FLUKE®

How to go home safely at the end of the day

Electrical safety requirements for using digital multimeters

Application Note

Safety standards of all types are written for a reason: to ensure we all go home safely at the end of the day. When it comes to electrical safety, the hazards are deadly and manifest themselves quickly, leaving virtually no response time for personnel.

When performing the routine tasks of maintenance and troubleshooting, a technician might place a test probe on a live, energized terminal, leaving fingertips perhaps only an inch or so from this terminal. Should that test lead or the test tool it is connected to fail, or should a fault occur while the technician is observing a reading, or even if the technician makes a human error, the results can be deadly.

Engineers, electricians, and technicians must follow electrical safe work practices when it comes to using multimeters, including inspection before use. The most effective method to ensure safety, and also the method required by OSHA, is for employees to demonstrate their ability to select, inspect, use, and maintain their test equipment.

Procedural guidance

OSHA regulations and the NFPA 70E® Standard for Electrical Safety in the Workplace® provide the procedural guidance when it comes to test equipment inspection. For example, NFPA 70E states that only "qualified persons" are allowed to perform tasks that include the use of test equipment on systems 50 volts and greater. The digital multimeter (DMM) is the most commonly used instrument. Since 2007, OSHA regulations require technicians to "demonstrate" their skills to their employer to be considered a qualified person. Thus, employers must verify an individual's ability to safely use DMMs.

Properly rated for the circuit

A DMM must be properly rated for the circuit on which it is to be applied, and technicians must be able to explain these ratings. This includes ratings of any test probes, flexible clamps, or other accessories to be used.

Stay safe, per the requirements, when working with DMMs like this Fluke 87V Industrial Multimeter.

The first step is to identify the nominal system voltage of the circuit to be tested. This is the voltage class assigned to systems and equipment and can be found on nameplates and drawings. Typical nominal voltages found in plants are 120/240, 208Y/120 and 480Y/277.

Technicians need to be aware of the extreme danger of using an inadequately rated DMM. Using a 1000-volt-rated DMM on medium-voltage circuits has, unfortunately, happened more than once with tragic results.

Nationally Recognized Testing Laboratory (NRTL)

In addition to proper voltage and current ratings, test tools must be listed by a Nationally Recognized Testing Laboratory (NRTL) and properly labeled with the NRTL's mark. OSHA lists which NRTLs have been approved to test and verify that DMMs meet consensus-based standards.

This testing reasonably assures that products are safe for use. Once the equipment meets the testing laboratory's criteria, the tool can be labeled with the NRTL's recognized mark. Any test equipment without such a label should not be used.

Among the most common testing laboratory marks found on DMMs are Underwriters Laboratories Inc. (UL), Canadian Standards Association (CSA), and TUV. Technicians must demonstrate their ability to recognize and identify these labels and explain their importance.

CAT ratings

Electrical workers must also be familiar with the Category Rating found on DMMs. The "CAT" rating indicates the multimeter's ability to withstand transient overvoltage conditions that could destroy the meter and injure personnel.

DMMs used in distribution systems should be at least CAT III rated. CAT IV offers a greater degree of protection. Most industrial DMMs are rated CAT III for use on 1000 volt and below systems and CAT IV for use on 600 volt and below systems. Electrical workers should be able to identify the CAT rating needed for their job.

Designed for environment and use

Technicians must verify that the test instruments and their accessories are designed for both the environment and the manner in which they will be used. For example, when examining a DMM for proper design, ask, "Will this DMM be used in a hazardous location?" When taking voltage readings it is possible for a very small electrical arc to be drawn when placing a test probe on, or removing a test probe from, an energized point. The National Electrical Code® identifies environments as Hazardous (Classified) locations if explosive atmospheres are present. Intrinsically safe DMMs are designed for use in such locations and technicians must look for such identification if applicable.

This is also a good reason to place and remove test probes at a ninety-degree angle to the terminal, and not let the probe "slide" from one terminal to another.

Visual inspection

The visual inspection must include not only the test tool itself, but all associated test leads, cables, power cords, probes, and connectors. Look for any obvious external defects. It is not uncommon to find damaged test leads or probes, which must be replaced before use.

One good method is to slowly pull test leads between your fingers as you perform a visual inspection of the lead. The fingers can often feel damaged insulation even if you miss seeing them. All test leads should have a shroud around the end that inserts into the DMM. This prevents accidental shock should the test lead become unplugged from the test tool while the probe is still on an energized component.

Test probes (both voltage and current probes) will have a voltage and category rating. The IEC symbol for "double-insulated" (one square box inside of another) indicates that one single insulation failure will not result in personnel being exposed to dangerous shock levels.

Do not discount the use of clamps, flex clamps, and test probes for current measurements when it comes to visual inspections. Such devices should be marked with a maximum current rating. They should also have the NRTL label. Many test probes are double insulated and marked with the double insulated symbol.

Check the condition

Never hesitate to remove a tool from service if there is any question about its condition. Make sure some method, such as tagging, is used to ensure someone else does not inadvertently use the defective test equipment before repairs are completed. A simple item—a frayed copper strand protruding from a test lead—once put this author in the hospital!

Consider the need for a protective case to protect the equipment from mechanical shock and general rough handling during a day's work. A storage case may also be needed for more complete protection when transporting or storing the test tool.

It would be foolish to use a DMM that did not operate correctly. Daily, before first use, DMMs should be verified to operate properly on voltage by testing on a known voltage source, such as a receptacle. Before measuring, short together resistance test leads to verify proper operation in the resistance function. This quick test also verifies continuity of test leads. Make sure a low battery warning does not appear on the display during this check.

A SAFETY CHECKLIST FOR DIGITAL MULTIMETERS (DMMS)

Perform the following items daily before using a meter. If you find a faulty measuring device or accessory, remove it from service.

1. Verify the DMM and accessories are appropriately rated and designed for the system and equipment on which they will be connected. Make sure each tool is suitable for the environment and manner in which it will be used.
See Figure 1.

a. Nominal System Voltage to be measured: _____ volts

b. DMM Category Rating: CAT _____ @ _____ volts, CAT _____ @ _____ volts

c. Test Probes Ratings: CAT _____ @ _____ volts, CAT _____ @ _____ volts

d. Are any components double insulated?

e. Is DMM NRTL Listed?

f. Are Voltage and Current Probes NRTL Listed?

g. Is an Intrinsically Safe DMM required?

h. Is a magnetic hangar or other device needed to support the multimeter during use?

2. Visual inspection. Verify.
See Figure 2.

a. No physical damage to case or display.

b. All function switches operate freely.

c. No "Low Battery" indication when display is ON.

d. Probes and test leads have NO physical damage.

e. Test leads are shrouded at end where they are inserted into the DMM.

3. Operation
See Figure 3.

a. Does the DMM indicate voltage correctly when tested on a known source?

b. Does the meter read continuity when placed in the Ohms function and test leads shorted together?

4. Storage
See Figure 4.

a. Is protection provided for the DMM and accessories during daily use?

b. Is a storage case available for storage of both test tool and accessories?

Figure 1. Always verify proper category rating based on location of use. This Fluke 87V is Category III rated for 1000 volts and Category IV rated for 600 volts.

Figure 2. A thorough visual inspection is mandatory. The yellow protective case prevents damage during normal usage.

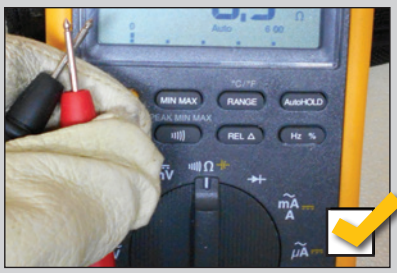

Figure 3. In addition to verifying the DMM operates on voltage, checking continuity of test leads while in the ohms function is always a good idea.

Figure 4. This DMM is kept in a soft case when not in use and placed in a tote bag with other test tools for travel to the next location.

THE THREE-POINT TEST METHOD

Lockout/Tagout Center

One of the most critical safety task performed by a technician is verifying the absence of voltage during the lockout/tagout process at voltages of 50 volts or more. Once the process is completed, technicians can be expected to remove their rubber protective gloves and place bare fingers and hands on once-energized components. A digital multimeter that fails to operate properly during this test could result in a catastrophic accident. Therefore, it is vital that technicians properly demonstrate the use of the "three-point" test method when verifying the absence of voltage during their qualification activities.

The three-step process follows.

1 Verify the DMM works properly when the function switch is placed to "voltage" by testing for voltage on a known energized source and observing the correct reading on the meter face.

2 Test the circuit to be verified by measuring phase-to-phase and phase-to-ground across all phases. Zero energy must be indicated.

3 Ensure the DMM still indicates voltage properly by placing the test probes, once again, on a known energized source.

When it comes to safety, never assume any test tool is operating correctly. Always verify proper operation!

It's up to the individual

Digital multimeter safety is an individual responsibility. While employees must be trained in test equipment usage, it is always up to the individual in the field performing the job to ensure their test equipment is in safe condition. Proper inspection takes time, and experienced personnel may not appreciate being audited in the field. However, mistakes cannot afford to be made and demonstrating safe work practices with test equipment is a mandatory component of the qualification process.

Summary

Using a procedural checklist to demonstrate proper DMM selection, inspection, and usage is the best method to ensure only qualified persons are performing electrical measurement activities. Auditing DMM safe work practices helps satisfy NFPA 70E requirements for test equipment and complies with OSHA's definition of qualified persons. A technician who can successfully demonstrate his or her ability to select, inspect and properly use a digital multimeter has taken a significant step in making sure of a safe return home at the end of the day.

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Printed in U.S.A. 2/2015 6004843a-en

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