DRAFT INTERNATIONAL STANDARD ISO/DIS 17657-3

ISO/TC **44**/SC **6** Secretariat: **DIN**

Voting begins on **2002-04-18** Voting terminates on **2002-09-18**

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

Resistance welding — Welding current measurement for resistance welding —

Part 3:
Current sensing coil

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

Partie 3: Tore de mesure de courant

ICS 25.160.10

To expedite distribution, this document is circulated as received from the committee secretariat. ISO Central Secretariat work of editing and text composition will be undertaken at publication stage.

Pour accélérer la distribution, le présent document est distribué tel qu'il est parvenu du secrétariat du comité. Le travail de rédaction et de composition de texte sera effectué au Secrétariat central de l'ISO au stade de publication.

Contents

Page

Foreword iv
1 Scope...5
2 Normative references 5
3 Terms and definitions..5
4 Physical environment and operating conditions..2
5 Classification of current sensing coils and designation of product 2
5.1 Class of current sensing coils..2
5.2 Standard values of the conversion coefficient 2
5.3 Designation of products...3
6 Requirements for current sensing coils 3
6.1 Current sensing coil and connecting lead 3
6.2 Conversion coefficient 3
6.3 Measuring accuracy...3
6.4 Mechanical strength 4
6.5 Setting position error...4
6.6 Influence of ambient temperature..4
6.7 Thermal property of cover materials..4
6.8 Test..4
6.8.1 Type test 4
6.8.2 Acceptance test..4
7 Test procedures..5
7.1 Conversion coefficient 5
7.2 Measuring accuracy..6
7.3 Mechanical tests 6
7.3.1 General...6
7.3.2 Tension test..6
7.3.3 Pressure test 7
7.3.4 Bending test 7
7.3.5 Repeat bending test..7
7.3.6 Crush test 8
7.4 Setting position error test 8
7.5 Thermal test..8
7.6 Contact test 8
8 Marking 8
Annex A (informative) Design of current sensing coils...10
A.1 Construction of current sensing coils...10
A.2 Adjustment of the conversion coefficient 11
Annex B (informative) Governing parameters of the conversion coefficient...12
Annex C (informative) Type of current sensing coils and their recommended specification range 13
Annex D (informative) Frequency response of current sensing coils 15

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 17657-3 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 3:
Current sensing coil

1 Scope

This International Standard specifies current sensing coils of the toroidal-coil type as a current sensor for welding current meters or a welding current measuring system used to monitor the welding current in resistance welding, and is applicable for both current types, i.e. ac of 50 Hz or 60 Hz and dc.

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 17657-1:2001, *Resistance welding — Welding current measurement for resistance welding — Part 1: Guideline for measurement.*

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

3 Terms and definitions

For the purposes of this part of ISO 17657, the terms and definitions given in ISO 669 and the following apply:

3.1
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

NOTE The coil is mounted around or encircles a conductor through which the current, to be measured, passes.

3.2
reference current sensing coil
a current sensing coil calibrated at a higher accuracy than the high accurate class defined in this standard

3.3
conversion coefficient
the ratio of output voltage from a current sensing coil against the welding current. The value is described with a unit [mV/kA]

NOTE The value is proportional to the frequency of the measured current, and is defined with a perfectly full wave current of 50 Hz as the test current.

3.4
frequency response
a feature indicating the influence of frequency of test current on the conversion coefficient and phase shift against the test current

NOTE When the current sensing coil connects to an integrator for converting to the welding current waveform, the maximum value of output voltage from the coil should be considered rather than the frequency response due to measurements without wave distortion.

3.5
accuracy
scatter and deviation of the conversion coefficient

NOTE The output load of the current sensing coil strongly influences the value of the conversion coefficient. If the output load and/or input impedance of an integrator changes, the conversion coefficient may deviate even though both devices have been separately calibrated at a high accurate class.

4 Physical environment and operating conditions

Unless otherwise specified, the current sensing coil shall be capable of operating under the following conditions:

— 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;

— where gas, fine dust, oil mist, spatters, etc. are included in the air such as those caused by ordinary arc or spot welding work.

When the operating conditions are out of those specified above, an agreement may be needed between the manufacturer and the purchaser.

5 Classification of current sensing coils and designation of product

5.1 Class of current sensing coils

The current sensing coils shall be classified depending on the construction, conversion coefficient, and measuring accuracy. Classifications by the accuracy are shown in table 1.

Table 1 — Classification of current sensing coils

Classification	Measuring accuracy	Explanation
High accurate class	± 0,5 % of full scale	Laboratory use
Accurate class	± 2,0 % of full scale	Routine use for high accurate systems
Ordinary class	± 5,0 % of full scale	Routine use for ordinary systems

5.2 Standard values of the conversion coefficient

Rated values of the standard conversion coefficient K shall be of 150 mV/kA, 220 mV/kA, and 1,5 V/kA for full wave alternating current of 50 Hz.

NOTE If a different test frequency is used for defining the conversion coefficient, the value can be converted by using equation (1) described in 7.1.

5.3 Designation of products

The following shall be indicated: design type as designated by type of construction, conversion coefficient, specified accuracy limit, and the coil size (length for flexible type, and inner diameter for rigid type). The designation of length is enable to be omitted if the value is not needed.

EXAMPLE 1 Flexible type of 800 mm length, conversion coefficient of 150 mV/kA in 50 Hz, and accurate class.

Flexible (800 mm) 150 mV/kA, 50Hz, class 2.0

EXAMPLE 2 Rigid type of 200 mm inner diameter, conversion coefficient of 180 mV/kA in 60 Hz, and high accurate class.

Rigid (200 mm) 180 mV/kA, 60Hz, class 0.5

6 Requirements for current sensing coils

6.1 Current sensing coil and connecting lead

The current sensing coil, connector, and connecting lead from the coil to the integrator/amplifier shall be designed such that the coil is sensitive only to magnetic flux generated by current flow through the conductor within the coil. Any external magnetic flux across the coil is not measured. The output of the coil is proportional to a derivative of the measured current waveform.

Both ends of the current sensing coil shall be closely fixed with metal fittings leaving very little, or no space between them when a flexible type or rigid hatched type is used as the coil. The connecting lead, and connector shall be protected from only magnetic flux, and low inductivity when applied the measurement of heat-controlled ac or medium frequency dc without wave distortion. In addition, a low inductive resistance shall be connected to the ends of the connecting lead as the output load R_L. The value should be constant between 200 Ω to 1 kΩ.

NOTE For new products, a low inductive resistance of 1 kΩ (± 0.2 %) is recommended as the output load of the current sensing coil in order to realize compatibility among products.

6.2 Conversion coefficient

The rated conversion coefficient of current sensing coils should be those described in 5.2. The values shall be checked, and adjusted according to the method described in 7.1 using full wave currents. The scatter of the conversion coefficient shall be checked using a reference current meter and data acquisition system, or a reference current sensing coil and a data acquisition system. The correction shall be performed by inserting a small resistance r_a in the end of coil or the end of connection lead as shown in figure A.1 of annex A. The coefficient value should not be adjusted by controlling the value of the output load R_L.

If the coils are checked with an alternating current of 60 Hz, the value shall be divided by 1,2 (= 60 / 50) to get the conversion coefficient in 50 Hz.

NOTE The input impedance of an integrator, connected to the current sensing coil, influences on the value of conversion coefficient. The output voltage should be measured with a high input impedance device larger than 1 MΩ as for the data acquisition system. If the input impedance of the integrator is smaller than 50 kΩ to 100 kΩ, which is shown in the annex B of ISO/DIS 17657-1:2001, a low inductive resistance of the same value should be connected to the input port. The conversion coefficient values for an alternating current of 60 Hz can be checked and adjusted although the value is indicated in 50 Hz. In the case of an alternating current of 60 Hz, the conversion coefficient marked on the coil is calculated according to the equation (1) described in 7.1.

6.3 Measuring accuracy

The measuring accuracy of current sensing coils shall be within those shown in table 1, and shall be checked according to the method described in 7.2 using full wave alternating currents of 50 Hz or 60 Hz.

NOTE Current sensing coils with a small deviation of less than 1 % can be manufactured, which meet the repeat bending requirements after 1 000 re-attachments, provided coil is set at positions ②, ⑥ or ⑧, or near the position illustrated in figure 1.

6.4 Mechanical strength

Mechanical tests shall be applied only to flexible coils. After using mechanical tests according to the methods described in 7.3.2 to 7.3.6 with full wave alternating currents at 50 Hz or 60 Hz, the measuring accuracy of the tested coil shall comply with those shown in table 1.

6.5 Setting position error

Scatters of the conversion coefficient for the test coil shall be checked according to the method described in 7.4 using full wave alternating currents of 50 Hz or 60 Hz. The scatters and/or deviation shall be within the measuring accuracy stipulated in table 1.

NOTE Current sensing coils with a setting position error less than ± 1 % can be manufactured except the metal connection part.

6.6 Influence of ambient temperature

The influence of ambient temperature on the current sensing coil shall be evaluated according to the method described in 7.5. The scatters and/or deviations of conversion coefficient shall be measured according to the method described in 7.2, and the values shall be within the measuring accuracy shown in table 1.

6.7 Thermal property of cover materials

The cover of current sensing coils shall not be damaged by contacting wire headed to a temperature higher than 60 °C. If the current sensing coil is mounted within a transformer, the cover shall withstand temperatures up to 100 °C.

6.8 Test

6.8.1 Type test

Some type tests shall be carried out on the same product according to clause 5:

1) Construction;
2) Conversion coefficient test;
3) Measuring accuracy test;
4) Mechanical tests;
5) Positioning test;
6) Thermal test;
7) Contact test.

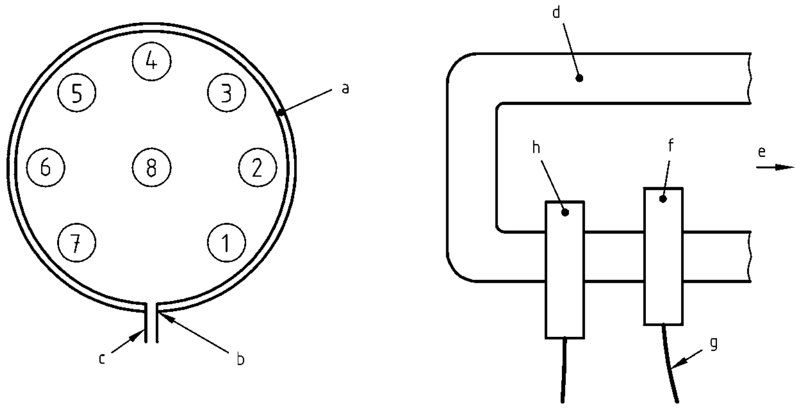
6.8.2 Acceptance test

1) Construction;
2) Conversion coefficient test.

7 Test procedures

7.1 Conversion coefficient

The conversion coefficient shall be measured with a reference welding current measuring system, or with a reference current sensing coil combined with a data acquisition system according to ISO/DIS 17657-4. The value shall be adjusted by an appropriate procedure.



Key

a	Test coil	e	To power source
b	Lead cable	f	Reference coil
c	Coupling metal of flexible coil – Output connector of rigid coil	g	To reference welding current meter
d	Conductor	h	Test coil
		1 to 8	Conductor positions

Figure 1 — Examples of the arrangement of a current sensing coil and their position numbers

The test should be carried out at position of ②, ④, ⑥, and ⑧ shown in figure1 with full wave alternating currents of 50 Hz or 60 Hz, and within the range 5 kA to 10 kA. Then the measured result shall be indicated by a value indicated in 50 Hz.

The reference welding current meter, reference current sensing coil, and a data acquisition system shall be calibrated at least every year according to ISO/DIS 17657-4.

If the current frequency used for the test differs from 50 Hz, the value shall be converted using the following equation (1). For example, when the coefficient is defined with a current of 60 Hz, the standard value should be converted to a value described in 60 Hz by the equation (1), then adjusted. The detail regarding the converting is explained in annex B.

$$K_t = K_m \times \frac{f_t}{f_m} \tag{1}$$