APPLICATION NOTE

Megger

Insulation Resistance Testing of Heat Trace Cable

Electric heat tracing systems are widely used in process industries and have applications in many other areas, as well. In general, these systems are used to maintain a preferred temperature. Applications include: keeping materials flowing at an ideal viscosity; preventing pipes from freezing, to help keep railroad tracks, roofs, gutters, antennas, etc. free from ice and snow; or to meet strict temperature variance requirements in food, pharmaceutical, and cosmetic processing industries, to name just a few.

Electric heat tracing systems commonly include electric heat tracing cable as one of their components. These cables come in a variety of forms including self-regulating, power-limiting, parallel constant watt, and series resistance. Most of these cables contain two conductors (bus wires) and a metallic braided shield. Typical damage to these cables includes nicks or cuts, which can lead to a shorted condition between the braid and heating cable core or between the braid and pipe.

Damage to these cables can result in failure of part or all of a heat tracing system. This damage can be caused by a number of issues including moisture ingress, over-bending of the cable, improper installation, etc. If the heat trace cable is not installed correctly or has incurred damage that allows water to contact the bus wires, this can result in sustained arcing, electric shock, or even fire.

Regular maintenance testing of heat trace cable is an important part of keeping electric heat tracing systems reliable and safe. One of the tests performed on these cables is insulation resistance.

IEEE 515 and IEC 60079-39 are two standards that provide “requirements for the testing, design, installation, and maintenance of electrical resistance trace heating”. Included in these standards are procedures for insulation resistance tests. In addition, there are insulation resistance test guidelines provided by a number of manufacturers of heat trace cable. These guidelines typically specify insulation resistance tests to be performed at 500 volts up to 2500 volts, with a minimum resistance value of 20 MΩ (megohms) up to 1 GΩ (gigaohm).

A number of manufacturers call for performing insulation resistance tests before installation of the cable, components, and thermal insulation – then again *after* installation of the thermal insulation, prior to the initial start-up (at commissioning), after any maintenance or repair work, during routine system inspection, and then regularly thereafter as part of a scheduled maintenance program.

Some manufacturers specify a minimum test voltage of 500 V and a test voltage of 2500 V for any polymer-insulated heating cables. At least one manufacturer recommends that the insulation resistance tests be done at three voltages: 500 V, 1000 V and 2500 V. The reasoning behind this is that potential issues may not be identified when testing at 500 V and 1000 V only.

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For routine insulation resistance tests, the test set is connected between the heating cable bus wires and the heating cable metallic braid, as shown in the below illustration.

Megger Model MIT525 Connected to Typical Heat Trace Cable with Two Conductors

Some manufacturers also recommend an additional insulation resistance test to be done between the braid and the metal pipe (in applications where the cable is installed on metal pipe).

Megger provides a number of insulation resistance tester models that are capable of testing heat trace cables. One popular model is the MIT2500. This is a hand held instrument with test voltages from 50 V to 2500 V. It is important to note that the MIT2500 has a capacitance limit of 15 nF when testing above 1000 volts. This is because the MIT2500 is designed to meet IEC 61010 safety standards.

IEC 61010-1 is a standard that specifies general safety requirements for electrical test and measurement equipment. This IEC standard requires sufficient creepage and clearance distances between the internal components, so that there is no internal arcing in the circuitry of the instrument caused by an influx of too much energy from an outside source - in this case, static voltage stored in the capacitance of the test item from the application of the test. The MIT2500 charges the capacitance during the test and then safely discharges it at the conclusion. Because of its convenient compact size, the MIT2500 has creepage and clearance distances that can only meet IEC 61010 below 15 nF of stored charge. The tester senses the potential for stored energy and disables testing above 1 kV so that the operator is kept safe from the possibility of arc flash or arc blast. Above 1 kV, the tester can output enough energy for the test item to store more static voltage than the tester can safely discharge within IEC61010 parameters. If the 15nF limit is exceeded, the MIT2500 will display a “High Cap” message and will not complete the test.

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In cases where the capacitance of the cable under test exceeds 15nF, the best option is to use either the Megger MIT515 or MIT525 model insulation resistance tester. These models have the same features except that the MIT515 has no memory functionality. These units have test voltage ranges from 100 V to 5000 V and have the ability to safely test heat trace cables that have a capacitance above 15nF.

Megger MIT2500

Megger MIT515

For more information regarding insulation resistance testing, please visit our website at https://us.megger.com/. On our website, you will find information on general insulation resistance testing, as well as additional application notes, technical papers, and product videos.

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