What makes a good variometer?

The variometer is one of our most important instrument as glider pilots. In this article we will explain our view of what makes a good variometer and also introduce a standardised performance test.

We, humans, lack a sense for air pressure change. Birds on the other hand have a sense (paratympanic organ) with which they can detect variation of altitude, a built in variometer! Imagine if you could feel the climb, or sink, the same way you feel temperature change.

We can view the variometer as an extension to our senses, to be able to sense steady climb or sink. By defining the variometer as an extension of our senses we can conclude that a good variometer should be defined by:
- Minimal mental energy should be needed to interpret it, it should just “be there”.
- Minimal delay, instant reaction.
- Consistency, linear responce.
- Error free

Humans are different, between each other but also as we age. As such we need the variometer to be adaptable to all ages and persons. An out-of-tune “sense" will be tiring. As such it should also have:
- Perfectly adjustable sensitivity

Looking at the above criteria we can start to evaluate a variometer. We can split the criteria's into two: The once that can be practically tested and those that need to be evaluated logically. Let’s start with the logically.

The variometer needs to communicate it’s reading to the pilot somehow, this is called Human Machine Interface(HMI). For this purpose almost all variometers have a dial with a needle that rotates. Most electronic variometers can also play a tone depending of the climb/sink rate.

It may seam obvious but the more clear the visual, and audio, signal is the better it is.
Logical Evaluation:
- Is the needle position easy to read in all light conditions, also when using your peripheral vision?
- Is the sound clear; good distinction between climb/sink?
- Does the needle and sound change smoothly without jumps?
- Are the visual, and sound, signals perfectly in sync?
- What are the possibilities for adjusting the variometer’s sensitivity?

After the logical evaluation we move on to the practical test. This test is aimed at testing pressure based electronic variometers.

The LÖFGREN Standardised electronic variometer test

For this test you will need:
- Exactly 1 meter of instrument tubing(5mm internal diameter), preferably of silicone.
- A glass of water.
- The variometer to test, pressure based sensors.
- Stopwatch

Begin by filling exactly 2cm of water in the glass. Attache the instrument tubing to the TE port of the variometer. Setup your variometer for TE probe use (not electronic compensation) and use a filtering setting that you use in-flight. Your test setup should look something like this:

Now, position the open end of the instrument tubing just above the water (1). Plunge the open end of the tube to the bottom of the water glass and start the stopwatch at the same time(2). The variometer will show a rapid sink, needle moving away from zero. When the needle stops at it's maximum deflection (reverses direction, moving back to zero) stop the stopwatch.

This measured time is the sum of delay, filtering and sensor speed. This should be as short as possible when the variometer is using a filter setting which is usable in-flight.

For comparison:

The LÖFGREN variometer, with 10s 10n setting, will stop in 0,9 seconds.

The Zander 940 set to 1.8s will stop in 2,9 seconds.

Redo the test a few times and make an average. Also note how the sound behaves during this test, it should be perfectly in sync with the needle. Also look for jumps or erratic behaviour of the needle(s).

Next, change the variometer to electronic compensation. Use a T-connection to simultaneously connect the airspeed pitot port and TE port to the 1m tube. Leave the static port open. Redo the test by plunging the tube end into the water glass. If the electronic compensation functions perfectly nothing should happen, the needle should stay still.

A few advice how to get the best performance from your variometer

Without any order of importance

- Avoid using the sound of one variometer and look at another; they will be out of sync. Even very small sync issues will make an effect.
- Put your best variometer on the top of the panel where it is clearly visible.
- Put your back-up variometer far away from the other and/or cover it with a piece of paper so to not see it in normal flight. Your mind will unconsciously average the two if they are next to each other creating a less clear reading.
- Do at lest a few pull-up tests to verify that the total energy compensation is OK and foremost how it behaves. Do whatever you can to improve it, bad compensation creates false readings.
- Always verify that the tubing and instruments does not have any air leaks.
- Avoid using the same TE tube for a mechanical and electronic variometer. The mechanical (with its expansion tube) will slow down the pressure signal in the instrument tubing, limiting the electronic variometer's performance. This is especially noticeable in big open class gliders.

It is important to understand that the variometer very much affects how the pilot flies and interprets the air. A pilot which flies with a slow and diffuse variometer will adapt a flying technique which is less efficient than someone flying with a fast and sharp variometer. Almost all pilots take the decision to turn when the feeling is correct and the variometer is indicating good climb. Seeing above, the "green light" to turn will be 2 seconds later with the Zander 940 compared to ours.

Beginner pilots learn what thermals feels like by looking/listening at the variometer, thus it is very important for beginners to fly with good functioning variometers.

Niklas Löfgren - 2026
Löfgren Electronics   www.lofgren-electronics.fr