INTERNATIONAL STANDARD

ISO 17657-4

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Resistance welding — Welding current measurement for resistance welding —

Part 4: Calibration system

Soudage par résistance — Mesurage des courants en soudage par résistance —

Partie 4: Système d'étalonnage

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 17657-4 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 6, *Resistance welding*.

ISO 17657 consists of the following parts, under the general title *Resistance welding — Welding current measurement for resistance welding*:

— *Part 1: Guidelines for measurement*

— *Part 2: Welding current meter with current sensing coil*

— *Part 3: Current sensing coil*

— *Part 4: Calibration system*

— *Part 5: Verification of welding current measuring system*

Introduction

Requests for official interpretations of any aspect of this part of ISO 17657 should be directed to the Secretariat of ISO/TC 44/SC 6 via your national standards body. A complete listing of these bodies can be found at http://www.iso.org.

Resistance welding — Welding current measurement for resistance welding —

Part 4: Calibration system

1 Scope

This part of ISO 17657 specifies calibration systems and calibration procedures for welding current measuring systems, current sensors, welding current meters and monitoring devices with current sensor used for measuring welding current in resistance welding with alternating current of 50 Hz or 60 Hz, or with direct current.

The procedures are applicable for a current range between 0,5 kA and 25 kA.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 669, *Resistance welding — Resistance welding equipment — Mechanical and electrical requirements*

ISO 17657-2, *Resistance welding — Welding current measurement for resistance welding — Part 2: Welding current meter with current sensing coil*

ISO 17657-3:2005, *Resistance welding — Welding current measurement for resistance welding — Part 3: Current sensing coil*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 669 and the following apply.

3.1
test (current) sensor
current sensor to be calibrated

3.2
reference (current) sensor
current sensor calibrated in highly accurate condition, used for calibration of current sensors

3.3
test welding current meter
welding current meter to be calibrated

3.4
non-inductive shunt
high precision and low value resistance with a very low inductive component

3.5
analog-to-digital converter
ADC
device to convert analog input signals into digital signals

3.6
data acquisition device
instrument or device used to acquire analog data, which tracks changes in physical variables such as voltage, current and temperature

3.7
measuring accuracy of reference welding current measuring system
sum of measuring accuracy values of each component calibrated by a certified reference equipment (e.g. reference sensor, integrator, ADC etc.)

4 Construction of calibration system

4.1 Reference welding current measuring system

Components of a reference welding current measuring system shall be calibrated by certified reference equipment in accordance with Clause 6. The reference welding current measuring system consists of a calibrated current sensor, a data acquisition system and a display unit or a recorder.

4.2 Test set-up

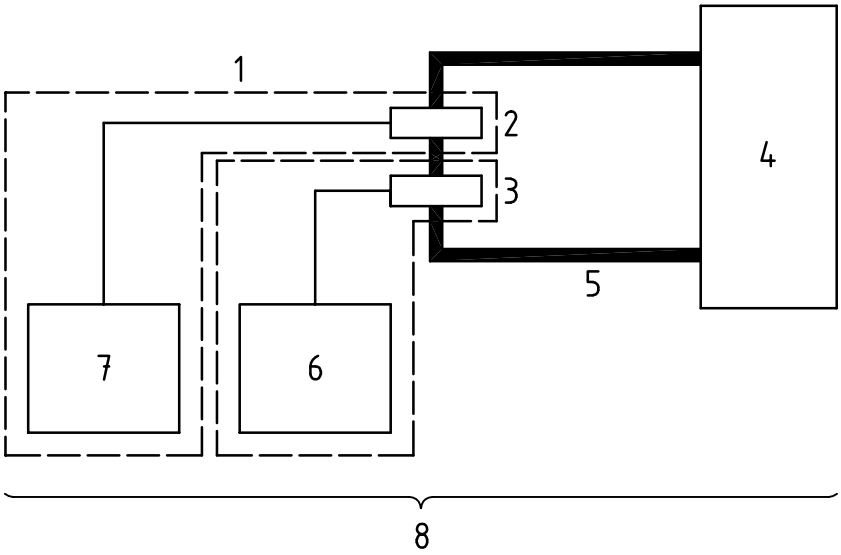
The test set-up consists of a test stage or an appropriate circuit for conducting high current, and a power source with a current control unit for supplying a test current.

All signal cables shall be twisted and shielded. The cable resistance shall be very small and negligible compared to the impedance of the current sensor. Typical examples of the test set-up are shown in Annex A.

NOTE A resistance welding machine/transformer can be used as a test set-up.

4.3 Basic feature for calibration of welding current measuring system

A welding current meter with a current sensor should be calibrated in a set consisting of the meter and the sensor. Calibration systems for a welding current meter with its sensor consist of a test set-up, a reference welding current measuring system and the welding current measuring system to be tested. The function of a reference welding current meter can be replaced with a calibrated data acquisition device. Figure 1 shows the basic features required for calibration of welding current measuring system.



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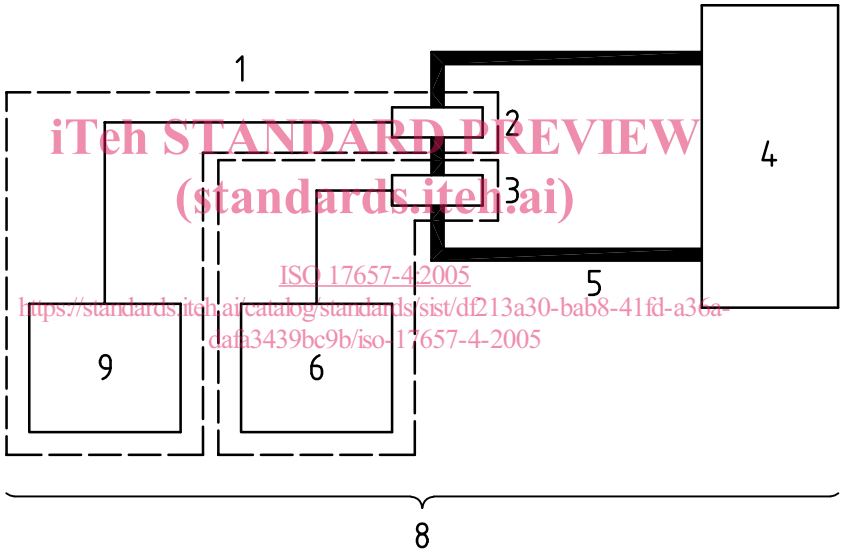


b)

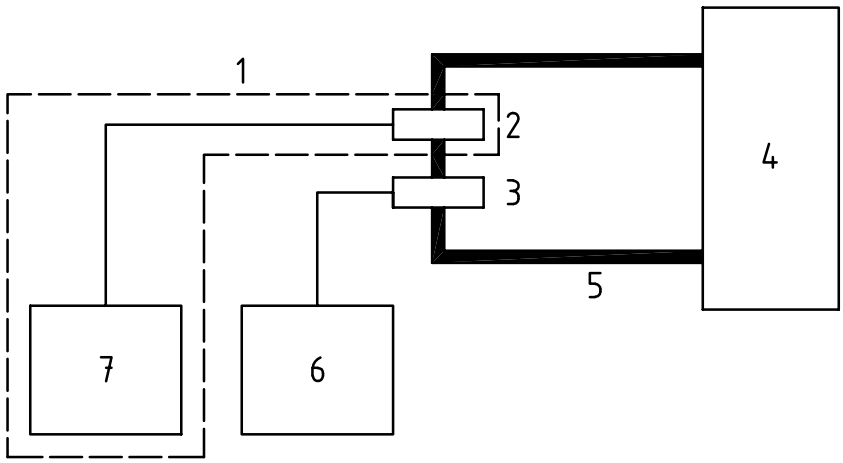
Key

1 reference welding current measuring system
2 reference sensor
3 test sensor
4 alternating current or direct current power source
5 secondary circuit
6 test welding current meter
7 reference welding current meter
8 test set-up
9 data acquisition device

Figure 1 — Basic feature for calibration of welding current measuring system

4.4 Basic feature for calibration of current sensor

A calibration system for a current sensor consists of a test set-up, a reference welding current measuring system and a calibrated data acquisition device connected to the current sensor to be tested. The function of the reference welding current meter can be replaced by using another channel of the data acquisition device. Figure 2 shows the basic feature required for the calibration of current sensor.



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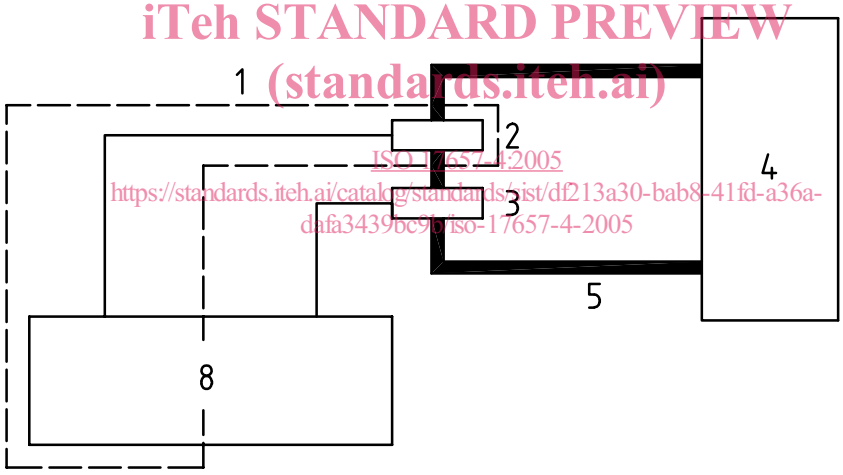


b)

Key

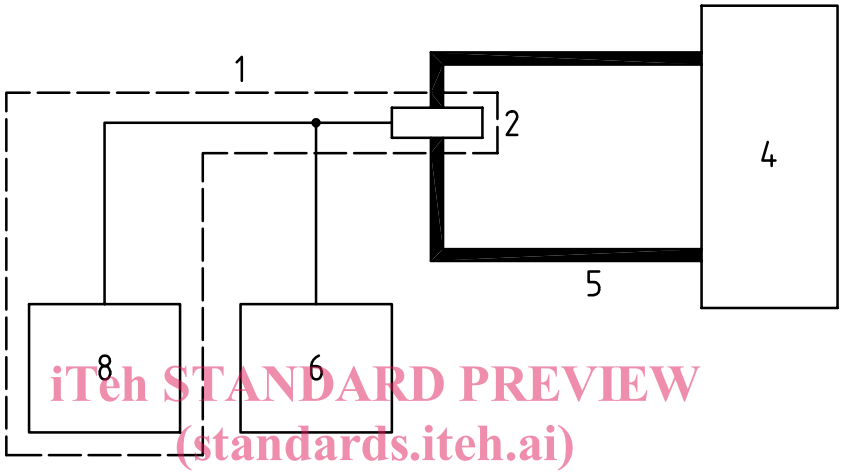
1 reference welding current measuring system
2 reference sensor
3 test sensor
4 alternating current power source
5 secondary circuit
6 data acquisition device
7 reference welding current meter
8 data acquisition device

Figure 2 — Basic feature for the calibration of current sensor

4.5 Basic feature for calibration of welding current meter without sensor

A calibration system for a welding current meter of the high-impedance integrator type without current sensor consists of a calibrated data acquisition device of the high-input-impedance integrator type, a calibrated reference sensor, and the test welding current meter. See Figure 3 a). The welding current meter to be tested is connected to the same output port of the reference current sensor. The data acquisition device shall not be replaced by a reference welding current meter of the low-impedance integrator type.

For calibration of a welding current meter with the low impedance integrator unit, and when two reference coils are used for the calibration, the calibration system shall consist of a calibrated reference welding current measuring system and a calibrated second reference sensor connected to the welding current meter to be tested. See Figure 3 b).



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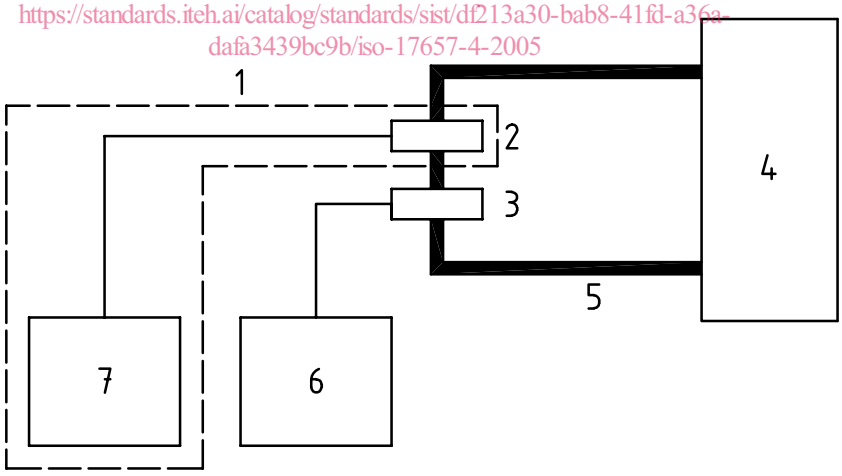

b)

Key

1 reference welding current measuring system
2 reference sensor
3 second reference sensor
4 alternating current or direct current power source
5 secondary circuit
6 test welding current meter
7 reference welding current meter
8 data acquisition device

Figure 3 — Basic feature for calibration of welding current meter without sensor

5 Physical environment and operating conditions

Unless otherwise specified, the calibration system shall be capable of operating under the following conditions without any adverse effect on its accuracy. Any deviation from these conditions shall be agreed upon between the test laboratory and the client.

— at an ambient air temperature between +5 °C and +40 °C;

— in relative humidity up to 95 %;

— at altitudes up to 1 000 m above mean sea level.

6 Calibration requirements

6.1 Reference welding current measuring system

Components of the reference welding current measuring system shall be calibrated by using certified reference equipment at least once a year. The total measuring accuracy is defined as the sum of measuring accuracy of each component of the reference welding current measuring system and shall be better than that stipulated for the highly accurate class stipulated in ISO 17657-2.

The specification, name of certifying test body and relevant data for the reference welding current measuring system, including the data acquisition device, and the reference current sensor shall be recorded on all documentation. See Annex B.

6.2 Reference current sensor

Properties of reference current sensor shall be measured accurately with no external influences (e.g. strong magnetic field caused by the high current) and calibrated by using certified reference equipment at a full wave alternating current of 50 Hz or 60 Hz, or direct current.

In the case of using a non-inductive shunt as the reference current sensor, the conversion coefficient shall be between 10 mV/kA and 150 mV/kA, and the error shall be less than ± 0,25 %. The phase shift between a measured welding current and the output voltage shall be less than 1° for a sinusoidal wave current of 10 kHz.

Measuring accuracy of the reference current sensor including positioning error shall be within ± 0,5 %, or the position should be fixed with pre-mounted current sensors on the current conductor to prevent any positioning error.

NOTE A current sensing coil used as a reference current sensor should be made with as low internal impedance as possible. Recommended specifications for a current sensing coil to be cased as a reference current sensor are shown below:

— toroidal coil with return winding known as a Rogowski-type coil;

— $L < 250$ µH;

— $r_i < 50$ Ω;

— K: measuring accuracy shall be within ± 0,25 %;

— $R_L = 1\ 000$ Ω (± 0,2 % and non-inductive type).

