

Dielectric Withstand Testing in a Production Environment

Performing a routine product safety test should not in itself represent a shock hazard to the operator who is conducting the test, yet anytime you are working with an energized circuit you must be aware of the hazards involved in performing the test and take the necessary safety precautions. Operators should be properly trained to avoid the shock hazards involved. The National Fire Protection Association, Standard for Electrical Safety Requirements for Employee Workplaces NFPA 70E stipulates that only qualified persons performing electrical work be permitted access to live parts. The NFPA 70E standard is one of the primary standards that the Occupational Safety and Health Administration (OSHA) 29 CFR Part 1910 subpart S Electrical Safety related Work Practices is based upon.

What makes a person qualified?

NFPA defines qualified persons in the following manner:

A qualified person shall be trained and knowledgeable of the construction and operation of equipment or a specific work method, and be trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method. Such persons shall also be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulating tools and test equipment.

It is the employer's responsibility to provide safety-related work practices, maintain a safe working environment and train the employees implementing those practices. One way an employer can help ensure a safe working environment is by using electrical safety testers with safety agency listings. Recognizing this OSHA requires that electrical instruments used in the workplace be listed by a Nationally Recognized Testing Laboratory (NRTL). Underwriter's Laboratories (UL) is qualified as an official NRTL. Therefore, in order to help meet OSHA requirements AR has several products with the UL listing mark.

The degree of training required for the operators performing the product safety test is highly dependent upon the set up of the product safety testing workstation. Whenever possible the workstation should be constructed where there are no exposed energized circuits and employ some positive means to protect the operator from coming in contact with the device under test (DUT). When the electrical testing workstation does not employ positive protection, the operator must be trained to recognize and avoid the potential hazards.

The Dielectric Voltage Withstand or Hipot Test

The Dielectric Voltage Withstand or Hipot test is a routine production line test that can be hazardous if the operator is not a qualified person, as they are working with voltages that are potentially hazardous. Following are 10 examples of the knowledge that a qualified person should have as it pertains to Hipot testing with exposed energized circuits.

1. A qualified person should have a basic understanding of electricity, voltage, current, resistance, and how they relate to each other. A qualified person should also understand conductors, insulators and grounding systems.
2. A qualified person should have a working knowledge of the test equipment, the tests that are being performed, and the hazards associated with the tests as well as the circuits that are being energized.
3. A qualified person should understand the approach distances and corresponding voltages to which they may be exposed.
4. A qualified person should be trained to understand the specific hazards associated with electrical energy. They should be trained in safety-related work practices and procedural requirements as necessary to provide protection from the electrical hazards associated with their respective job or task assignments. Employees should be trained to identify and understand the relationship between electrical hazards and possible injury.
5. A qualified person should understand that the three primary factors that determine the severity of electric shock are:
 - A. The amount of current flowing through the body
 - B. The path of the electrical current through the body
 - C. The duration or length of time the person is exposed
6. A qualified person should know that the human body responds to current in the following manner:
 - A. 0.5 to 1 mA is the perception level
 - B. 5 mA a slight shock is felt, a startle reaction is produced
 - C. 6 -25 mA for women and 9 -30 mA for men produce the inability to let go
 - D. 30 – 150 milliamps results in extreme pain, respiratory arrest, ventricular fibrillation and possible death
 - E. 10 Amps Cardiac Arrest and sever burns can occur

7. A qualified person working on or near exposed energized electrical conductors or circuit parts should be trained in methods of release of victims from contact with exposed energized conductors or circuit parts.
8. A qualified person should understand that the test instrument is a variable voltage power source and the current will flow to any available ground path. They should be aware that contacting the device under test (DUT) during the test can result in a dangerous shock hazard under certain conditions.
9. A qualified person should understand that if the return circuit is open during the test then the enclosure of the DUT can become energized. This can occur if the return lead is open or the operator lifts the return lead from the DUT while a test is in process.
10. A qualified person should be made aware of the importance of discharging a DUT. Lifting the high voltage lead from the DUT before the test is complete can leave the DUT charged. When you are performing a Hipot test you are testing the insulation between two conductors which is essentially a capacitor. This capacitor can act as a storage device and hold a charge even when performing an AC test. If the circuit is opened at the peak of the applied voltage then the DUT could even under an AC test hold a charge. When the test is allowed to finish and the voltage is reduced to zero the charge is dissipated through the impedance of the high voltage transformer. Most DC Hipot testers today employ an output shorting device to discharge the DUT, but the Hipot must remain connected to the DUT throughout the test cycle.

This is just a partial listing of the knowledge required for qualified person to be able to perform a Hipot test safely. They must be trained in safety related work practices and proper work methods. Most accidents happen when the employee is distracted while performing their assigned duties or takes a short cut in an effort to save time. Many times you will find that the product safety testing workstations are set up for maximum productivity rather than safety. If the test station is not set up with positive protection against direct contact then a potentially hazardous situation can result. Even the placement of the test equipment can create a potential shock hazard. For instance, if the operator has to look away from the DUT to observe the test equipment they could inadvertently contact an energized circuit or a return probe could accidentally slip off resulting in an energized chassis.

Performing a Hipot test on a DUT with exposed energized circuits can be much safer when you utilize a tester that employs the latest technology and safety features. Many testers today have multiple shut down circuits to disable high voltage. These testers use both adjustable high limit and low limit current sense circuits. The high limit circuit will shut down the Hipot within 0.5 seconds if the adjustable current threshold

is exceeded and the low limit circuit will shut down the circuit if a minimum current flow through the DUT is not detected. The second situation could be due to an open lead or the operator not making a good contact with the return lead. In either case the DUT chassis could become energized. Another safety feature is the patented SmartGFI® circuit, which is designed to sense if the DUT is floating or referenced to earth ground (see figure 1). If the DUT is isolated from ground the GFI circuit is enabled and monitors any current which flows back to earth ground and will send an interrupt signal to shut down the high voltage if it detects any current in excess of 0.5 mA, thus protecting the operator. This sensing circuit is independent of the current trip setting for the DUT which can set to a much higher current level.

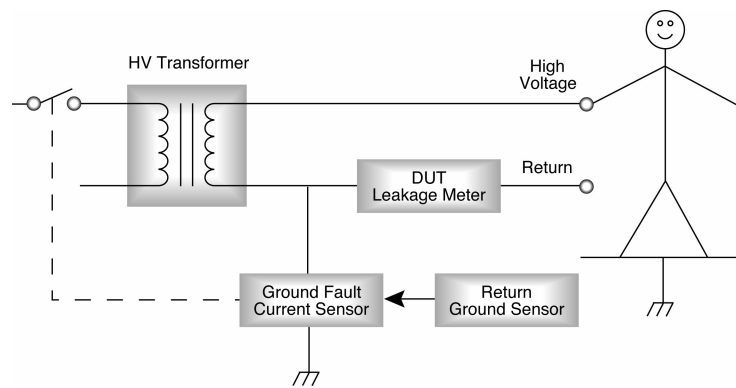


Figure 1: Patented SmartGFI Safety Circuit

Engineering and work practice controls should be the primary factor in safeguarding against the risk of injury. In order to provide for the highest level of protection safety controls should automatically be in place and not rely on the involvement of the operator. Likewise, personal protective equipment should not be the primary means of protecting the operator. These types of safeguards are only effective should the operator make a decision to utilize them.

The qualified person should also be trained in the care, use and inspection of any personal protective equipment and insulating tools required to do the job. Qualified persons should also perform a daily visual and functional verification test on the test equipment. This is done to certify that the equipment is functioning properly and to verify that the equipment will detect a fault condition. In order to help satisfy this requirement AR has developed the VERI-CHEK® function, which is a built-in self verification feature. All of AR's new instruments include this feature. See figure 2 for an example of how the VERI-CHEK® feature works. If personal protective equipment such as high voltage gloves is used, then they must be inspected before each use and electrically tested at a minimum of every 6 months. Any defects must be reported immediately and the defective item must not be used.



Figure 2: VERI-CHEK Self Verification Screen

It is a good practice to regularly review your product safety testing workstations and the skill levels of your operators. Reviewing these guidelines in a regular interval will help to limit potential shock hazards. Newer test instruments that include new technology can also make testing safer. These things together with properly training and educating your operators are the best means to prevent the risk of injury. We hold free ½ day seminars throughout the year. These seminars can help manufacturers to provide their personnel with proper training and education. Please contact Associated Research if we can be of any assistance at 1-800-858-8378 or email us at info@asresearch.com. You can also obtain additional information on safe testing methods from our web site at www.asresearch.com.