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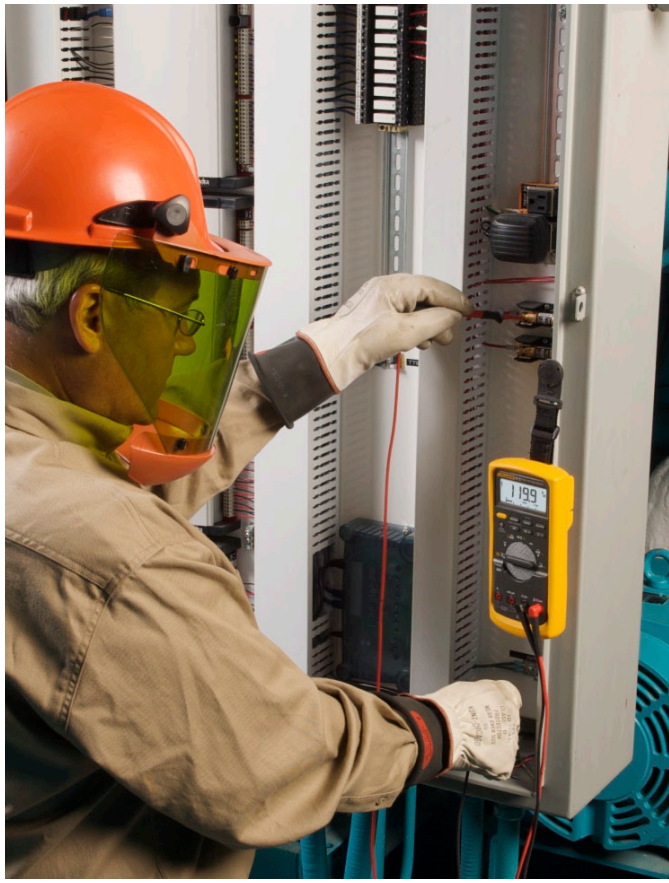
Ten dumb things smart people do when testing electricity

Application Note

Anyone who makes their living by working with electricity quickly develops a healthy respect for anything with even a remote chance of being "live." Yet the pressures of getting a job done on time or getting a mission-critical piece of equipment back on line can result in carelessness and uncharacteristic mistakes by even the most seasoned electrician. The list below was developed as a quick reminder of what *not* to do when taking electrical measurements.

1. **Replace the original fuse with a cheaper one.** If your digital multimeter (DMM) meets today's safety standards, that fuse is a special safety sand fuse designed to pop before an overload hits your hand. When you change your DMM fuse, be sure to replace it with an authorized fuse.
2. **Use a bit of wire or metal to get around the fuse.** That may seem like a quick fix if you're caught without an extra fuse, but that fuse could be all that ends up between you and a spike headed your way.
3. **Use the wrong test tool for the job.** It's important to match your DMM to the work ahead. Make sure your test tool holds the correct CAT rating for each job you do, even if it means switching DMMs throughout the day.
4. **Grab the cheapest DMM on the rack.** You can upgrade later, right? Maybe not, if you end up a victim of a safety accident because that cheap test tool didn't actually contain the safety features it advertised. Look for independent laboratory testing.
5. **Leave your safety glasses in your shirt pocket.** Take them out. Put them on. It's important. Ditto insulated gloves and flame-resistant clothing.
6. **Work on a live circuit.** De-energize the circuit whenever possible. If the situation requires you to work on a live circuit, use properly insulated tools, wear hearing protection, safety glasses and an arc rated face shield or hood if required, and insulated gloves. Remove watches or other jewelry, stand on an insulated mat and wear flame-resistant clothing, not regular work clothes.
7. **Fail to use proper lockout/tag-out procedures.**
8. **Keep both hands on the test.** Don't! When working with live circuits, remember the old electrician's trick. Keep one hand in your pocket. That lessens the chance of a closed circuit across your chest and through your heart. Hang or rest the meter if possible. Try to avoid holding it with your hands to minimize personal exposure to the effects of transients. For hazardous measurement applications, additional measures for reducing the risk of hazard and arc flash should be considered. These include the use of protective equipment including gloves, clothing, and eyewear as prescribed by NFPA 70E and NEC (National Electrical Code) Article 110.16 for flash protection, plus consideration for additional local government and country requirements.
9. **Neglect your leads.** Test leads are an important component of DMM safety. Make sure your leads match the CAT level of your job as well. Look for test leads with double insulation, shrouded input connectors, finger guards and a non-slip surface.



Hazard/Risk categories are described by the National Fire Protection Association (NFPA) Standard 70E. The higher the electrical environment, the stronger the personal protective equipment (PPE) must be to withstand an arc flash incident.

Hazard/Risk Category 1: < 240 V electrical environments (110 V/120 V/208 V/220 V panels, 0 to 50 hsp motors and drives) **Minimum arc rating for FR clothing:** 16.74 J/cm(2) or 4 cal/cm(2)	• Flame-resistant (FR) long-sleeved shirt and/or jacket with sleeves rolled down and front fully buttoned up (FR clothing must fully cover all skin and ignitable clothing) • FR pants • Rubber insulating gloves with leather protectors worn over top • Arc-rated face shield and safety glasses • Hard hat and hearing protection • Leather work boots • No jewelry, keys, or watch • Insulated hand tools
Hazard/Risk Category 2*: 240 V to 600 V electrical environments (270/480/600 V electrical panels, MCCs, switchgear, transformers, bus bars, UPS, and lighting; 100+ hsp motors and drives) **Minimum arc rating for FR clothing:** 33.47 J/cm(2) or 8 cal/cm(2)	• FR long sleeved shirt and/or jacket with sleeves rolled down and front fully buttoned up • FR work pants (not denims) or coveralls • Rubber insulating gloves with leather protectors worn over top • Heavy-duty leather work boots • Switching hood or a balaclava hood combined with an arc-rated face shield • Hard hat, hearing protection, and safety glasses • No jewelry, keys, or watch • Insulated hand tools
Hazard/Risk Category 3: High voltage environments (1600 A or higher, substations, utility transformers, big facility service entrances) **Minimum arc rating for FR clothing:** 104.6 J/cm(2) or 25 cal/cm(2)	• Full flash suit (jacket, overalls, and hood) • Rubber insulating gloves with leather protectors worn over top • Heavy-duty leather work boots • No jewelry, keys, or watch • Insulated hand tools • Hard hat, hearing protection, and safety glasses

Reference: NFPA (National Fire Protection Association) Standard 70E Tables 130.7 (C)(9), (C)(10), (C)(11)
Note: Category 2* is a higher risk than Category 2. This chart only lists PPE for 2*, not for 2. See NFPA 70E Table 130.7 (C)(10) for the specific distinctions between Category 2 and Category 2*.

Overvoltage category	In brief	Examples
CAT IV	Three-phase at utility connection, any outdoor conductors	• Refers to the "origin of installation", i.e., where low-voltage connection is made to utility power. • Electricity meters, primary overcurrent protection equipment. • Outside and service entrance, service drop from pole to building, run between meter and panel. • Overhead line to detached building, underground line to well pump.
CAT III	Three-phase distribution, including single-phase commercial lighting	• Equipment in fixed installations, such as switchgear and polyphase motors. • Bus and feeder in industrial plants. • Feeders and short branch circuits, distribution panel devices. • Lighting systems in larger buildings. • Appliance outlets with short connections to service entrance.

CAT II	Single-phase receptacle connected loads	• Appliance, portable tools, and other household and similar loads.
		• Outlet and long branch circuits.
		  • Outlets at more than 10 meters (30 feet) from CAT III source.
		  • Outlets at more that 20 meters (60 feet) from CAT IV source.

CAT I	Electronic	• Protected electronic equipment. • Equipment connected to (source) circuits in which measures are taken to limit transient overvoltages to an appropriately low level. • Any high-voltage, low-energy source derived from a high-winding resistance transformer, such as the high-voltage section of a copier.

Overvoltage installation categories. IEC 1010 applies to *low-voltage* (< 1000 V) test equipment.

10. **Hang onto your old test tool forever.** Today's test tools contain safety features unheard of even a few years ago, features that are worth the cost of an equipment upgrade and a lot less expensive than an emergency room visit.

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