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Standard Guide for Testing Sheathed Thermocouples Prior to, During, and After Installation¹

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INTRODUCTION

Thermocouples are widely used in industry and provide reliable service when used within their specified temperature range. However, if thermocouples fail in service the consequences can range from negligible to life-threatening. Often, an expensive loss of equipment, product, or operating time will result. The user should weigh the potential consequences of thermocouple failure when considering what tests should be performed either prior to, during, or after installation.

This standard is a guide for the field testing of thermocouples to ensure that they were not damaged during storage, installation, or use rather than being a guide for acceptance testing of thermocouples as delivered from the vendor. The test methods range from the most basic tests to assure the thermocouple was properly installed to simple tests necessary for failure analysis. Thermocouple tests such as homogeneity, capacitance, and loop-current step-response require elaborate equipment and sophisticated analysis and are not included in this guide.

Faulty installation practices and in-service operation beyond prescribed limits are frequently the cause of failure in properly made sheathed thermocouples. Many of the most common forms of these conditions may be detected through use of the test methods described in this document. For further information, the reader is directed to MNL 12, Manual on the Use of Thermocouples in Temperature Measurement,² which is an excellent reference document on metal sheathed thermocouples.

The user should always remember that a voltage (not a temperature) is measured when a thermocouple is used. Any extraneous voltages that are introduced in the thermocouple circuit will be interpreted as a temperature, resulting in an error in the indicated temperature. Although the extension wires are not usually a part of the sheathed thermocouple, they are a portion of the measuring system and, if the extension wires are improperly installed with incorrectly matched material or polarity, the extension wires can produce voltages that will introduce substantial errors into the temperature measurements. When high accuracy measurements are made with calibrated thermocouples, it is especially important that the extension wires have thermoelectric properties closely matched to those of the thermocouple over the temperature range to which the extension wires are exposed.

1. Scope

1.1 This guide covers methods for users to test metal sheathed thermocouple assemblies, including the extension wires, just prior to, during, and after installation.

1.2 The tests are intended to ensure that the thermocouple assemblies have not been damaged during storage or installation, to ensure that the extension wires have been attached to connectors and terminals with the correct polarity, and to provide benchmark data for later reference when testing to

assess possible damage of the thermocouple assembly after operation. They are not, generally, applicable to thermocouples that have been exposed to temperatures higher than the recommended limits for the particular type.

1.3 The tests described herein include methods to measure the following variables of installed sheathed thermocouple assemblies and to provide benchmark data for determining if the thermocouple assembly is subsequently damaged in operation:

1.3.1 Loop Resistance:

1.3.1.1 Thermoelements,

1.3.1.2 Combined extension wires and the thermoelements,

1.3.2 Insulation Resistance:

1.3.2.1 Insulation, thermocouple assembly

1.3.2.2 Insulation, thermocouple assembly and extension wires.

¹ This guide is under the jurisdiction of ASTM Committee E-20 on Temperature Measurement and is the direct responsibility of Subcommittee E20.04 on Thermocouples.

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² Manual on the Use of Thermocouples in Temperature Measurement, MNL 12, ASTM. Available from ASTM Headquarters.