THE IN SITU PRESSURE CALIBRATION SYSTEM IN MÉTÉO FRANCE

J. Duvernoy, A. Dubois

Météo France, Direction des Systèmes d'Observation, Laboratoire de Métrologie
7, rue Teisserenc de Bort
78195 TRAPPES Cédex
☎ 01.30.13.63.50
✉ jerome.duvernoy@meteo.fr
✉ aurelie.dubois@meteo.fr
www.meteo.fr

ABSTRACT :

Surveying and forecasingt the atmosphere's behaviour is the first vocation of Météo France. The responsability of the observation in Météo France has been entrusted to the Direction of Observation's Systems (DSO), which manages, in consequence, a network of 600 automatic weather stations. On these 600 stations, more than 300 barometers are installed.

In order to ensure the accordance of the barometers with metrological specifications, they are calibrated every 2 years in the Laboratory of Metrology of the DSO and are controlled in situ once per year. For that, the DSO developped its own in situ pressure calibration system, which is composed of a portable generator and a special software, called LEON SITE. It enables them to easily garantee the traceability chain.

In a first part, we will describe the generator's running, which was achieved by EFFA. The running is based on the creation into two gasholders of high and low pressure (compared to the ambient pressure). The barometers to compare are connected with the mixer gasholder. The plateau are generated between 800 and 1060 hPa with a stability of 0.03 hPa.

In a second part, we will study the opportunities of the software LEON for the data acquisition and processing. The system enables us to use as reference either the inner barometer or an other reference standard, on condition that it should be calibrated before and after.

Finally, we will present the operational use of this system for Météo France's network and the usual uncertainty of measurement. For example, countries such as Cuba, Libya or Madagascar or the Asecna organization require the Meteo-France's support as Regional Instrumentation Center (RIC) to check their barometers in situ with this system.

Next step will be a LEON Software update to take into account the in-situ accreditation criteria and a Multilanguage interface.

TEXT :

1. Specifications

1.1. Description

The whole generator is embedded in a small suitcase in order to make it easy to use and transport.

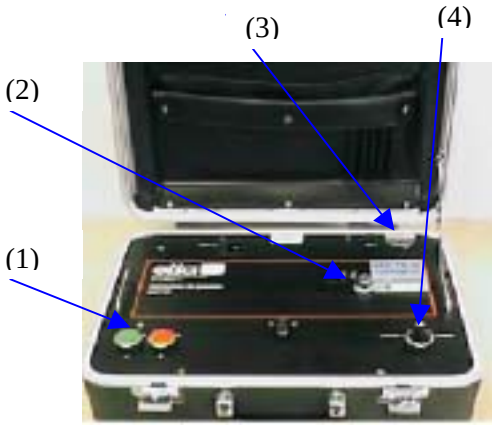

fig.1 : Photo of the generator

- Weight : 8 kG
- Size : 170 x 410 x 300 mm
- Power supply : - 220 V
  - inside lead-acid battery 12V (for an autonomy of 5 hours)

The electrical system and the circuit of gas generation are inside. On the outside, there are impulsive buttons for generation (1), pressure socket (2) and serial interface RS 232 (3) to connect a computer. The switch (4) is used to select the loading, measuring or stop mode.

Every kind of barometers equipped with external pressure fittings can be used.

The generator is also equipped with an internal capacitive barometer, as travelling standard.

1.2. Generation

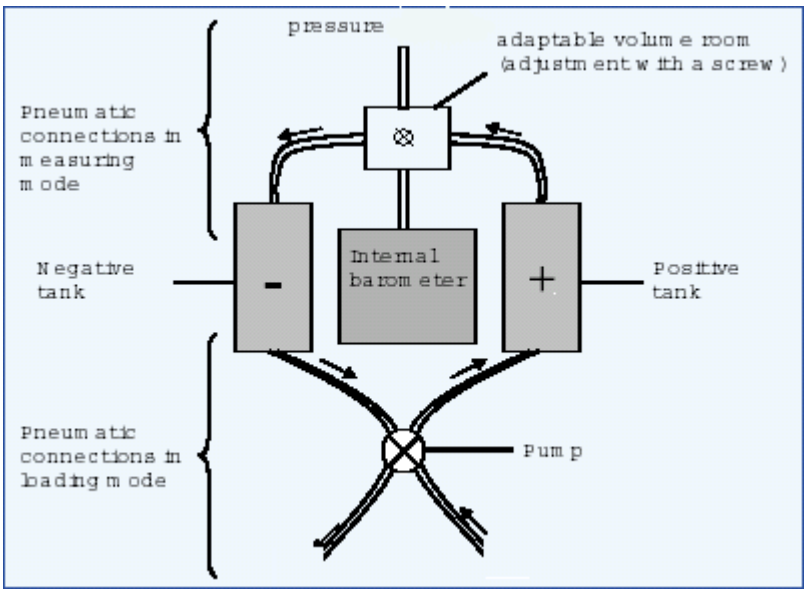

fig.2 : Inside the generator

An electric pump creates in two air tanks high (+400 hpa) and low (-600 hPa) pressure, compared to the ambient pressure. In loading mode, filtered air is pumped to fill the positive tank and some air is expulsed from the negative. In measuring mode, the tanks are driven by electrovalves in order to fill and empty the air circuit. An accurate adjustment of the level of pressure is obtained by changing the volume adjusted by a specific screw. The maximum speed of variation is limited to 4 hPa per second through the pressure range of 600 hPa to 1100 hPa.

2. Calibration principle

2.1. Operating principle

fig.3 : Complete calibration system

Calibrated barometers are connected with the generator by the pressure socket (fig.1-(2)). The data acquisition and processing is done by a computer, thanks to a calibration software, called LEON.

LEON is a french acronym for Logiciel d'Etalonnage en pressiON. That means Pressure Calibration Software. Figure 3 shows the whole calibration system. The travelling standard is the internal barometer but the software enables the use as standard of either the internal or an other barometer standard.

The operating barometers are checked by a cycle calibration at fourteen pressure values from 1060 hPa down to 800 hPa.

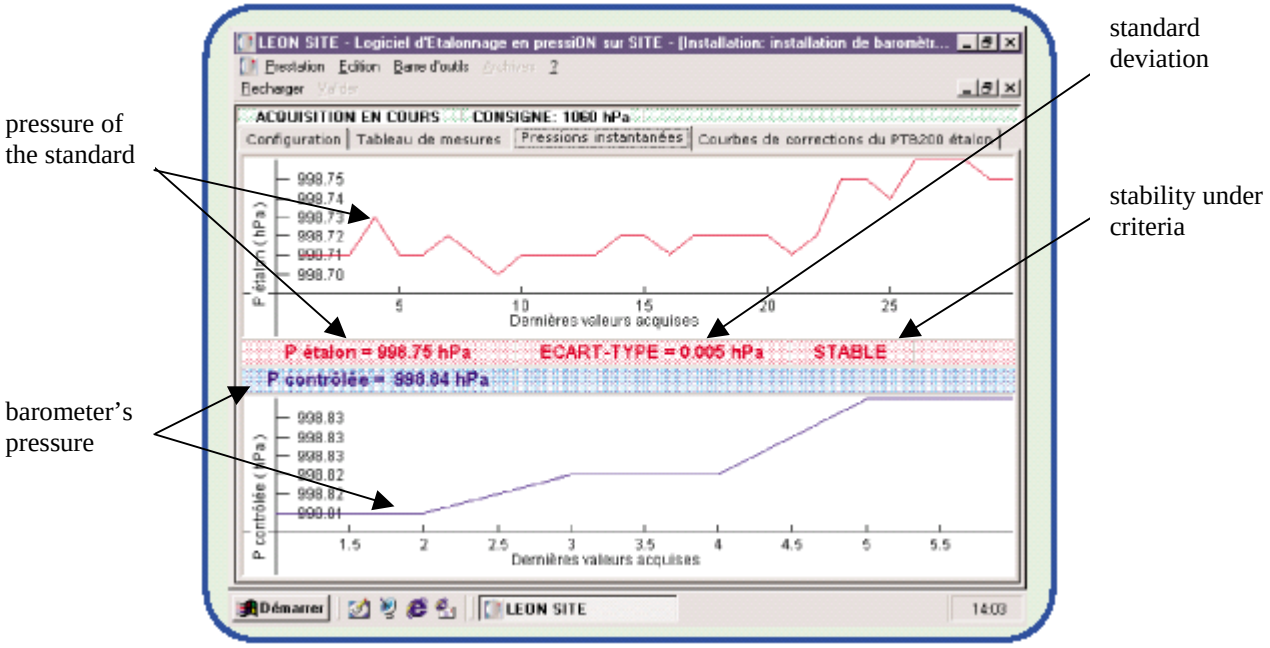

fig.4 : Software LEON

The calibration software, programmed in Delphi® (Pascal), uses serial RS 232 communication but there are manual calibration options too. This software is very useful for the calibration operator. The management of raw and corrected data, reference barometer, working standard and calibrated barometer is simplified.

2.2. Validation of the calibration

This system fulfills the needs of the traceability chain when there is no permanent installations to calibrate automatic weather station network barometers.

To validate in situ measurement, the travelling standard is calibrated before the travel and after the return (The tolerated criteria is 0.03 hPa). That means that the difference between both calibrations must be less than 0.03 hPa This criteria is part of the uncertainty balance.

3. Performance

3.1. Stability

The stability of the generator belonging to the Laboratory of Metrology was studied in July, 2004, to characterize its response time and its range of generation.

The study was led in the laboratory, at the ambient temperature, with an external standard (one of the working standard of the Laboratory of Metrology) at 20 %, 50 % and 80 % of the whole common range (1060 hPa-800 hPa). So the generator was studied from 850 hPa to 1010 hPa down first and from 1010 hpa to 850 hPa up after. Two blank cycles were made before testing.

Once the established working obtained (the standard deviation on the last five measurements is below than 0.01 hPa), one measurement was taken every 5 seconds during one minute.

Here, results are shown:

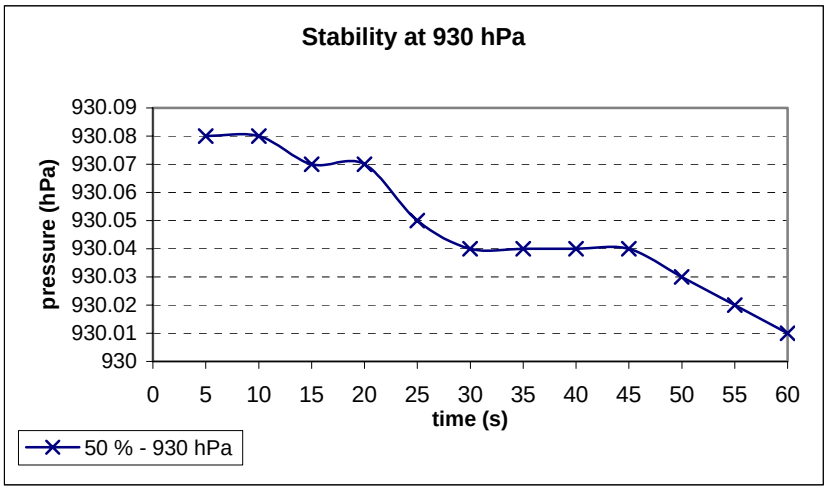

fig.5 : Stability from 1010 hPa to 850 hPa down

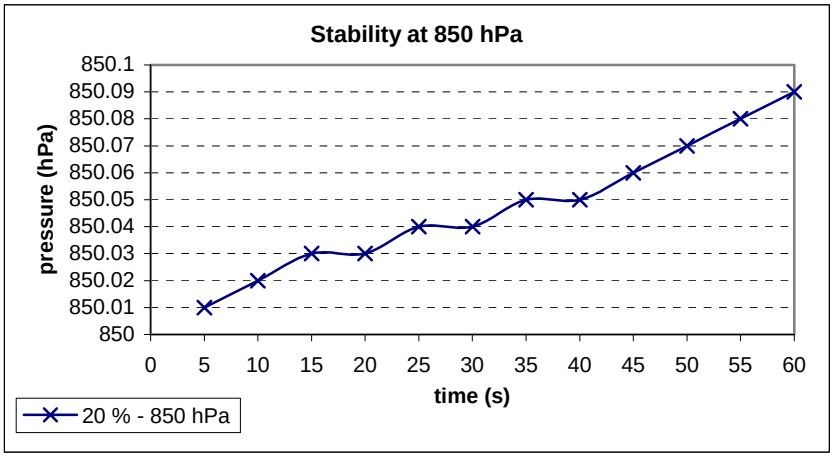

fig.6 : Stability from 1010 hPa to 850 hPa up

During one minute, the generation range is 0.08 hPa in the two cases. The diagrams shows the hysteresis of the generation. It contributes to the uncertainty balance with a component of 2.3 Pa considering a normal distibution law.

3.2. Intercomparison

To study the efficiency of our in situ calibration in pressure, an intercomparison was made with the calibration in laboratory. In our laboratory, we use a PPC 1 generator, with an external standard and special software for data acquisition.

We chose two paroscientific-sensor based barometers among our standards : n°1331, our reference standard, which was considered as the standard, and the n°1332, a working standard, which was considered as the calibrated barometer .

N°1331 was calibrated in October, 2003.
N°1332 was calibrated with LEON in January, 2004, compared to n°1331, in our laboratory. Then, it was calibrated also in our laboratory with our fixed means, in March, 2004, by the same operator and according to the same measurement procedure : two blank cycles, one cycle from 1060 hPa to 800 hPa down, hence fourteen points.

Here the calibration diagram :

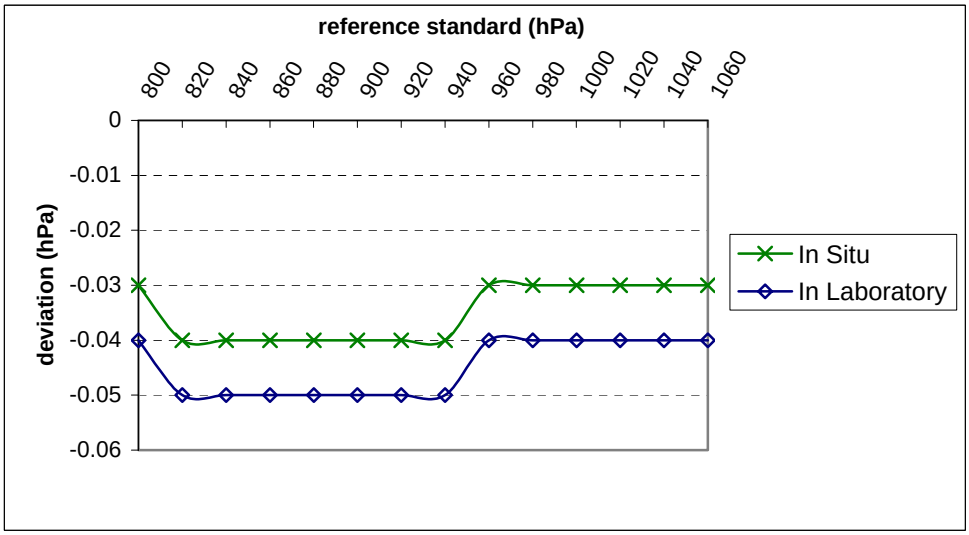

fig.7 : Intercomparison between in situ and in laboratory

The two calibration diagrams are similar on figure 7. The normalised deviation is : 0.08 <<1 so the two calibrations are very coherent.

To conclude, this in situ calibration system is a reliable one, which fulfills the needs of the traceability chain, provided the requirements are satisfied.

It is used by Météo France to check the drift of the french synoptical network operating pressure transmitters in addition to the calibration in the Laboratory of Metrology. This equipment is also used by Asecna, french nuclear plants network or when some countries require Météo France's support as Regional Instrument Center (RIC) to check their reference barometers (recently Egypt and Algeria).

Next step will be a LEON Software update to take into account the in-situ accreditation criteria.

This step will also include a multiple language setup (French, English, Spanish, Italian and Czech in the first step).