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# Resistance welding — Welding current measurement for resistance welding —

# Part 2:
## Welding current meter with sensing coil

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

*Partie 2: Ampèremètre avec tore de mesure de courant*



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 17657-2 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 2:
Welding current meter with sensing coil

## 1 Scope

This International Standard specifies a welding current meter with a current sensing coil to measure the weld time and the effective value or peak one of the welding current during a certain interval in single phase ac of frequency of 50 Hz or 60 Hz, or dc.

This standard is applicable for a welding current measuring system with a display or output port calibrated, which may be connected into a welding controller. When the welding current meter is used for measuring pulsed currents as capacitor discharge current, an agreement concerning additional specifications may be needed between the manufacturer and the purchaser.



## 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 17657-3:2001, *Resistance Welding — Welding current measurement for resistance welding — Part 3: Current sensing coil*.

## 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**
**indicated measuring time**
The measuring duration of welding current flow to be indicated

NOTE Normally the start and finish times for measuring current flow is automatically set. If the start time is set at zero or at a value greater than zero, and the finish time is set at a smaller value than the weld time as shown in figure A.1 of annex A, then the welding current is calculated for the measuring duration between the start time and the finish time.

**3.2**
**maximum measuring time**
Maximum value of the measuring time can be set as the finish time of measurement, see figure A.1 of annex A

**3.3**
**minimum measuring time**
Minimum value of the measuring time, can be set as the start time, see figure A.1 of annex A

**3.4**
**initial cut-off time**
The time due to omit a transient effect to measure steady current value

NOTE This effect should eliminate by setting the start value of the indicated measuring time to a positive value. The initial up-slope condition is caused switching transient phenomena, or up-slope control of the welding current etc..

**3.5**
**automatic zero level correction**
A device which allows to remove the effect of zero drift of output when direct welding current measurement is incorporated

**3.6**
**drift**
The amount of shift in the zero position

NOTE This phenomenon can occur in both analog and digital devices, but can be avoided by careful design of the appropriate circuitry.

**3.7**
**measuring accuracy**
A scatter limit of indicated or output values allowable, which is indicated against the full scale value



## 4 Physical environment and operating conditions



Unless otherwise specified, the welding current meter shall be capable of operating under the following conditions without any adverse effect on its accuracy:

— 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 deviate from those specified above, an agreement shall be needed between the manufacturer and the purchaser.

## 5 Classification of welding current meters and designation of product

### 5.1 Class of welding current meters

Welding current meters are classified as in table 1 depending on the measuring accuracy.

**Table 1 — Classification of welding current meters by the measuring accuracy**

| 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 system |
| Ordinary class | ± 5,0 % of full scale | Routine use for ordinary system |

### 5.2 Designation of product

The following shall be indicated:

— current type which can be measures i.e. ac and/or dc;

— maximum current measurable;

— and specified accuracy.

EXAMPLE 1 Only single-phase ac measurable, ordinary class, and maximum measuring current value of 15 kA:

**15 kA ac class 5.0**.

EXAMPLE 2 Single phase ac and dc current measurable, accurate class, and maximum measuring current value of 20 kA:

**20 kA ac/dc class 2.0**.



## 6 Requirements for welding current meter with current sensing coil



### 6.1 Welding current meter

The welding current meter shall consist of a data processing unit, and a display of the welding current and weld time. The welding current shall be indicated at least the true R.M.S. (root-mean-square) value. The weld time should be counted on a cycle basis or the length indicated in ms. An example of the construction is illustrated in annex B.

The scatter shall be checked against the rated values of test welding current meter, or its output value from the meter when the output is compared to some measuring results obtained from a reference welding current measuring system.

### 6.2 Current sensing coil

The current sensing coil shall conform to requirements described in ISO/DIS 17657-3. The conversion coefficient, and the value of resistance mounted at the output lead of the sensing coil should coincide with requirements of the integrator of the welding current meter.

Both ends of the current sensing coil should be closely fixed by means of two metal fittings leaving very little, or no space between them when a flexible type is used as the current sensing coil.

The connecting lead shall be protected from any magnetic field, and be low inductance.

## 6.3 Welding current measuring system

The error of welding current measuring system should be adjusted together as a set of the welding current meter and its current sensing coil. If it is necessary to change the current sensing coil, the welding current measuring system shall be calibrated with a reference welding current measuring system.

The error of welding current measuring system shall be calculated with the sum of both error values of the welding current meter and its current sensing coil, or determined by measurements for a welding current meter with its current sensing coil.

The maximum error of welding current measuring systems within the measuring range shall be with in the measuring accuracy stipulated in table 2 corresponding to required class.

**Table 2 — Requirements for measuring accuracy of welding current measuring system**

| Classification | Measuring accuracy | Explanation |
|---|---|---|
| High accurate class | ± 1,0 % of full scale | Laboratory use |
| Accurate class | ± 4,0 % of full scale | Routine use for high accurate system |
| Ordinary class | ± 10,0 % of full scale | Routine use for ordinary system |

## 6.4 Integrator



The integrator for processing the output signal from the current sensing coil shall be designed to allow the measurement of at least full wave ac and heat-controlled ac. The output signal should not be clipped or distorted by the supply voltage to the integrator.



NOTE When the welding current meter is applied for measuring the medium frequency ac or medium frequency dc, an agreement may be needed between the manufacturer and the purchaser.

## 6.5 Data processing unit

The data processing unit consists of at least analog-digital converter, memories, and CPU. The values shall be kept until the next measurement by the memory.

The computing algorithm shall be designed to obtain true R.M.S. value of the welding current.

Annexes attached in this standard and ISO/DIS 17657-1 shall be referred to calculate the welding current value for the weld time and for an indicated measuring time.

## 6.6 Display unit and output ports

The welding current meter should be built up with a display device of pointer type, digital display one, or print-out one indicating the measured welding current and weld time defined in ISO/DIS 17657-1, and show the welding current value for an indicated measuring time. The indicated measuring time and initial cut-off time should be controlled with some buttons or switches. The current flow time shall be automatically determined in the case of direct current measurements.

The time unit for input of all time values in alternating current mode shall be controlled in half cycle or one cycle unit of the frequency of power source. In direct current mode, however, a millisecond unit may be used in addition to, or as an alternative to cycles.

Welding current meter may have some output ports for welding current waveform as an analog output signal, and the values of welding current and weld time etc. as digital signals.

### 6.7 Minimum and maximum duration of welding current

Measuring duration of welding current shall be determined based on the start and finish times of measurement as illustrated in annex A.

The start and finish times for direct welding current shall comply with the principle of figure A.1 of this standard and annex A in ISO/DIS 17657-1:2001.

### 6.8 Maximum measuring current

Measuring accuracy for the maximum measuring current indicated on the nameplate shall comply with those shown in table 1 provided it is measured according to the method described in 7.1 using full wave current.

### 6.9 Minimum measuring current

Measuring accuracy for 30 % (± 5 %) current of the maximum measuring current indicated on the nameplate shall comply with those shown in table 1 provided it is measured according to the method described in 7.2 using full wave current.

### 6.10 Phase-controlled current

A measuring accuracy for a phase-controlled alternating current of 60° (± 10°) firing angle shall comply with those shown in table 1 according to the method outlined in 7.3 in a welding current value of each full scale of the welding current meter.



NOTE This requirement may be amended if there is an agreement between the manufacturer and the purchaser.



### 6.11 Minimum time for current measurement



A measuring accuracy of the welding current meter shall comply with those shown in table 1 provided the welding current is measured in the minimum measuring time indicated on the nameplate according to the method described in 7.4.

### 6.12 Fluctuation of supply voltage

If the fluctuation in supply voltage to the welding current meter is up to ±10 %, or battery voltage is within an allowable value, measuring accuracy of the welding current values shall comply with those shown in table 1 when measurements are made using the method described in 7.5. Furthermore, a device shall be used to indicate any voltage drop in the power supply below the allowable value of the welding current meter should be capable of indication when to use a battery.

### 6.13 Mechanical strength of current sensing coil

If the current sensing coil is subjected to a mechanical test as described in ISO/DIS 17657-3, then after the test, the measuring accuracy shall comply with those stipulated in table 1.

### 6.14 Setting position error of current sensing coil

Measuring accuracy shall be checked with the test procedure described in 7.4 in ISO/DIS 17657-3:2001, and the deviation shall be recorded. The maximum measuring accuracy value shall comply with those shown in table 1.

### 6.15 Influence of ambient temperature

If the welding current meter is subjected to a temperature test as described in 7.6, then the measuring accuracy for the maximum measuring current of the welding current meter indicated on the nameplate shall comply with those