Picking the right meter for the job

Application Note

Manufacturing plants and their testing and maintenance needs are as diverse as the products they manufacture. They come in all sizes from storefront operations to sprawling campuses and make everything from "stuff" to "things." Simply put, stuff is usually considered products produced by continuous processing. These include petrochemicals, chemicals, and other products that are manufactured in bulk and generally sold that way. Most food and beverage, paper, and primary metal products also fall into this category. Things, on the other hand, are products of discrete manufacturing. These include a wide variety of hard goods, everything from automobiles to clock radios, refrigerators to industrial fasteners. Items such as candy bars and automobile tires start their industrial "lives" as stuff only to become things later in the manufacturing process.

No matter that products are made by the tens of thousand of facilities located in the United States alone, ongoing testing, maintenance, and repair of production equipment is of utmost importance in maintaining product quality, operational efficiency, facility safety, environmental compliance, and corporate profitability. Industrial meters perform a key role in most maintenance operations. In the hands of an experienced industrial technician (an increasingly rare commodity in today's lean departmental staffing), these instruments are called upon to perform a wide variety of tasks including testing, troubleshooting and repair, and instrument calibration.

Not all meters are created equal

Picking the right meter for the job is critical. Because digital multimeters (DMMs) and process calibrators can be similar in look and feel, it is possible for a less experienced technician or electrician to grab the wrong device at the tool crib or from his tool chest and head into the plant. Attempting to use the wrong tool for the job can result in wasted time and worker frustration. The most serious results of using the wrong tool, however, could be improper or unnecessarily time-consuming setup and, worse yet, dangerous and insufficient job safety. New meters of both types are now designed to conform to IEC 1010, the recently developed safety standard that has replaced the older, well-known IEC 348 standard. (Note that many calibrators are not IEC1010 compliant.)

A DMM is essentially an electronic measuring device used for making "industrial-strength" electrical measurements. Although it may have any number of special features, a DMM uses Ohm's Law theory and its internal circuitry to measure volts, ohms, and amperes and display the results digitally. A wide variety of special features are available to make using a DMM easier, especially under factory-floor conditions.

Fluke DMMs simplify testing processes with features like annunciators that show at glance what is being measured, a Touch Hold button that freezes stable displays allowing two-handed probe manipulation, automatic autoranging and autopolarity functionality, and most importantly comprehensive overload protection. These safeguards prevent damage to the meter and the circuit as well as the user. Special high-energy fuses provide extra protection for both user and meter during current measurements and overload situations. Ratings available vary from IEC 1010 CAT I through CAT IV.

The Fluke 744 HART documenting process calibrator allows technicians to calibrate, maintain, and document HART-based field devices without the need for additional equipment.

Selection simplified

Since "application-specific" is the key word in picking a DMM suitable for a specific factory environment, care must be taken to match it to the job. It must be able to make accurate readings at all required ranges, and do so safely. The DMM **and** test leads selected should be rated for the highest over-voltage installation category (CAT I through CAT IV) that could be encountered during use.

Features like ease-of-use enhancements and documenting capabilities allow versatile and efficient operation. These features are part of the overall meter specification and should not be overlooked. Efficient testing, troubleshooting, and repair and control of plant maintenance expenses and manufacturing efficiency may depend on the added benefit of a PC interface or other key feature. Ruggedness requirements should also be investigated prior to making any final meter selection. In the case of Fluke DMMs, information on these and other multimeter accessories are available on their website (**www.fluke.com**).

Enter the process calibrator

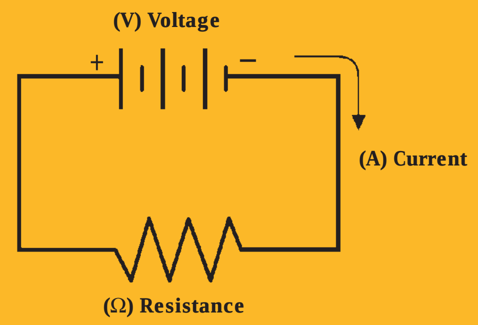
Unlike DMMs, process calibrators are designed specifically to calibrate process instrumentation. In order to keep process plants running efficiently, safely, and to uniform product specifications, process variables (pressure, temperature, flow, and level, and often chemical/physical characteristics like pH, viscosity, etc.) need to be controlled. While these instruments have the ability to measure volts, milliamps, ohms, frequency, thermocouples, and RTDs similar to a DMM, they also can provide source/simulation of these variables in order to calibrate process transmitters. They are **not** intended to make electrical measurements such as voltage, current, etc. at industrial levels. As such, they are **not** suitable for 600V CAT III environments.

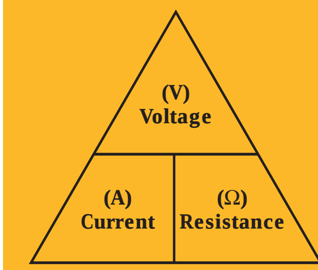
According to Jim Shields, process tools product manager at Fluke Corporation, "Electronic test tools for process engineers have become more and more specialized. Tools that have been specifically developed for instrumentation maintenance are neither rated nor intended for high power measurement applications. The highest voltage measured in this application is typically 24 V dc."

"Conversely, an industrial electrician may encounter lower voltage measurements but the bulk of the measurements made are 120, 220 and 480 V ac. The two professionals have vastly different test tool needs. The instrumentation professional needs a multifunction tool with the ability to source and measure for low voltage applications, the industrial electrician needs a DMM designed to be safely used in high power applications. These are not the same tool," Shields adds.

Just as with DMMs, process calibrators feature a host of functionality and convenience features. They can be, however, much more difficult to select. Before the selection process can begin, the process equipment performance characteristics or product testing scenario must be thoroughly understood and documented. Good specs must be complete, easy to understand, and include information about effects that will be encountered in normal usage, including environment and loading.

Comprehensive specifications are essential in maintaining a chain of traceability and product uniformity, quality, and safety on a global basis, if necessary. Factors other than the specifications and functionality of the instruments to be calibrated include those of the calibrator itself.





V = A x Ω

Where:

V = Volts
A = Current in Amps
Ω = Resistance in Ohms

Ohm's Law explains the relationship between voltage, current and resistance.
Put your finger over the value you want to find. Multiply the remaining values if side-by-side; divide if one is over the other. But it really is much easier just to use your DMM.

Ohm's Law explains the relationship between voltage, current, and resistance. Both DMMs and process calibrators use this basic principle to measure electrical values. As far as basic meter function and intended use is concerned, however, this is where the similarity ends. They are designed for completely different jobs and are not interchangeable.

Key components of a specification

The four most important components of a documenting process calibrator specification are time, temperature, allowance for traceability standards, and confidence level. Time refers to a specific period that a calibrator can be expected to perform as specified. Setting this time period or calibration interval is necessary to account for the drift rate inherent in a calibrator's circuitry.

In order to account for thermal coefficients in a calibrator's analog circuitry, it is essential that this specification be accurate. Performance over the specified temperature range is critical. The calibrator's operating temperature range must match environmental conditions present during the testing procedure. Calibrating for a given temperature range assumes that the instrument calibrated will perform accurately over the entire range specified. Measurement uncertainty increases outside the specified temperature range.

Any uncertainty in measurement can be evaluated as relative or total. Relative uncertainty does not include the relative uncertainty of reference standards. Relative uncertainty is not a true picture of a calibrator's total uncertainty. Total uncertainty includes all uncertainties in the traceability chain, including those of the unit and the equipment used to calibrate it.

Finally, the most critical factor in a calibrator's performance is what percentage of the calibrators themselves will be out of calibration. Confidence level specifications must be conservative to ensure that a device is in tolerance with a high degree of confidence at the end of its calibration interval.

Although accuracy specifications are very important in determining if a particular calibrator will meet the needs of its user, there are others. These include matching a calibrator's specifications to workload requirements, determining how support standards are serviced, reliability (MTTF and MTBF considerations), and the service philosophy and reputation of the vendor. (Do they service what they sell in a timely and efficient manner?)

Versatility counts

Advanced process calibrators, such as the Fluke 740 Series, should offer a comprehensive set of capabilities in order to perform calibration procedures accurately and efficiently. They must be able to simultaneously source and measure all common process parameters, eliminating the need for bringing multiple meters or a wide variety of auxiliary equipment onto the plant floor. The ability to interface universally with the broad array of pressure modules often required for comprehensive calibration in many plant environments plays a large part in efficient calibration operations.

Because corporate profitability concerns have resulted in a trimmed workforce at all levels, departmental efficiency is now key. Calibrators that allow users to create and execute automated procedures using bar-coded tagging and then automatically capture the results are no longer a luxury but a necessity. Features such as serial interfaces that allow two-way communication to PC-based instrumentation management applications have also become a necessity for efficient and accurate calibration procedures.

In addition, many of today's process plants have taken advantage of smart transmitters to support their operations. As a result, more facilities are benefiting from the use of a documenting process calibrator that can handle these devices without additional tools (separate communicator devices, etc.). The Fluke 744 HART calibrator features integrated HART communication functions, allowing a technician to monitor, control, and calibrate a wide variety of popular HART instrumentation.

DMMs and process calibrators may look alike but are entirely different tools meant for entirely different jobs. And although there are some common features that can be applied to instrument calibration and industrial electrical measurement, their functionality does not provide for efficient or safe operation during a "pinch-hitting" situation.

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