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Resistance welding — Welding current measurement for resistance welding —

Part 1:
Guideline for measurement

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

Partie 1: Lignes directrices pour le mesurage

ICS 25.160.10

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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 3.

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 part of ISO 17657 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard 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: Guideline 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.*

Resistance welding — Welding current measurement for resistance welding —

Part 1:
Guideline for measurement

1 Scope

This International Standard specifies equipment for calibration of measuring systems of welding current and indicating weld time in resistance welding using single-phase ac of frequency of 50Hz or 60 Hz, or dc.

The guideline defines various basic terms for the measurement of welding current, and gives some basic information for users of welding current measuring systems including welding current meters with current sensing coil.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 17657. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 17657 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

ISO/DIS 17657-2:2001, *Resistance welding — Welding current measurement for resistance welding — Part 2: Welding current meter with current sensing coil.*

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

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

ISO/DIS 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 International Standard, the terms and definitions given in ISO 669 and the following apply:

3.1
test
a technical operation that consists of the determination of one or more characteristics or performance of a given product, 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
the set of operations which establish, under specified conditions, the relationship between values indicated by the measuring instrument or measuring system, and the corresponding known values of a calibrated measured instrument

3.4
welding current measuring system (for resistance welding)
a measuring system which 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 (for resistance welding)
a meter of portable type, or built into the weld controller for measuring short period current, which consists of at least data capturing and calculating unit (e.g. integrator and accumulating unit), and a display unit

3.6
master welding current meter
a welding current meter of the portable type calibrated against a reference welding current meter

3.7
reference welding current meter
a welding current meter, one or more properties of which are sufficiently well established to be used for calibration of welding measuring systems or welding current meters

3.8
certified reference equipment
a reference equipment, one or more of whose property values are certified by a technically valid procedure, accompanied by, or traceable to, a certificate or other documentation, which is issued by a certifying body

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

3.10
weld time
current flow time on a cycle basis or, the length indicated in the ms

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

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. In the case of pulsed current, e.g. a capacitor discharged current, the welding current is indicated by the peak value

NOTE Annex A in ISO/DIS 17657-2:2001 gives further information how to calculate the welding current values.

3.13
phase control
a 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, none-inductive shunt, or any suitable sensors), and display.

4.2 Applicability

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 (ac, dc or pulsed current);

— current level or current range;

— frequency of current or current waveform;

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

NOTE Welding current measuring system are classified into two types. One is used for measurement of alternating current only, which does not apply to measurements of dc or pulsed current correctly. The other is multi-purpose type being applicable for the measurement of all current types including dc and pulsed current in addition to the ac.

4.3 Accuracy

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

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

— setting position of current sensor;

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

— temperature variations during measurement;

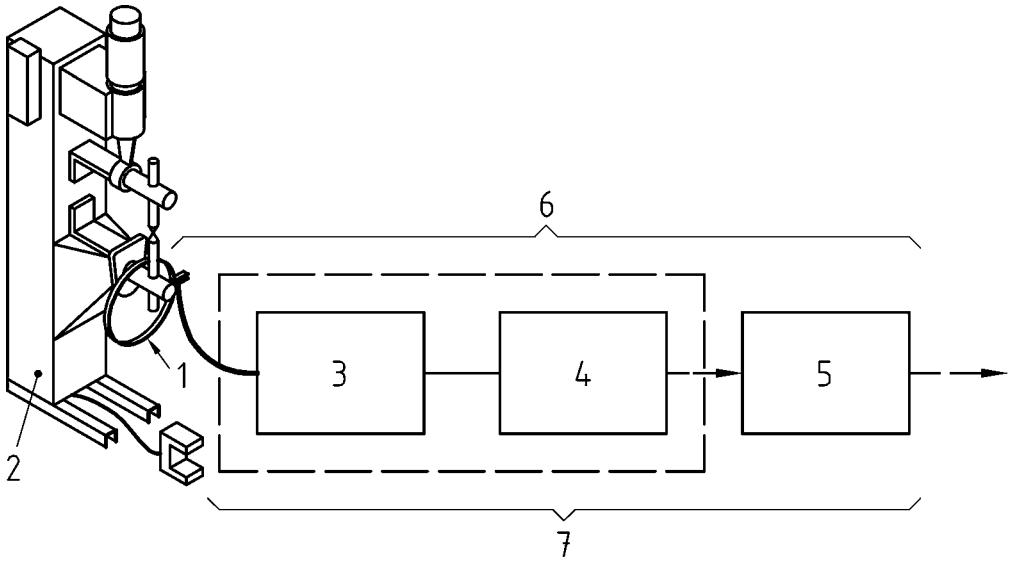
— design differences in the integrator/amplifier used to convert the output signal of the current sensor to a current waveform, and different calculation algorithm for welding current value in data the processing unit;

— variation of the input impedance and gain setting of the integrator if the combination of the current sensor, and the integrator was changed (in case of using 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 that it was calibrated.

NOTE If a current sensing coil is calibrated alone by using a calibration system, the input impedance of the integrator/amplifier mounted in the test measuring system should be checked because there are at least three types of integrator/amplifier (Annex B gives further information on the construction and input impedance of integrators). 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 a calibration of 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 should be set up to the same value as that of the calibration system.



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

4.4 Welding current meter with current sensing coil

The welding current measuring 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.

The current sensing coil is used for detecting the changing magnetic flux around the welding electrode or current conductor. The integrator converts 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.

5 Current sensors

5.1 Type of sensor

The following current sensor can be used in resistance welding:

— current sensing coil;

— none-inductive shunt;

— any other suitable sensors (for example, 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 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 conversion coefficient;

— output impedance of current sensor;

— influence of external magnetic flux (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.

NOTE Mechanical properties of current sensing coil are specified in ISO/DIS 17657-3 in addition to electrical properties shall be considered if it is necessary to guarantee the measuring accuracy. If a digital integrator or an analog integrator with a pre-amplifier is chosen, the maximum input voltage to the integrator should be designed below the supplying power voltage in order to prevent the wave distortion by the clipping phenomenon.

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.

6 Tests and calibration of the welding current measuring systems

The tests and calibration of new welding current measuring systems including welding current meters with current sensing coil etc., shall be achieved by the manufacturer using a reference welding current measuring system. Calibration of the devices or equipment after purchasing should be carried out in a laboratory of the manufacturer, the customer, or an approved test body by using a reference welding current measuring system.