In 2002, the IEEE/ANSI C37.90.1 and IEC 61000-4-18 standards were harmonized and the resulting differences are very small. For this paper we used text from the IEC standards to clarify the testing of surge protective devices (SPD). Other IEEE and IEC standards are referenced when relevant.

The testing of SPDs is not in the scope of IEC 61000-4-18: "Electromagnetic compatibility (EMC) - Part 4-18: Testing and measurement techniques - Damped oscillatory wave immunity test." This standard is intended to test the immunity against "damped oscillatory waves" of (more or less) complex electronic devices, and to test their operational behavior after being exposed to damped oscillatory waves. Preferably, devices under test shall not become conductive during the test and they shall be immune to the effects of damped oscillatory waves.

Testing in accordance to IEC 61000-4-18 is not intended to simulate the surges which SPDs are exposed to during their prospective lifetime. The relevant test standard for SPDs is IEC 61643-1: "Low-voltage surge protective devices – Part 1: Surge protective devices connected to low-voltage power systems – Requirements and tests." The test procedure, stipulated in IEC 61643-1, simulates the electrical stress that SPDs are exposed to during their prospective lifetime.

The voltages reached when testing in accordance to IEC 61000-4-18 can be higher than the maximum continuous operating voltage (MCOV) of an SPD. If the instantaneous voltage during testing is higher than the MCOV of the SPD, the device can become conductive and limit and/or deform the voltage-wave shapes produced during the IEC 61000-4-18 testing. If an electrical device is tested together with an SPD in accordance to IEC 61000-4-18, the testing is not suitable to prove that a certain electrical device without an SPD is capable to pass the testing in accordance to IEC 61000-4-18. To get a proper test result during the IEC 61000-4-18 testing, the testing has to be carried out without additional voltage-limiting components (SPDs) installed.

The IEEE C62.45 – 2002 standard describes surge testing methodology (impedance matching, current and voltage waveforms, etc.) to be used when testing equipment connected to low-voltage AC power circuits. The IEEE C62.45 – 2002 specification also describes scenarios that are not appropriate for inclusion of SPDs in the test circuit.

If an electrical installation with SPDs for a nominal voltage of 120 V AC is tested with an insulation tester (Megger®) and a test voltage is 500 V DC (or damped oscillatory waves), it can be expected that there will flow a leakage current through the SPD. This is not a fault condition; this is the intended behavior of an SPD. Leakage currents, caused by using improper testing methods, can heat up and even damage or destroy SPDs.

IEC 60364-5-53 also describes the proper procedure for the testing of the dielectric strength of power supply systems equipped with SPDs: "a surge protective device with a maximum continuous operating voltage (MCOV) lower than the test voltage of the insulation tester (or the voltage of damped oscillatory waves), shall be disconnected from the power supply system."

To achieve accurate measurement results during the measurement of the insulation resistance (or the testing with damped oscillatory waves) of electrical installations with SPDs, the surge device MUST be removed. IEC 60364-5-53, Chapter 534.2.7 Measurement of the insulation resistance states, "During the measurement of the insulation resistance of the installation according to IEC 60364-6-61, SPDs installed at
or near the origin of the installation or in a distribution board and not rated for the test voltage of the insulation measurement may be disconnected.”

The use of IEEE C62.45 – 2002 standard is also applicable for the testing of surge protected equipment. IEEE C62-45 – 2002 specification provides guidance on applying surge testing to AC power interfaces of equipment connected to low voltage AC power circuits that are subject to transient overvoltages.

**Summary**

IEEE/ANSI C37.90.1 and IEC 61000-4-18 are not applicable for installations with SPDs. The test results from testing electric and electronic devices together with SPDs does not provide any information about the immunity of electric and electronic devices during or after exposure to damped oscillatory waves.

The solution is to have the SPDs disconnected, in accordance to IEEE 62.45-2002 and IEC 60364-5-53, during testing with voltages higher than the maximum continuous operating voltage of the respective SPD.

Phoenix Contact’s surge protection products, such as PLUGTRAB and VALVETRAB are pluggable devices. The plugs can easily be removed, and thus be disconnected from the supply lines during the testing.