110.4 Use of Equipment.

(A) Test Instruments and Equipment.

1 Testing.

Only qualified persons shall perform tasks such as testing, troubleshooting, and voltage measuring within the limited approach boundary of energized electrical conductors or circuit parts operating at 50 volts or more or where an electrical hazard exists.

Based on Tables 130.4(C)(a) and (C)(b), a limited approach boundary exists only if the ac circuit voltage is 50 volts or greater or the dc circuit voltage is 100 volts or greater. Only qualified persons are permitted to be within the limited approach boundary. However, wet conditions, high available fault current, and other conditions associated with circuits operating under the 50 and 100 volt benchmarks also have to be evaluated as to whether an electrical hazard exists. If determined that an electrical hazard does exist, only those persons considered as qualified are permitted to perform tasks such as testing, troubleshooting, voltage measuring, or similar diagnostic work.

To be qualified to perform testing, such as measuring voltage or load current, the employee must be trained to understand the electrical hazards associated with the work task and select the necessary PPE.
Employees must be trained to understand that when they are performing work tasks involving testing, they are exposed to shock and electrocution. Each qualified person must be trained to understand how to use the specific meter (see Exhibit 110.2) and to understand and interpret its indication(s). The meter must be in good working condition, appropriate for the task, and inspected before use.

All employees who are qualified persons must be trained to test for the absence of voltage. Each qualified person must be able to operate every meter that he or she could be expected to use and to interpret any possible meter indication. No voltage-testing device should be available for use until each qualified person has been trained to use it. Employees must understand all limitations of the testing instrument.

(2) Rating.

Test instruments, equipment, and their accessories shall be rated for circuits and equipment to which they will be connected.

Informational Note: See ANSI/ISA-61010-1 (82.02.01)/UL 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements, for rating and design requirements for voltage measurement and test instruments intended for use on electrical systems 1000 V and below.
Test instruments are safety equipment and should be considered in the same category of protection as voltage-rated gloves or arc-rated face shields. Although they have some characteristics of a tool, all test equipment and accompanying accessories should be purchased without artificial cost restraints. Test equipment must be selected based on the intended use and expected voltage or current rating. Leads and probes are an integral part of the test equipment and must be rated at least as great as the instrument.

See Exhibit 110.2 for an example of a voltage meter. Note that the Cat rating [per ANSI/ISA-61010-1 (82.02.01)/UL 61010-1] is on the lower left of the device (see insert) and the approved testing organization listing is on the back. Notice that the leads are appropriate for the use.

Equipment and instruments that contact an exposed potentially energized electrical contact or conductor might expose an employee to both electrocution and arc flash. These devices must be rated for the expected service. Voltage-detecting devices must have a voltage rating at least as great as the maximum operating voltage of the circuit or conductor. Accordingly, instruments that measure other circuit parameters must be rated accordingly.

The Informational Note to 110.4(A)(2) explains that one important factor for test instruments used to measure voltage is a static discharge rating for devices used on conductors rated
at 1000 volts or less. Any static discharge, such as a lightning discharge, has the potential to damage an instrument that happens to be in contact with a conductor, even if the lightning discharge is remote from the work location.

The rating of the measuring device also must be at least as great as the parameter being measured. Section 110.4 also requires that employees observe any duty rating assigned by the manufacturer.

(3) Design.

Test instruments, equipment, and their accessories shall be designed for the environment to which they will be exposed and for the manner in which they will be used.

Section 110.4(A)(3) requires that the design of instruments and similar equipment must be consistent with the conditions of use. For example, voltmeters should have a static rating (category) that is consistent with their use. All components of the instrument must be designed for the application. Design of the meter, probes, and mounting/holding device must be consistent with the environment in which the device is used. ANSI/ISA 82.02.01 describes static discharge ratings for voltmeters and other devices that make direct contact with an electrical circuit.

Instruments that measure voltage, current, and other parameters must be selected for the conditions of use.
Contacting an exposed energized electrical conductor with an instrument to measure voltage normally results in a small arc immediately before contact is made or broken. Therefore, devices such as these must not be used when the atmosphere is explosive.

(4) Visual Inspection.

Test instruments and equipment and all associated test leads, cables, power cords, probes, and connectors shall be visually inspected for external defects and damage before each use. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, and no employee shall use it until repairs and tests necessary to render the equipment safe have been made.

A visual inspection must be conducted prior to each use of test instruments and equipment. All test instruments must be inspected for physical damage before each use. Only listed test equipment should be used, and the employee must look for the listing on the device before using it. The inspection must include all leads, probes, and other attachments. If any damage, such as a cracked case, cut or pinched leads, or damaged probe tips, is observed, the instrument must be removed from service, repaired, and tested before it is used again.
If a defect is found during the visual inspection, a tag or label indicating that the instrument is defective should be attached to the instrument or equipment and the instrument should be removed from service. No attempt should be made to repair a lead or probe in which a defect is found. Any defective lead or probe should be destroyed and replaced with a new one.

(5) Operation Verification.

When test instruments are used for testing the absence of voltage on conductors or circuit parts operating at 50 volts or more, the operation of the test instrument shall be verified before and after an absence of voltage test is performed.

When a voltage-testing device is used to test for absence of voltage, an indication of zero volts might mean that no voltage is present when the test was performed, or it could mean that the instrument has failed. Employees must be able to determine if an electrocution hazard exists, and the employee must be aware of that condition. The voltmeter or device must be verified as operating normally before testing for absence of voltage. After the voltage test has been conducted, the voltmeter or device again must be verified as operating normally to ensure that a failure did not occur during the testing for absence of voltage.

The operation must be verified before and after use in every instance in which the voltage is 50 volts or more. The
shock or electrocution hazard is significantly reduced if the circuit voltage is less than 50 volts (caution still should be exercised because under certain conditions, such as wet contact or immersion, circuits operating under 50 volts can pose a shock hazard). The 50-volt limit does not rely on the frequency of the circuit and applies to 60 Hz as well as high frequency circuits. See Exhibit 110.3 for an illustration of the procedure to test for absence of voltage.