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An American National Standard

Specification for Calibration and Performance Testing of Secondary Current Sensing Coils and Weld Current Monitors used in Single-Phase AC Resistance Welding

American Welding Society

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Specification for Calibration and Performance Testing of Secondary Current Sensing Coils and Weld Current Monitors used in Single-Phase AC Resistance Welding

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Prepared by the
American Welding Society (AWS) A10 Committee on Instrumentation for Welding

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This specification sets forth accepted methods for testing and describing the performance of Rogowski-type air core current sensing coils (CSC) and weld current monitors (WCM) used in the measurement of single-phase ac resistance welding currents. A definition of terms relevant to this measurement is included. CSC and system tests and calibration methods are described in detail. Detailed information that shall be made available to the user are prescribed.

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1. Scope

This specification sets forth accepted methods for testing and reporting the performance characteristics of Rogowski-type air core Current Sensing Coils (CSCs) and the Weld Current Monitors (WCMs) used in the measurement of secondary current in single-phase ac resistance welding. CSCs mounted inside transformers are not included in this specification. Traceability of measurements to National Standards as required by this specification is discussed. References regarding traceability concepts and requirements are provided. Sources of measurement uncertainty, methods of combining these uncertainties, and the manner in which the overall uncertainty is to be stated are discussed.

This standard makes sole use of SI units.

Safety and health issues and concerns are beyond the scope of this standard and therefore are not addressed herein. Safety and health information is available from other sources, including, but not limited to, applicable federal and state regulations.

2. Testing

This clause describes the accepted methods that are needed to evaluate common sources of measurement uncertainty. Each test will include a description of the purpose for the test, list the equipment needed, describe the test setup and the test procedure.

2.1 Measurement Standards. The calibration shall be done using appropriate Measurement Standards. The Measurement Standard shall be more accurate than the device being calibrated. The uncertainty of the Measurement Standard used shall be included in the documentation of the calibration. Further, to ensure that adequate calibration is performed, the Measurement Standards must be traceable to NIST or other acceptable national metrology laboratory or nationally recognized standards. A more detailed explanation of traceability can be found in Annex F. Measurement Standards used must be calibrated and used in the range and type of currents in which they were intended to be used.

For example, to comply with this specification, it is not acceptable that a shunt calibrated by dc continuous current be used in a calibration of pulsed current at 20 kA. The shunt must be calibrated by ac methods at current levels for which the shunt will be used.

It is recommended that multiple sets of Measurement Standards with NIST or National Standards traceability be maintained by all calibrating organizations in order to periodically compare them against one another and assess any changes in the values of the standards.

2.2 Test Categories. There are no firmly established limits of uncertainties for the measurement applications of CSCs, or for the WCM-CSC combination. It is common to group the applications as shown below. The values of uncertainties may vary from one organization to the next, depending on their individual needs, capabilities, and economic considerations. Note that there may be overlap between the ranges of uncertainties. Uncertainties may be expressed as a percentage of full scale, or of reading.

(1) Laboratory Standards: uncertainty typically ±0.25% to ±1%,

(2) Working Standards: uncertainty typically ±1% to ±2%, and

(3) Production Instruments: uncertainty typically ±2% and greater.

Tests described in this specification are divided into three categories: “Type Tests,” “Routine Tests,” and “Optional Tests.”

(1) Type tests are carried out to characterize the product design and manufacturing process. It is also being done when uncertainty requirements are less demanding.

(2) Routine tests shall be done on every piece of hardware because test results depend on manufacturing differences from CSC to CSC. It is required when uncertainty requirements cannot be met with type tests alone.

(3) Optional tests are conducted when more rigorous estimates of the measurement uncertainties are required.

The categories are shown for 3 typical classes of instruments, namely instruments used as Laboratory Standards, Working Standards, and Production Instruments. Laboratory Standards are usually maintained at a company standards laboratory for the purpose of establishing a uniform and traceable basis of measurements. Working Standards typically are used to disseminate the calibration from the standards laboratory to the field, shop, or production areas of a company. Production instruments typically are the instrumentation in the field, shops, or production areas of a company.

Table 1 lists all the tests included in this specification and their categories. Under the Test Category columns, there may be a "double listing" of the test category, such as "Type/Routine" or "Type/Optional." In these instances, the test category may depend on the uncertainty that is trying to be achieved, or conversely, the uncertainty is acceptably large enough so as not to require the test. Furthermore, considerations have to be given to whether the CSC is being tested by the original manufacturer (in which case, Type Testing may be appropriate) or whether the CSC is being tested by a user

Table 1
CSC and WCM-CSC Combination Tests and Their Categories

Test No. (Clause No.)	Test	Test Categories			Comments
		Lab. Std.	Work Std.	Prod. Instr.	
1 (3.1)	Mutual inductance calibration at manufacturer recommended load	Routine	Routine	Type/ Routine	The most important characteristic of the CSC. It is used to describe the relationship between the CSC output voltage and the current it is being used to measure when connected to the WCM for which it was designed.
2 (3.1)	Mutual inductance calibration at no load	Routine	Optional	Optional	The results of this test help evaluate the CSC interchangeability since the manufacturer recommended load might differ from WCM to WCM.
3 (3.2)	Position sensitivity	Routine	Type/ Routine	Type	Often the single highest source of uncertainty in measurements made with Rogowski-type CSCs.
4 (3.3)	Tilt tests for position sensitivity	Routine	Type/ Routine	Type/ Optional	These additional tests are needed to provide a more rigorous estimate of the uncertainties due to position sensitivity.
5 (3.4)	Sensitivity to external magnetic fields	Optional	Type/ Optional	Type/ Optional	These additional tests are needed to provide a more rigorous estimate of the uncertainties due to position sensitivity. Particularly relevant when CSCs are placed in smaller secondary loops.
6 (3.5)	Temperature coefficient of a CSC	Routine	Type/ Routine	Type	It is important to know the temperature coefficient since CSCs are commonly used at temperatures different from where they are calibrated.
7 (3.6)	Frequency Response Testing of a CSC	Type/ Routine	Type	Type	Frequency response of CSC must be evaluated with respect to the spectrum of the current waveform being measured.
8 (4)	WCM-CSC combination calibration	Routine	Routine	Routine	Commonly performed, but the uncertainties and traceability aspects are usually not taken into account.