

1. Introduction

This application note answers all questions regarding calibration and calibration “freshness” of VPIstruments products. Over the years we received many questions regarding the recommended interval for re-calibration and the shelf life of a calibrated flow meter. This article answers all those questions and provides practical recommendations. We used several publications on this topic during our investigation of this matter. References to these publications can be found in the annex.

Customers are faced with increasing pressures to minimize costs while improving compliance with “Rev. A” of Mil-STD-45662A, establishing compliance with ISO 9000, and improving the reliability of measurement equipment. By optimizing calibration intervals, unnecessary calibration can be minimized, thereby reducing costs. Moreover, optimizing intervals will improve compliance with regulatory directives while ensuring maximal compliance with reliability targets. In this application note we give practical answers to the following questions:

- What is calibration and why is it necessary?
- What is the calibration interval for a flow meter?
- What can I do in the field to service and check my flow meter?
- What is the shelf life of an unused flow meter?

2. What is calibration?

The formal definition of calibration by the International Bureau of Weights and Measures (BIPM) is the following: *“Operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties (of the calibrated instrument or secondary standard) and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication.”*

Calibration is comparing the reading of a measurement instrument to a known standard. This standard should be traceable to National standards, and well maintained. At VPIstruments, we use certified gas meters (rotary type), with pressure and temperature compensation. These instruments have a proven track record on stability and are 100% traceable to national standards at the Dutch Institute for Metrology (NMI).



3. Why calibration is necessary

Calibration is a “necessary evil”. Sensors and electronics may drift, they might get polluted or mechanically wear out. This is applicable to all instrumentation, including all flow meters, independent of the brand. Moreover, if you are a company that is ISO 9001 or ISO 50001 certified, regular recalibrations are mandatory.

Re-calibration ensures reliable and repeatable measurement data. This is important for instance for:

- mission-critical applications like energy management
- making important decisions on the best measures to reduce energy waste
- accounting purposes such as to get rebates from local utility companies or the government and to allocate costs.
- avoiding wrong conclusions e.g. about compressor output.

The costs for re-calibration is mentioned most often as reason why one does not re-calibrate their instrumentation. Consider however the consequences of making wrong decisions based upon inaccurate measurement data.

4. Recommended calibration interval

For most instruments, the recommended re-calibration interval is annually. The best interval is dependent though on the application, on air quality, the intensity of use, and process parameters, etc. For example:

- **Air quality:** When your air quality is poor, fouling of the sensor element of your flow meter can occur and it can even damage it. Your flow meter might need recalibration more often than once a year. ISO 8753.1 is a reference for air quality that might help you determine the best recalibration interval for your situation.
- **Legislation / certification:** If you are a company that is ISO 9001 or ISO 50001 certified, regular recalibrations are mandatory. The calibration interval for each instrument needs to be defined by a company policy and then adhered to. You can start with an interval of once a year and modify it as needed to the specifics of your situation. Be sure to update your company policy when you change the calibration interval.
- **Energy monitoring:** If your goal is energy savings, you need to make sure your equipment is recalibrated on a regular basis to avoid basing decisions on incorrect data. We recommend an annual re-calibration for these applications. Some ISO 50001 compliant energy management software platforms also offer automatic re-calibration alerts for all connected sensors.
- **Auditors:** Professional air auditors need equipment that is maintained, calibrated and in excellent condition. As an auditor, you might want to insist on recalibrating your equipment before every audit. Your customers must have confidence in your results, which should be traceable to a National Standard.

- Incidents: For example, if a flow meter is exposed to physical conditions which are out of specifications, it is wise to have the sensor checked and recalibrated. For example, when exposed to an extreme temperature above the maximum limit, the internal sensor could be damaged. Unless you do a calibration check, you will not know for sure that the sensor is working correctly.

5. What can I do myself in the field?

Visual inspection: Take out your flow meters for a visual inspection, with insertion type flow meters this can be done in pressurized conditions. Check if the device is still clean and looks proper. We have seen it all: from bent probes, housings completely rusted to water damage, and more. If this is the case, sent it back for servicing.



Periodical cleaning: Any dirt and oil in your air or gas can remain on the sensor. Cleaning the sensor may result in more accurate readings and a longer high performance of your device. Cleaning is a delicate procedure, so carefully check the instructions for your specific device.

Check the accuracy with a reference meter: Be sure to use a recent calibrated flow meter and install it in series with your flow meter, make sure to follow installation guidelines for proper installation. When comparing the results, take into account field accuracy as insertion type flow meters typically have around 5% field accuracy. So only if your deviation is above 10%, contact your supplier.

Software and firmware updates. Have the latest updates as these take out bugs, improve connectivity and provide more reliable results. Check the latest updates:
<https://www.vpinstruments.com/service-support/software-firmware>

6. Calibration shelf life

The shelf life of VPInstruments flow meters, both thermal and differential pressure based, exceeds 12 months without compromising the initial calibration accuracy. This means that the products can be stocked for 12 months without significant drift of accuracy.

To determine this, we have studied the shelf life of 9 mass flow sensors over a period of years, table 1. For this test, we initially calibrated the units, then stowed them away in our storage room, and verified the meters on fixed intervals and checked the deviation. In table 2 you can see the results, which are all within the specified accuracy.

Table 1: Sample group products

Product	Sensor technology	Serial number		
VPFlowScope	Thermal mass	5102289	5101191	5102263
VPFlowScope DP	Differential pressure	5102675	5102676	5102283

VPFlowScope In-line	Thermal mass	5500506	5500504	5500505
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Table 2: Calibration deviation (average) initial and after 12 months

Product	VPFlowScope Probe	VPFlowScope DP	VPFlowScope In-line
New	0,6%	0,7%	0,4%
12 Months	0,8%	0,7%	0,7%
Delta	0,1%	0,0%	0,3%

Based upon these results we have concluded:

1. The shelf life of VPInstruments flow meters, both thermal and differential pressure based, exceeds 12 months without compromising the initial calibration accuracy. This means that the products can be stocked for 12 months without significant drift of accuracy.
2. As an internal quality guideline, VPInstruments will re-calibrate flow meter products on stock when shelf life exceeds 6 months, so we include a safety factor of 2.
3. Rental and exchange products are calibrated before each rental period, as best practice for any audit/ rental tool is to perform a complete check-up after each return.
4. As pollution, wear and tear of the product have an effect on the accuracy over time, we recommend using the initial installation date as starting date for recalibration interval. This date can be set via VPStudio. The recommended re-caibration interval can initially be set on 12 months. Based on actual performance and pollution one can decide to change this interval to a shorter or longer period.
5. The storage conditions and transport conditions should not exceed the maximum limits. When the maximum limits are exceeded, we recommend recalibrating the product. The storage considerations:
 - Temperature between 10 and 40 degrees C
 - Relative humidity between 20 and 95% non-condensing
 - Sunlight: No excessive sunlight to prevent packaging from discolouring

7. Service programs

VPInstruments offers flow meter calibration services at a state-of-the-art calibration facility. Check out our single service options and our programs at: <https://www.vpinstruments.com/services>

8. References

[1] OIML, Guidelines for the determination of calibration intervals of measuring instruments. ILAC-G24:2007 / OIML D 10:2007 (E)
 [2] Donald W. Wyatt, Howard T. Castrup, Ph.D., Managing Calibration Intervals.