INTERNATIONAL STANDARD

ISO 17657-1

First edition
2005-09-15

Resistance welding — Welding current measurement for resistance welding —

Part 1: Guidelines for measurement

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

Partie 1: Lignes directrices pour le mesurage

Reference number
ISO 17657-1:2005(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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 17657-1 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 1: Guidelines for measurement

1 Scope

This part of ISO 17657 specifies equipment for the calibration of measuring systems of welding current and indicating weld time in resistance welding using single-phase alternating current of frequency 50 Hz or 60 Hz, or direct current.

The guidelines define various basic terms for the measurement of welding current, and give some basic information for users of welding current measuring systems including welding current meters with current sensing coil.

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 17657-2:2005, *Resistance welding — Welding current measurement for resistance welding — Part 2: Welding current meter with current sensing coil*

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

ISO 17657-4, *Resistance welding — Welding current measurement for resistance welding — Part 4: Calibration system*

ISO 17657-5, *Resistance welding — Welding current measurement for resistance welding — Part 5: Verification of welding current measuring system*

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
technical operation that consists of the determination of one or more characteristics or performance of a given product or equipment according to a specified procedure

3.2
verification
confirmation by examination and provision of evidence that specified requirements have been met

3.3
calibration
set of operations that establish, under specified conditions, the relationship between values indicated by the measuring instrument or measuring system, and the corresponding values of a measuring instrument or measuring system with confirmed higher accuracy

3.4
welding current measuring system
〈resistance welding〉
measuring system that measures the welding current value and/or welding current waveform at the primary or secondary circuit of a welding transformer by using a sensing coil, non-inductive shunt or other suitable sensors

3.5
welding current meter
〈resistance welding〉
meter of portable type, or built into the weld controller for measuring short period current and which consists of at least a data capturing and calculating unit (e.g. integrator and accumulating unit) and a display unit

3.6
master welding current meter
welding current meter calibrated against a reference welding current meter

3.7
reference welding current meter
welding current meter which is sufficiently well-established to be used for the calibration of welding measuring systems or welding current meters

3.8
certified reference equipment
reference equipment which is certified by a technically valid procedure, accompanied by, or traceable to, a certificate or other documentation issued by a certifying body

3.9
current sensing coil (toroidal coil or **Rogowski coil)**
multi-wound coils, in which wire is wound around a non-magnetic core of constant cross section, for detecting the magnetic flux generated by current

3.10
weld time
time during which the welding current is applied, expressed as a number of cycles or a length of time in milliseconds

NOTE Annex A gives further information on the definition of weld time.

3.11
current flow time
duration defined from the start time of current conduction to the time when its current has decreased to a 10 % level of the measured welding current value, which is applied only to direct current for determination of minimum value of the hold time

NOTE 1 Annex A gives further information on the definition of current flow time.

NOTE 2 Current flow time is applicable only to direct current.

3.12
welding current
current value accumulated over the weld time and indicated by the r.m.s. value, which is applicable for alternating and direct current

NOTE 1 In the case of capacitor discharge current, the welding current can be indicated by the r.m.s. or the peak value.

NOTE 2 Annex A in ISO 17657-2:2005 gives further information on how to calculate the welding current values.

3.13
phase control
typical current control technique in resistance welding, e.g. by changing the firing angle in each half-weld cycle of alternating current

4 Welding current measuring system

4.1 General

Welding current measuring systems consist of a welding current meter, a current sensor (e.g. current sensing coil, non-inductive shunt, or any suitable sensors) and display.

4.2 Applicability

The welding current measuring system shall be selected based on a consideration of the following factors, in order to guarantee highly accurate measurement:

— type of current sensor (coil, shunt, other suitable sensors);

— type of welding current (alternating, direct or pulsed current);

— current level or current range;

— frequency of current or current waveform;

— location of current sensor (primary or secondary of circuit).

Welding current measuring systems are classified into two types. One is used for measurement of alternating current only, which does not apply correctly to measurements of direct current. The other is a multi-purpose type applicable for the measurement of all current types, including continuous direct and pulsed direct current in addition to alternating current.

4.3 Accuracy

The scatter in measured current value is caused by the following factors:

— manufacturing variations of current sensor and existence of distortion caused by incorrect use, or excessive repeat bending in fitting and detaching the coil;

— setting position of current sensor;

— magnetic noise affecting the connection parts of cables and connecting leads;

— temperature variations;

— design differences in the integrator/amplifier used to convert the output signal of the current sensor to a current waveform, and different calculation algorithms for welding current value in the data processing

unit, in particular different definitions of the start time and finish time for calculation of r.m.s. current values;

— variation of the input impedance and gain setting of the integrator if the combination of the current sensor and the integrator has been changed (when using a current sensing coil).

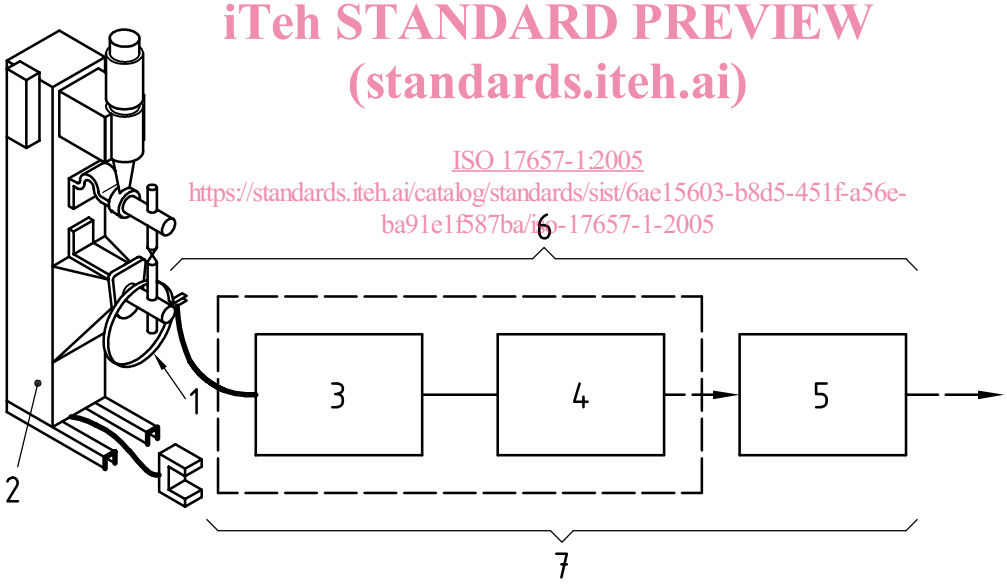
For high accurate measurements of welding current, i.e. less than ± 0,5 % error, the current sensing coil shall be located in the same position as that in which it was calibrated.

The welding current measuring system shall be calibrated as a set including the current sensor and integrator/amplifier in order to guarantee the accuracy. If calibration of the sensor alone is required, the input impedance of the calibration system shall be the same value as the input impedance of the welding current meter.

4.4 Welding current meter with current sensing coil

The welding current sensing system consists of at least a current sensing coil, an integrator, a data processing unit, and output devices for displaying or recording the welding current value and weld time. See Figure 1.

The current sensing coil is used for detecting the changing magnetic flux around the welding electrode or current conductor. The integrator converts a signal detected by the current sensing coil to the current waveform, and the data processing unit calculates the r.m.s. value of current over the weld time or for a fixed duration (see Annex A).



Key

1	current sensing coil	5	display unit, recorder, or control devices
2	resistance welding machine	6	welding current measuring system
3	integrator	7	welding current meter
4	data processing unit		

Figure 1 — An example of welding current meter with current sensing coil

5 Current sensors

5.1 Type of sensor

The following current sensors can be used in resistance welding:

— current sensing coil;

— non-inductive shunt;

— any other suitable sensors (e.g. hall devices).

The current sensing coils are predominantly used for current measurement, and classified into two main types, one is a flexible coil, the other is a rigid coil. The flexible coil type is usually used to measure the welding current set at the secondary circuit of a resistance welding machine. The rigid coil type can be mounted in any positions in the secondary or primary circuit, or built into the transformer.

5.2 Selection of current sensor

The following factors shall be checked when selecting the type of a current sensor to be used:

— sensitivity/conversion coefficient;

— maximum output voltage of the current sensor in the measuring range;

— frequency response;

— setting position error;

— temperature dependency of the sensitivity/conversion coefficient;

— current sensor output load required by manufacturer;

— influence of external magnetic flux on current sensing coil (especially affecting the connecting part and connecting lead);

— mechanical properties and design of winding, which closely related to the distortion of cross section, and any irregular winding of coil. The winding density can change as a consequence of repeat bending of the coil, e.g. when fitting and detaching a flexible current sensing coil.

Mechanical properties of current sensing coil specified in ISO 17657-3, in addition to electrical properties, shall be considered, if necessary, to guarantee the measuring accuracy.

5.3 Conversion coefficient

The conversion coefficient shall be described as the ratio of output voltage to the welding current. The scatter in conversion coefficient depends on the type, structure, temperature sensitivity, and physical/dimensional change of the sensor.

The conversion coefficient of a current sensing coil is dependent on the frequency of measured current (Annex C gives further information on the conversion coefficient of current sensing coil). The scatter in conversion coefficient when using a coil is caused mainly by the irregular winding, and detected as a positional error and/or distortion of the coil cross section during long term use.