Best Methods for Safe Hipot Testing

When working with electrical safety test equipment, instruments that output potentially dangerous voltages and currents, it is always important to regular review and encourage safe testing techniques. This includes setting up a safe work area, properly training any test operators and establishing safe test procedures. Knowing and recognizing the potential safety hazards can go a long way in helping a manufacturer safeguard their workstation. This whitepaper will serve as an overview of the best approach to safeguard a workstation. It can be used as a general guide to make sure that there is a safe work environment for everyone involved in testing.

Work Area

It is important to understand that a Hipot tester generates voltages and currents that can cause harmful or even fatal electric shock. When setting up a work area to test products it is important to configure the workstation in a manner that provides a safe test environment. This should be the first step in safeguarding your workstation.

Do not perform electrical safety tests at an Electro Static Discharge (ESD) workstation. The ESD workstation is designed to conduct electricity to dissipate an electrostatic charge. Most static control equipment is not designed to be used near voltages greater than 250 volts. Electrical safety test equipment is routinely performed at voltages ranging from 120 to 5000 volts. Keep in mind that the product safety testing workstation should be designed for personal safety and to isolate other personnel from a potential electric shock. To do so be sure to limit the testing area from employees who are not familiar with the test instruments or the safety precautions. An untrained employee should not be able to have free access to the testing area particularly when tests are being performed. Ideally the test station would be completely isolated from the main activity and flow of employees. Due to the production line flow, this set up may be a little impractical for manufacturers. If you do have a workstation as part of a larger production line, then it is very important to mark the area off with rope and warning signs. It should be overtly clear that high voltage testing is being performed. Only properly trained test operators should be granted access to this area. This will prevent employees, who are unfamiliar with the shock hazards, from being exposed to high voltage testing.

An extremely important safeguard that should be installed into the test station is a main power shut off switch. This power switch should be located and prominently marked at the entrance of the test station providing a quick and easy way to shut off power to the test area. In the event of an emergency, it is important to act as quickly and safely as possible. The main power switch allows anyone to respond in a quick and safe manner.

Another aspect that is often overlooked is the layout of the workstation. Simply setting up the test equipment appropriately can provide additional safeguards to the test operator.

28105 North Keith Drive, Lake Forest, Illinois 60045 U.S.A
Toll Free: 1-800-504-0055 • Phone (847) 932-3662 • Fax (847) 932-3665
E-Mail: info@hipot.com • http://www.hipot.com

Dielectric Withstand test equipment must be connected to a good ground. The grounding system of dielectric withstand test equipment is essential in providing protection to the test operator. Under no circumstances should this ground be defeated. It is also important that the input receptacle to which the test equipment is connected is properly polarized and the proper low resistance bonding to ground is in place. In addition to that the test bench should be of a non-conductive material. This will isolate the Device Under Test (DUT), which further reduces the risk of electrical shock.

Engineering and work practice control is another important factor to consider when setting up a proper test station. For instance the test equipment and the DUT should be positioned in the safest manner possible. The test operator should not have to reach over the DUT in order to start, stop or adjust the tester. This provides an opportunity to come in contact with a DUT that need not exist. The test equipment should be positioned in a way that allows the test operator to conduct the test without turning, repositioning or even taking their eyes off the DUT. This allows the test operator to be aware of the test area at all times and reduces the risk of an operator accidentally touching the DUT while a test is in progress or not noticing a test clip that may have accidentally fallen off.

It is recommended that if the DUT is small enough, an enclosure or guards can be constructed around the DUT. This enclosure can be fit with switches so that unless the enclosure is closed, and access to the DUT is restricted, the test equipment will not start. This is a very effective method in reducing shock hazards because it is impossible for someone to come in contact with the DUT while the test is in process.

In addition to being clearly marked for high voltage testing, the test area should be clean and uncluttered. Test leads and other test equipment should be properly stored away. If these pieces of equipment or any other items are left on the workstation, it may be unclear to the test operator or a passerby which piece of equipment is actually being used and which product is actually being tested.

Test Operator

Another step that is essential to limiting the potential hazards of high voltage testing is making sure that the test operator is properly trained and is equipped with the knowledge to identify any potential hazards and acknowledge that the intended safeguards are indeed in place. This is one of the biggest challenges that a manufacturer can face. If an operator is unable to identify the potential hazards, they will be unable to avoid those hazards. Any individual, who is working with the instruments in a primary or backup mode, should have the essential knowledge to be able to properly identify the hazards and risks associated with high voltage testing.

To begin with, the test operator should have a basic understanding of electricity, voltage, current, resistance, and how they relate to each other. They should also understand the

28105 North Keith Drive, Lake Forest, Illinois 60045 U.S.A
Toll Free: 1-800-504-0055 • Phone (847) 932-3662 • Fax (847) 932-3665
E-Mail: info@hipot.com • http://www.hipot.com

function of conductors, insulators and grounding systems. In their understanding of electricity, test operators should understand the primary factors that determine the severity of electric shock. Those factors are the amount of current flowing through the body, the path that the electrical current takes through the body and the duration that the person is exposed to the electrical current. In addition to that the test operator should also be aware of how the body responds to electrical current. A brief overview of how the body responds tells us that 0.5 mA is the body's perception level. The body will feel a slight shock once the electrical current reaches 5 mA. The body will respond with the inability to let go of an object once the range of 6 -25 mA is reached for women and 9- 30 mA is reached of men. Once a body reaches the range of 30 – 150 mA it will experience extreme pain, respiratory arrest, and ventricular fibrillation. When levels reach 10 Amps cardiac arrest and sever burns can occur. This knowledge will allow the test operator to better identify the potential hazards associated with the test equipment they are using.

In addition, the test operator needs to be familiar to the test equipment. Their knowledge base should be sufficient enough to understand the test equipment, the tests that are being performed, the circuits that are being energized during the test, and the potential hazards associated with the tests. The test operator should understand that if the return circuit of the tester is open during the test, then the enclosure of the DUT can become energized. This happens when the return lead is left unconnected or if the return lead is either lifted off during the test or accidentally falls off while the test is in process. A test operator also needs to be made aware of the importance of discharging a DUT. The removal of the high voltage lead from the DUT before the test is finished can leave the DUT charged. This is because after a DC Hipot test the DUT must be discharged. If the leads are removed prematurely, then there is no opportunity to discharge the DUT through an auto-discharge circuit or otherwise. The test operator should also 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 DUT during the test can lead to a dangerous shock hazard. The test operator must also understand that conductive materials or jewelry should not be worn by anyone who is working at the test station. These conductive materials could accidentally come in contact with a DUT and become energized.

Lastly, a test operator working on or near exposed energized electrical conductors or circuit parts should be trained in the proper methods of release in the event of an emergency. The best method to release a victim is to shut off the power to the test station. This quickly eliminates the electrical current without exposing others to electrical shock hazards. This is why it is very important that every test station has a main power switch that is clearly marked. In the event that there is no main power switch, any non-conducting materials such as wood boards can be used to push or pull the victim away from the electrical contact. It is important to act as quickly as possible without exposing additional personnel to shock hazards.

28105 North Keith Drive, Lake Forest, Illinois 60045 U.S.A
Toll Free: 1-800-504-0055 • Phone (847) 932-3662 • Fax (847) 932-3665
E-Mail: info@hipot.com • http://www.hipot.com

Testing Procedures

Once the testing area is correctly set up and the operator is properly trained, then it is important to make sure that the testing procedure is soundly established. This is the last step in the approach. Make sure that the operator understands exactly the testing instructions. This not only will ensure safe testing but also eliminate incorrect testing that could possibly damage a DUT. Remember never to perform a Hipot test on energized circuitry or equipment. If this is done, the Hipot tester could be damaged.

Make sure that the external safety ground connection is secure. Always connect the return lead of the test equipment first regardless of the type of DUT. The high voltage test lead should be handled by the insulator only. Never touch the clip directly. If remote test switches are being used, make sure that the test operator has complete control over those switches and that a test is not accidentally started while test connections are being made. Prior to starting the test double-check and verify that the test connections are proper and secure. Once the test has been properly set up and the test has started, it should be reinforced to the test operator to never touch the DUT or anything connected to it while the test is in progress. The operator must understand that the high voltage present during the Hipot test is a potential hazard.

After a test is finished, when using DC test voltage, it is necessary to discharge the capacitance of the DUT and anything that the high voltage from the test equipment may have contacted. This should be done prior to handling the DUT or disconnecting the test leads of the DUT. Most Hipot testers today contain an automatic discharge feature that will automatically discharge the capacitance in the DUT.

Hot stick probes can be used to discharge any capacitance in the DUT as a further safety precaution. A hot stick is a non conducting rod about two feet long with a metal probe at the end which is connected to a wire. To discharge the DUT, touch one probe tip to the same place the return lead was connected. While holding the first probe in place, touch the second probe tip to the same place where the high voltage lead was connected

The technology that is present in test instruments is always advancing making the test instruments themselves safer. However, technology alone will not make the test environment completely safe. That is why it is important to develop engineering and work practices that provide a safe and efficient means of conducting safety tests. By doing so, manufacturers will be able to protect both their test operators and products to the best of their ability. Developing a three prong approach that safeguards the test area, the test operator, and the test procedure is the best approach to developing a safe test environment.

28105 North Keith Drive, Lake Forest, Illinois 60045 U.S.A
Toll Free: 1-800-504-0055 • Phone (847) 932-3662 • Fax (847) 932-3665
E-Mail: info@hipot.com • http://www.hipot.com

KEY SAFETY POINTS TO REMEMBER

- Keep unqualified and unauthorized personnel away from the test area
- Arrange the test station in a safe and orderly manner
- Do not make any unauthorized modifications on the test equipment
- Make sure any custom test fixtures carry the proper ratings
- Never touch the product or connections during a test
- In case of any problem, turn off the high voltage first
- Properly discharge any item tested with DC before touching connections

For further information on ways to safeguard your workstation, you can refer to the following specifications; EN 50191 and OSHA29 CFR Part 1910, Subpart S, Electrical Safety Work Practices.

28105 North Keith Drive, Lake Forest, Illinois 60045 U.S.A
Toll Free: 1-800-504-0055 • Phone (847) 932-3662 • Fax (847) 932-3665
E-Mail: info@hipot.com • http://www.hipot.com