Hi-pot testing, derived from “high potential”, ensures that good isolation exists between parts of the system. This helps guarantee the safety of the equipment and avoids operator injury or death by electric shock. Higher test voltages are used, then normally applied to the power supply; this is to simulate transient voltages on the input line, caused by lightning storms or electrical switching equipment.

Common faults identified during this test are pinched cables, stray wire strands, loose metallic hardware and even wrong screw lengths.

This test voltage is usually applied between the power input connections, which the safety bodies refer to as the “primary” side, and earth ground and then again between primary and user accessible “secondary” circuits.

It is important to ensure to short the line and neutral terminals together during the test, and when making the primary to secondary test, connect the secondary side to chassis. If testing a power supply on the bench, short the output terminals together as shown below.

Failure to do this can result in damage to the power supply, as internal capacitance can cause high voltages to be present across the input or output terminals. In addition, the hi-pot voltage should always be applied slowly and discharged slowly.

A common question is “should the applied test voltage be AC or DC?” The majority of power supply manufacturers use a DC voltage because of the use of “Y” capacitors. Y capacitors are used to reduce electrical interference and are often connected between line and neutral to earth ground, or between input and output as shown in figure 2.

As can be seen, applying an AC hi-pot voltage test between the input and chassis would result in milliamps of current flowing through the capacitors. This could mask faulty insulation on the verge of breaking down.

The majority of safety standards like UL and CSA allow DC hi-pot test voltages. Instead of applying 1500VAC for example, one would use the peak voltage of the AC, \( \sqrt{2} \times 1500 = 2121 \text{VDC} \). Adding 10% to reduce the test time from 1 minute to 1 – 2 seconds is often allowed, but check with your safety representative first.

Using a calibrated hi-pot tester, with the appropriate operator safety guards, apply the DC voltage slowly to allow the internal capacitance to charge up without tripping the current limit of the test equipment. Remember to discharge the capacitors after the test before handling the equipment. Automated
test equipment is readily available for continuous production testing.

Insulation resistance testing from the power supply output to ground can be covered during the same test if a DC test voltage was used to perform the dielectric withstand test. Again ensure the output terminals are shorted during the test to avoid damaging the unit under test.

The output to ground isolation voltage often varies between power supply manufacturers, so check the datasheet before making the insulation resistance test. Typically a 500VDC voltage is used and the resistance specified is greater than 20MΩ. Ambient temperature and relative humidity is also usually specified. If an AC voltage was used for the dielectric withstand test, then another piece of test equipment, often referred to as a “Megger”, must be employed.

The last production test performed is the ground bond test, or earth continuity test. The purpose of this test is to ensure that in the event of an insulator failing, all accessible conductive parts of the equipment are securely connected to the earth terminal.

Specialized test equipment is required that can deliver a high current (25-30A) and measure the resistance to earth in milliohms. Common faults identified with this test are missing grounding straps, non-conductive plating or paint around the grounding points or loose hardware.

Where high voltage test equipment is present on the factory floor, ensure that adequate safety precautions are taken. This should include operator training, emergency shut-off switches and clearly readable “Danger” signs. Locate the test stations away from walkways or crowded areas.