APPLICATION NOTE

When choosing a multimeter, safety is in the numbers

Maintenance professionals are constantly being deluged with new models, new manufacturers, and new functionality in handheld digital multimeters. Safety features are perhaps the most critical factors in that decision, but it is sometimes difficult to sift through all the specifications to determine which represent the best tool for your application.

To help put it all in perspective, here are some of the key points to consider when selecting a digital multimeter.

Selection criteria:

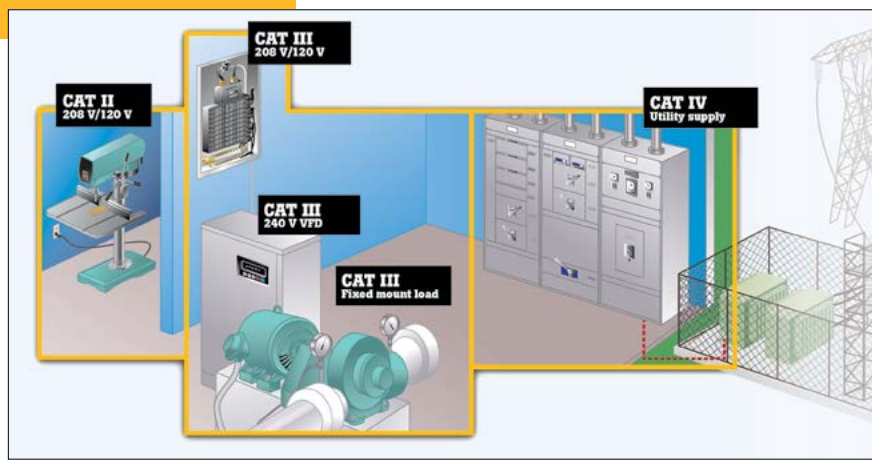
- ☐ **1.** What CAT rating do you require for your environment?
- ☐ **2.** What is your "true" voltage environment?
- ☐ **3.** What IP rating do you need?
- ☐ **4.** How rugged does your meter need to be?
- ☐ **5.** Is the meter independently tested?

For a multimeter selection guide to map these qualities against meter models, visit **www.fluke.com**

1 What CAT rating do you require for your environment?

A common misconception is that as long as you choose a multimeter with a high enough voltage rating, you're covered. However, the voltage rating is only part of the story. A multimeter may be subjected to much higher voltage than the user thought was being measured due to a momentary high voltage spike or transient that hits the multimeter input without warning. Your safety depends on the safety margin built into your meter. And that is based on several specifications beyond the voltage rating.

The International Electrotechnical Commission (IEC) publishes international standards for all electrical, electronic and related technologies. The most important thing to understand about the IEC safety standards is the "Measurement Category". Make sure that any meter you consider has an IEC category (CAT) rating that is appropriate for the electrical environment in which you will use it. The CAT rating typically appears near the multimeter input jacks. Multimeters that are not CAT rated should never be used in high energy, three-phase electrical work environments. Be sure that the test leads you use with the meter have an equal or greater CAT rating as well. The categories related to commercial and industrial use are:



The IEC "CAT" rating is a combination of proximity to source and level of potential energy

Overvoltage Category	Description
CAT IV	Three-phase at utility connection, any outdoor conductors
CAT III	Three-phase distribution, including single-phase commercial lighting
CAT II	Single-phase receptacle connected loads

Table 1. Measurement categories. IEC 1010 applies to *low-voltage* (< 1000 V) test equipment.

Multimeters that are not CAT rated should never be used in high energy, three-phase electrical work environments.

2 What is your true voltage environment?

You need to make sure your meter has the appropriate voltage rating for the electrical environment in which you will use it. A higher voltage rating denotes a higher transient-withstand rating. This means that the meter's input circuitry is designed to withstand voltage transients commonly found in this environment without harming the user.

It is important to consider both the CAT rating and the voltage rating. For example, a CAT III 1000 V meter offers superior protection to a CAT III 600 V rated meter, but a CAT II 1000 V rated meter is not superior to a CAT III 600 V rated meter. That is because in calculating the voltage-withstand ratings, IEC 61010-1 test procedures take into account steady-state voltage, peak impulse transient voltage, and source impedance.

The following chart shows those values in context of the top three CAT ratings.

Measurement Category	Working Voltage (dc or ac-rms to ground)	Peak Impulse Transient (20 repetitions)	Test Source (Ω = V/A)
CAT II	600 V	4000 V	12 Ohm source
CAT II	1000 V	6000 V	12 Ohm source
CAT III	600 V	6000 V	2 Ohm source
CAT III	1000 V	8000 V	2 Ohm source
CAT IV	600 V	8000 V	2 Ohm source

Table 2: Transient test values for measurement categories. (50 V/150 V/300 V values not included.)

3 What IP rating do you need?

If you work outdoors in harsh, wet, and or dusty environments, you'll need a water- and dust-resistant multimeter. Water and dust resistance standards are defined in IEC 60529 as levels of "ingress protection" (IP) from solids and water.

An IP rating has two digits. The first specifies the size of excluded objects. Zero indicates no protection and 6 means that it is dustproof. The second digit specifies the level of protection against water. Zero indicates no protection and 8 means that it is protected against continuous immersion in one meter of water. For example, a rating of "IP67" means the meter is tested to be dustproof and to withstand immersion in water to a depth of one meter for 30 minutes.

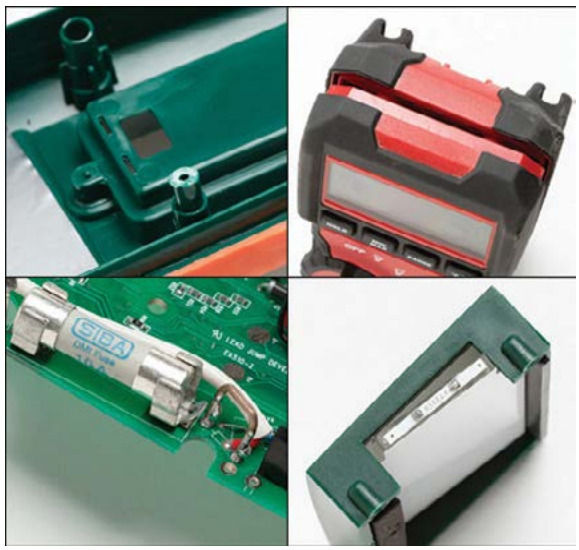
Note: *Safety certification testing for IEC 61010 does not test for compliance with the IEC 60529 IP standard, so check with the manufacturer or vendor for proof of compliance.*

An IP67 rated-meter like the Fluke 28-II is better suited for outdoor work environments than meters rated for generic use.

4 How rugged does your meter need to be?

As careful as technicians may be, multimeters still are subjected to rough use on a daily basis. So look for a solid, well-built instrument that is free of obvious defects and is built to withstand years of tough use.

The most common measure of ruggedness is the IEC 61010 safety standard that specifies that a product must survive a one-meter drop at both its highest and lowest specified operating temperatures. If you've ever seen what happens to a meter that doesn't meet that requirement after a one-meter drop on a concrete floor, you know how important that specification is.



Damage to multimeters subjected to a six-foot drop onto concrete. Clockwise from top left: Broken screw boss, case separation, dislodged display, bent fuse clip with loose

5 Is the meter independently tested?

Some manufacturers, rather than getting independent certification, simply state that their products are “designed to meet” tough standards for safety, ruggedness, and durability. That isn’t the same as being certified. To be sure that the multimeter you’re using is rated for safety, look for at least one (more is better) of the certifications shown here. The marks will be stamped on the meter body and included in the meter’s brochures and catalogs. The presence of those marks ensures that the meter has been independently tested and certified to meet those agencies’ certification requirements. If in doubt, ask the vendor or manufacturer for proof of compliance with established safety standards

Look for these test lab marks on your meter. Don’t trust meters that haven’t been independently tested!

A final note

If you are looking to replace your multimeter, start by analyzing the worst case scenario for your job and choose the Measurement Category for that scenario. Then choose a meter rated for that measurement category, with the highest voltage rating you will need within that category.

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