instant, here 9,004 hPa. The below table show also the theoretical absolute pressure of your weather station to you, here 993,34 hPa with a relative reference pressure of 1002,35 hPa at – 0,3°C

2 - Check on the atmospheric pressure sensor

Input of values in tables		
needed	monitoring	option

Station elevation	72 m	**Max. Adjustment Error ±**	**0,125 hPa**	**Max. Error on sensor measures ±**		**0,625 hPa**
you live above the sea level		Current Temperature at sea level	t_m =		**Recorded Deviations**	
Temperature station t_s =	-0,3 °C	Theoretical Temperature at sea level	t_{tm} =	0,17 °C	$\Delta t = t_{tm} - t_m$	
Relative Pressure station P_{rs} =		**Current Pressure** at sea level	P_m =	1002,35 hPa	$\Delta P_r = P_{rs} - P_m$	0,000 hPa
Absolute Pressure[1] station P_{as} =		Theoretical Absolute Pressure station	P_{at} =	993,34 hPa	$\Delta P_a = P_{as} - P_{at}$	**0,000 hPa**
Current adjustment $C_a = P_{rs}-P_{as}$	na	**Theoretical adjust. to be done**	$C_t=P_m-P_{at}$	**9,004 hPa**	$\Delta C = C_a - C_t$	**0,000 hPa**
For checking your sensor after setting: input the station pressures						0,000 check.

[1] *Important : if you have a calibration value (constant offset), please consider as absolute pressure the absolute sensor pressure increased or reduced*

If your sensor is correctly calibrated, it should be displayed the same absolute pressure or a very close value. Nevertheless, all measuring device has tolerances due to its making and stability in the time, the accuracy.

This Barometric Adjustment is the offset corrected by pressure and temperature you must normally set up to compensate your altitude.

If we look only at the pressure combination of the two first airports, we have:

2 - Check on the atmospheric pressure sensor

Input of values in tables		
needed	monitoring	option

Station elevation	72 m	**Max. Adjustment Error ±**	**0,125 hPa**	**Max. Error on sensor measures ±**		**0,625 hPa**
you live above the sea level		Current Temperature at sea level	t_m =		**Recorded Deviations**	
Temperature station t_s =	-0,3 °C	Theoretical Temperature at sea level	t_{tm} =	0,17 °C	$\Delta t = t_{tm} - t_m$	
Relative Pressure station P_{rs} =		**Current Pressure** at sea level	P_m =	1002,22 hPa	$\Delta P_r = P_{rs} - P_m$	0,000 hPa
Absolute Pressure[1] station P_{as} =		Theoretical Absolute Pressure station	P_{at} =	993,22 hPa	$\Delta P_a = P_{as} - P_{at}$	**0,000 hPa**
Current adjustment $C_a = P_{rs}-P_{as}$	na	**Theoretical adjust. to be done**	$C_t=P_m-P_{at}$	**9,003 hPa**	$\Delta C = C_a - C_t$	**0,000 hPa**
For checking your sensor after setting: input the station pressures						0,000 check.

[1] *Important : if you have a calibration value (constant offset), please consider as absolute pressure the absolute sensor pressure increased or reduced*

We note the theoretical barometric adjustment is 9,003 hPa corresponding to a relative reference pressure of 1000,22 hPa at – 0,3°C.

If your console corrects nothing at normal conditions, i.e. 1013,25 hPa and 15°C, the theoretical barometric adjustment will be 8,620 hPa as shown below:

2 - Check on the atmospheric pressure sensor

Input of values in tables		
needed	monitoring	option

Station elevation	72 m	**Max. Adjustment Error ±**	**0,125 hPa**	**Max. Error on sensor measures ±**		**0,625 hPa**
you live above the sea level		Current Temperature at sea level	t_m =		**Recorded Deviations**	
Temperature station t_s =	15,0 °C	Theoretical Temperature at sea level	t_{tm} =	15,47 °C	$\Delta t = t_{tm} - t_m$	
Relative Pressure station P_{rs} =		**Current Pressure** at sea level	P_m =	1013,25 hPa	$\Delta P_r = P_{rs} - P_m$	0,000 hPa
Absolute Pressure[1] station P_{as} =		Theoretical Absolute Pressure station	P_{at} =	1004,63 hPa	$\Delta P_a = P_{as} - P_{at}$	**0,000 hPa**
Current adjustment $C_a = P_{rs}-P_{as}$	na	**Theoretical adjust. to be done**	$C_t=P_m-P_{at}$	**8,620 hPa**	$\Delta C = C_a - C_t$	**0,000 hPa**
For checking your sensor after setting: input the station pressures						0,000 check.

[1] *Important : if you have a calibration value (constant offset), please consider as absolute pressure the absolute sensor pressure increased or reduced*

You note that the **pressure and temperature conditions have a significant incidence on the value of the barometric adjustment** at the installation, here 0,383 hPa (9,003 – 8,620). The difference between the relative reference pressures chosen is close to 0,13 hPa (1002,35 – 1002,22). They give you very similar theoretical barometric adjustments at 0,001 hPa; in other words, it is negligible.

6 Sensor Monitoring of your station

We have just seen we can get a barometric adjustment with a very good accuracy, calculating from a value of relative reference pressure as well as accurate.

6.1 Case of homogeneous measures with the reference values

Then, we can check our current barometric adjustment and verify the quality of our pressure sensor. For doing that, it is enough to input the values of the absolute and relative pressures of our weather station into the appropriated yellow cells:

2 - Check on the atmospheric pressure sensor

Input of values in tables		
needed	monitoring	option

Station elevation	72 m	**Max. Adjustment Error ±**	**0,125 hPa**	**Max. Error on sensor measures ±**		**0,625 hPa**	
you live above the sea level		Current Temperature at sea level	t_m =		**Recorded Deviations**		
Temperature station	t_s = -0,3 °C	Theoretical Temperature at sea level	t_{tm} =	0,17 °C	$\Delta t = t_{tm} - t_m$		
Relative Pressure station	P_{rs} = 1002,37 hPa	**Current Pressure** at sea level	P_m =	1002,35 hPa	$\Delta P_r = P_{rs} - P_m$	0,025 hPa	t
Absolute Pressure[1] station	P_{as} = 993,43 hPa	Theoretical Absolute Pressure station	P_{at} =	993,34 hPa	$\Delta P_a = P_{as} - P_{at}$	**0,088 hPa**	t
Current adjustment	$C_a = P_{rs}-P_{as}$ **8,940 hPa**	**Theoretical adjust. to be done**	$C_t=P_m-P_{at}$	**9,004 hPa**	$\Delta C = C_a - C_t$	**-0,064 hPa**	t
For checking your sensor after setting: ok						-0,064 check.	

[1] *Important : if you have a calibration value (constant offset), please consider as absolute pressure the absolute sensor pressure increased or reduced*

The tool or spreadsheet gives you immediately the results. The difference between the theoretical barometric adjustment calculated and the current barometric adjustment of your station is – 0,064 hPa. This value is very good.

The difference between the theoretical absolute pressure and the absolute weather station pressure is 0,088 hPa, value also good.

We have a barometric adjustment correctly set and a pressure sensor without abnormal deviation, requesting a calibration or an offset constant. Everything is right.

6.2 Cases of measures different from the reference values

Now from this point, the input values are given as example values for allowing to show the various actions suggested by the tool.

6.2.1 Relative Pressures are different but Absolute Pressures are correct

2 - Check on the atmospheric pressure sensor

Input of values in tables		
needed	monitoring	option

Station elevation	72 m	**Max. Adjustment Error ±**	**0,125 hPa**	**Max. Error on sensor measures ±**		**0,625 hPa**	
you live above the sea level		Current Temperature at sea level	t_m =		**Recorded Deviations**		
Temperature station	t_s = -0,3 °C	Theoretical Temperature at sea level	t_{tm} =	0,17 °C	$\Delta t = t_{tm} - t_m$		
Relative Pressure station	P_{rs} = 1002,00 hPa	**Current Pressure** at sea level	P_m =	1002,35 hPa	$\Delta P_r = P_{rs} - P_m$	-0,345 hPa	t
Absolute Pressure[1] station	P_{as} = 993,43 hPa	Theoretical Absolute Pressure station	P_{at} =	993,34 hPa	$\Delta P_a = P_{as} - P_{at}$	**0,088 hPa**	t
Current adjustment	$C_a = P_{rs}-P_{as}$ **8,570 hPa**	**Theoretical adjust. to be done**	$C_t=P_m-P_{at}$	**9,004 hPa**	$\Delta C = C_a - C_t$	**-0,434 hPa**	i
For checking your sensor after setting: ok						-0,434 check.	

[1] *Important : if you have a calibration value (constant offset), please consider as absolute pressure the absolute sensor pressure increased or reduced*

That means the measures of the absolute pressure recorded by your sensor are right but the relative pressures are wrong. Remind you the relative pressure at sea level is equal to the absolute pressure corrected by the barometric adjustment. Here, the barometric adjustment of your station is 8,570 hPa instead of theoretical 9,004 hPa.

Input of values in tables		
needed	monitoring	option

r ±	0,125 hPa	Max. Error on sensor measures ±		0,625 hPa
sea level	t_m =		Recorded Deviations	
at sea level	t_{tm} =	0,17 °C	$\Delta t = t_{tm} - t_m$	
a level	P_m =	1002,35 hPa	$\Delta P_r = P_{rs} - P_m$	-0,345 hPa
essure station	P_{at} =	993,34 hPa	$\Delta P_a = P_{as} - P_{at}$	0,088 hPa
be done	$C_t = P_m - P_{at}$	9,004 hPa	$\Delta C = C_a - C_t$	-0,434 hPa
				-0,434 check.

total error on the pressure measure (DPa + DC)

the measure of sensor is satisfactory : sensor OK

increase your current barometric adjustment by 0,43 hPa at least

er as absolute pressure the absolute sensor pressure increased or reduced by this value

The tool indicates well the measure of the sensor is satisfactory but your barometric adjustment is badly adjusted. By correcting of 0,43 hPa or resetting it to 9,004 or 9,00 hPa, you will back to a good value of your relative pressure at sea level. In our case, 1002,00 + 0,43 = 1002,43 hPa for your station, the reference value is 1002,35 hPa, so satisfactory.

6.2.2 Barometric Adjustments are correct but Pressures are different

We have a good barometric adjustment in the following example but the relative and absolute pressures are shifted from reality by excess. We could also have them by default.

2 - Check on the atmospheric pressure sensor

Input of values in tables		
needed	monitoring	option

control at the next publication of METARs (ev
or entire hour according to the airports) for
confirmation of your results

Station elevation		72 m	**Max. Adjustment Error ±**		**0,125 hPa**	**Max. Error on sensor measures ±**	**0,625 hPa**
you live above the sea level			Current Temperature at sea level	t_m =		**Recorded Deviations**	
Temperature station	t_s =	-0,3 °C	Theoretical Temperature at sea level	t_{tm} =	0,17 °C	$\Delta t = t_{tm} - t_m$	
Relative Pressure station	P_{rs} =	1003,00 hPa	**Current Pressure** at sea level	P_m =	1002,35 hPa	$\Delta P_r = P_{rs} - P_m$	0,655 hPa
Absolute Pressure[1] station	P_{as} =	994,00 hPa	Theoretical Absolute Pressure station	P_{at} =	993,34 hPa	$\Delta P_a = P_{as} - P_{at}$	0,658 hPa
Current adjustment	$C_a = P_{rs} - P_{as}$	9,000 hPa	**Theoretical adjust. to be done**	$C_t = P_m - P_{at}$	9,004 hPa	$\Delta C = C_a - C_t$	-0,004 hPa
For checking your sensor after setting: ok							-0,004 check.

[1] Important : if you have a calibration value (constant offset), please consider as absolute pressure the absolute sensor pressure increased or reduced

That means your pressure sensor records absolute pressure above the true value when we are by excess. It record absolute pressure below the true value when we are y default.

Here, the discordance between your measure and the relative reference pressure is higher than 0,750 hPa, see important note at the beginning of § 4. Before change anything, do a new check at the next publication of METARs.

Pa

discordance of measures and trends > 0,5 hPa,
check all of the input pressures. If ok, make a new
control at the next publication of METARs (every 1/2 h
or entire hour according to the airports) for
confirmation of your results

n = 5,2561 constant with

Input of values in tables		
needed	monitoring	option

ror ±	0,125 hPa	Max. Error on sensor measures ±		0,625 hPa
at sea level	t_m =		Recorded Deviations	
ure at sea level	t_{tm} =	0,17 °C	$\Delta t = t_{tm} - t_m$	
sea level	P_m =	1002,35 hPa	$\Delta P_r = P_{rs} - P_m$	0,655 hPa
Pressure station	P_{at} =	993,34 hPa	$\Delta P_a = P_{as} - P_{at}$	0,658 hPa
o be done	$C_t = P_m - P_{at}$	9,004 hPa	$\Delta C = C_a - C_t$	-0,004 hPa
				-0,004 check.

total error on the pressure measure (DPa + DC)

before adjustment, control again at the next publication of METARs

the current adjustment is satisfactory

ider as absolute pressure the absolute sensor pressure increased or reduced by this value

If you get similar result in spite of the possible relative reference pressure change, then undertake an adjustment for the calibration of your sensor. If your software or your station allows it, put an offset constant for correcting the deviation of your sensor. AWEKAS allows you to set an adjustment from the menu Community>>Change user data. In this instance, the offset will be above – 0,658 hPa,

round to - 0,66 hPa because your measures are done by excess. We must reduce the absolute pressure of 994,00 hPa. It becomes 994,00 – 0,66 = 993,34 hPa in comparison with the reference value of 993,34 hPa. So, ok.

If your measure is done by default, you will have a negative value in cell Q19. We must increase the measure then add the positive value of cell Q19 to the absolute pressure.

6.2.3 Absolute Pressures and Barometric Adjustments are different

If your absolute station pressure and your current barometric adjustment are very different of the reality as shown below:

2 - Check on the atmospheric pressure sensor

Input of values in tables		
needed	monitoring	option

Station elevation		72 m	**Max. Adjustment Error ±**		**0,125 hPa**	**Max. Error on sensor measures ±**	**0,625 hPa**
you live above the sea level			Current Temperature at sea level	t_m =		**Recorded Deviations**	
Temperature station	t_s =	-0,3 °C	Theoretical Temperature at sea level	t_{tm} =	0,17 °C	$\Delta t = t_{tm} - t_m$	
Relative Pressure station	P_{rs} =	1002,60 hPa	**Current Pressure** at sea level	P_m =	1002,35 hPa	$\Delta P_r = P_{rs} - P_m$	0,255 hPa
Absolute Pressure[1] station	P_{as} =	**994,00 hPa**	Theoretical Absolute Pressure station	P_{at} =	993,34 hPa	$\Delta P_a = P_{as} - P_{at}$	**0,658 hPa**
Current adjustment	$C_a = P_{rs}-P_{as}$	**8,600 hPa**	**Theoretical adjust. to be done**	$C_t=P_m-P_{at}$	**9,004 hPa**	$\Delta C = C_a - C_t$	**-0,404 hPa**
For checking your sensor after setting: ok							-0,404 check.

[1] *Important : if you have a calibration value (constant offset), please consider as absolute pressure the absolute sensor pressure increased or reduced*

Start by correcting first your barometric adjustment, here 9,004 or add 0,40 hPa. Check again with this new value and calibrate the deviation of your sensor by an offset constant as explained in the previous case.

Input of values in tables		
needed	monitoring	option

r ±	**0,125 hPa**	**Max. Error on sensor measures ±**		**0,625 hPa**
sea level	t_m =		**Recorded Deviations**	
e at sea level	t_{tm} =	0,17 °C	$\Delta t = t_{tm} - t_m$	
ea level	P_m =	1002,35 hPa	$\Delta P_r = P_{rs} - P_m$	0,255 hPa
ressure station	P_{at} =	993,34 hPa	$\Delta P_a = P_{as} - P_{at}$	**0,658 hPa**
be done	$C_t=P_m-P_{at}$	**9,004 hPa**	$\Delta C = C_a - C_t$	**-0,404 hPa**
				-0,404 check.

total error on the pressure measure (DPa + DC)

before compensating your sonde with a fixed value

increase your current barometric adjustment by 0,4 hPa at least

der as absolute pressure the absolute sensor pressure increased or reduced by this value

After a new setting of barometric adjustment, you will have normally this result:

2 - Check on the atmospheric pressure sensor

Input of values in tables		
needed	monitoring	option

adjustment if > ±0,125 hPa. If ok, correct the d
of your sensor if > ±0,625 hPa with a calibrati
value if your software or station allows it. If n
replace your sensor!

Station elevation		72 m	**Max. Adjustment Error ±**		**0,125 hPa**	**Max. Error on sensor measures ±**	**0,625 hPa**
you live above the sea level			Current Temperature at sea level	t_m =		**Recorded Deviations**	
Temperature station	t_s =	-0,3 °C	Theoretical Temperature at sea level	t_{tm} =	0,17 °C	$\Delta t = t_{tm} - t_m$	
Relative Pressure station	P_{rs} =	1003,40 hPa	**Current Pressure** at sea level	P_m =	1002,35 hPa	$\Delta P_r = P_{rs} - P_m$	1,055 hPa
Absolute Pressure[1] station	P_{as} =	**994,40 hPa**	Theoretical Absolute Pressure station	P_{at} =	993,34 hPa	$\Delta P_a = P_{as} - P_{at}$	**1,058 hPa**
Current adjustment	$C_a = P_{rs}-P_{as}$	**9,000 hPa**	**Theoretical adjust. to be done**	$C_t=P_m-P_{at}$	**9,004 hPa**	$\Delta C = C_a - C_t$	**-0,004 hPa**
For checking your sensor after setting: ok							-0,004 check.

[1] *Important : if you have a calibration value (constant offset), please consider as absolute pressure the absolute sensor pressure increased or reduced*

The barometric adjustment is now satisfactory 9,000 compared to 9 004 hPa. On the other hand, because we record by excess we must calibrate the sensor by an offset constant equal to – 1,058 hPa, round to - 1,06 hPa. The absolute pressure will become 994,40 – 1,06 = 993,34.

The relative pressure will be 1003,40 – 1,06 = 1002,34 hPa. This is a good value. We could also check by another way. The relative pressure is the sum of the absolute pressure corrected by the barometric adjustment. Here with the new values gets, we have: 993,34 + 9,000 = 1002,34 hPa.

If the recorded deviation value is negative, we record by default. In that case, we must add it.

6.3 The other cases

The tool normally allows processing all possible cases. If by chance, you should face to a case not described, please send me an email at mail@meteo-dinan.fr. I will try to help you and find a solution.

7 Variation accepted

7.1 Tolerance on Barometric Adjustment

The tolerance on the **barometric adjustment is fixed to ± 0,125 hPa**.

This value is small but it is realistic and rather large. The accuracy of the relative reference pressure, around ± 0,02 hPa allows defining an adjustment value error close ± 0,001 hPa. Considering ± 0,1 hPa on pressure, we get a tolerance error close 0,05 hPa.

For improving this value, take into account the more accurate elevation for your pressure sensor, not this of your station.

All equipment on the market authorises a minimum displaying with one digit 0,1 hPa and very often with two digits 0,01 hPa.

7.2 Tolerance on Absolute Pressure Measure

The tolerance on the **absolute pressure measure of the sensor is fixed to ± 0,625 hPa**.

This value is satisfactory for all the common cases. Its accuracy is well; today the electronic sensors are reliable. It can perhaps sometimes have a sensor baldly calibrated. The most of sensors supplied with weather station are generally with an accuracy of ± 0,1 hPa. The proposed tolerance is more six times more.

7.3 Total deviation on measure

The errors adding up, we can have a **maximal error equal to ± 0,750 hPa**. That is three-quarter of hector-Pascal.

If we look at the extreme values of the measure scale, generally between 880 hPa and 1080 hPa, the measure range is 200 hPa.

The relative error on the extremes gives:

Low value: 0,750 / 880 x 100 = 0,085% High value: 0,750 / 1080 x 100 = 0,069%

The relative error on the measure range is:

0,750 / 200 x 100 = 0,375 %

This value is acceptable but we are already 50 % above the standard limit for measuring device, generally 0,25 %. What would say a measure with a tolerance above 0,375 %? Nothing! That will not be a measuring device.

…Hoping this small tool will help you.