INTERNATIONAL STANDARD

**ISO 22829**

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# Resistance welding equipment — Transformers — Integrated transformer-rectifier units for welding guns operating at 1 000 Hz

*Équipement de soudage par résistance — Transformateurs — Transformateurs-redresseurs pour pinces de soudage à transformateur incorporé alimentés sous une fréquence de 1000 Hz*



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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 6, *Resistance welding and allied mechanical joining*.

This second edition cancels and replaces the first edition (ISO 22829:2007), which has been technically revised.

Requests for official interpretations of any aspect of this document 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 www.iso.org.



# Resistance welding equipment — Transformers — Integrated transformer-rectifier units for welding guns operating at 1 000 Hz

## 1 Scope

This document specifies additional requirements to those given in ISO 5826 for single-phase inverter transformers with connected rectifier for DC welding. This document applies to transformers, primarily used in welding guns, operating at 1 000 Hz with a rated input voltage of 500 V or more.

The requirements of ISO 5826 shall be followed unless amended by this document.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 5826, *Resistance welding equipment — Transformers — General specifications applicable to all transformers*

ISO 17677-1, *Resistance welding — Vocabulary — Part 1: Spot, projection and seam welding*

IEC 60417:2002, *Graphical symbols for use on equipment*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 669, ISO 5826 and ISO 17677-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

**3.1**
**output DC current**
$I_{2d}$
root-mean-square (RMS) value of the direct current at the output terminals of the transformer-rectifier unit

**3.2**
**on time**
$t_s$
time during which the current is applied

## 4 Power supply to the transformer-rectifier unit

The rated voltage supply shall be delivered by an inverter. This inverter shall deliver the rated voltage at a frequency of 1 000 Hz in a waveform to suit the transformer-rectifier unit characteristics.

## 5 Transformer types

The minimum principal electrical characteristics of a transformer-rectifier unit shall conform to Table 1.

**Table 1 — Electrical characteristics**

| Type | Nominal value of the DC no load voltage<br>$U_{2d}$<br>V | Minimum rated permanent apparent input power<br>$S_{1p}$<br>kVA | Minimum permanent output current<br>$I_{2p}$<br>kA | Minimum output current on load condition<br>$I_{2R}$[a]<br>kA |
|---|---|---|---|---|
| H1 | 6,3 | 36,0 | 5,0 | 11 |
| H2 | 8,4 | 45,0 | 5,0 | 14 |
| J1 | 6,3 | 45,0 | 6,3 | 18 |
| J2 | 10,0 | 68,0 | 6,3 | 28 |
| J3 | 9,3 | 63,0 | 6,3 | 25 |
| J4 | 12,5 | 83,0 | 6,3 | 32 |
| N1 | 10,4 | 64,0 | 5,7 | 20 |
| P1 | 12,2 | 75,0 | 5,7 | 27 |
| S1 | 8,2 | 71,0 | 6,3 | 25 |

[a] $R$ = 200 µΩ ± 5 % = load resistance.

NOTE Indicated values are RMS values and are given for a cooling liquid flow rate of 6 l/min for types J1, J2, H, N and P, and of 8 l/min for types J3, J4 and S, with a maximum temperature of the cooling liquid at transformer input of 30 °C.

The manufacturer of transformer-rectifier units shall provide a set of curves showing the maximum output current relative to duty factor and welding time at the rated supply voltage. An example of a set of curves is given in Annex A.

## 6 Dimensions

The dimensions of the transformer-rectifier unit shall be as given in Table 2 and as illustrated in Annex B.

**Table 2 — Transformer-rectifier unit dimensions**

Dimensions in millimetres

| Type | Maximum length<br>$L_1$ | Length between mounting holes<br>$L_2$ | Overall width | Overall height | Output terminals dimensions |
|---|---|---|---|---|---|
| H1 | 270 | 170 | 106 | 150 | 32 × 32 |
| H2 | 270 | 170 | 106 | 150 | 32 × 32 |
| J1 | 300 | 190 | 125 | 160 | 32 × 32 |
| J2 | 300 | 190 | 125 | 160 | 32 × 32 |
| J3 | 300 | 190 | 125 | 160 | 40 × 50 |
| J4 | 360 | 250 | 125 | 160 | 40 × 50 |
| N1 | 400 | 115 | 130 | 190 | 45 × 50 |
| P1 | 400 | 128 | 125 | 200 | 50 × 50 |
| S1 | 370 | 279 | 127 | 171 | 51 × 67 |

# 7 Additional equipment

## 7.1 Grounding provision

The transformer shall be provided with a ground terminal that is connected to its case. The mid-point of the secondary winding shall be connected to the ground terminal by a removable link.

## 7.2 Thermal protection

The rectifier and the primary and secondary windings of the transformer shall be equipped with thermoswitches. The position of the wiring shall be according to Figure B.1 to Figure B.6.

The wiring colour shall be as follows:

— thermoswitch on primary winding: light blue;

— thermoswitch on secondary winding: black;

— thermoswitch on rectifier: yellow.

NOTE Additional requirements are given in ISO 5826.

## 7.3 Output current sensing coil

If the transformer-rectifier unit is equipped with an output current sensing coil, it shall comply with ISO 5826.

## 7.4 Output voltage sensing wires

If the transformer-rectifier unit is equipped with output voltage sensing wires, red and dark blue colour coding shall be used for the wiring. The red wire shall be connected to the "+" output terminal and the dark blue wire to the "–" output terminal.

The wiring shall be protected from short-circuit currents by suitable means, e.g. by fuses, resistors or positive temperature coefficient thermistors.

If a resistor or a positive temperature coefficient thermistor is used, a value of 100 Ω is recommended.

# 8 Protection of the rectifier

The rectifier should be protected against the accumulation of welding spatter and other contamination.

# 9 Marking

## 9.1 Primary

Identification of the voltage and ground connections shall be clearly marked: U, V and the symbol ⏚ in accordance with IEC 60417:2002.

The connection to the mid-point of the transformer shall be marked with "MP".

## 9.2 Output terminals

The polarity of the output terminals shall be marked on the transformer and on the technical documentation with the symbols "+" and "–" in accordance with Figure B.1 to Figure B.6.

### 9.3 Rating plate

The rating plate shall conform with ISO 5826 except that box 4 shall reference this document and year of publication, i.e. ISO 22829:2017.

## 10 Designation

The designation shall comprise the following information in the order given:

a) a reference to this document, i.e. ISO 22829:2017;

b) type of transformer-rectifier unit (e.g. “H1”);

c) DC no load voltage, $U_{2d}$;

d) minimum permanent output current, $I_{2p}$ (see Table 1);

e) rated supply voltage, $U_{1N}$, and frequency;

f) T, indicating presence of thermoswitches;

g) M, indicating presence of current sensing coil;

h) U, indicating presence of voltage sensing wires.

EXAMPLE **ISO 22829 — H1 — 6,3 — 5,4— 500/1000 — TMU**

## 11 Test conditions

### 11.1 Type tests

The following type tests shall be carried out, in the following order, in accordance with the procedures in ISO 5826, except where amended by this document:

a) general visual examination (preliminary);

b) insulation test (preliminary test);

c) DC no load voltage, $U_{2d}$, open-circuit input current, $I_{10}$;

d) minimum output current under load condition;

e) temperature-rise test;

f) dynamic behaviour;

g) calibration of the current sensing coil, if appropriate;

h) insulation test;

i) mechanical strength;

j) dielectric test of the transformer-rectifier unit;

k) cooling circuit;

l) general visual examination (final).

The bandwidth of the reference measuring current and voltage systems shall be at least 100 kHz (–3 dB) and the accuracy class rating shall be 0,5 % of the upper limit of the full scale.

For temperature meters, the accuracy class rating shall be 0,5 % of the full scale.



## 11.2 Routine tests

The routine tests shall comprise only a reduced set of tests:

— general visual examination;

— dielectric tests;

— DC no load voltage, $U_{2d}$;

— cooling circuit.

## 11.3 Test procedures

### 11.3.1 General visual examination

Visual examination shall be undertaken to assess visible imperfections. The visual examination performed at the end of the type test procedure shall include the measurement of the dimensions of the transformer-rectifier unit. The dimensions measured shall be reported.

### 11.3.2 Open-circuit tests

Testing shall be carried out in accordance with ISO 5826.

At the rated supply voltage, $U_{1N}$, the open-circuit input current, $I_{10}$, shall meet the following condition [see Formula (1)]:

$$I_{10} \leq \frac{0{,}04 \times S_{1p}}{U_{1N}} \tag{1}$$

### 11.3.3 Minimum output current under load condition

Test shall be performed according to ISO 5826 with a nominal load resistance value of 200 μΩ.

The output current, $I_{2R}$, shall not be less than the values listed in Table 1.

### 11.3.4 Cooling circuit test

The cooling liquid pressure drop shall not exceed 100 kPa (1 bar) for types J1, J2, H, N and P, and 160 kPa (1,6 bar) for types J3, J4 and S, when supplied at the nominal flow rate, $Q$.

NOTE 1 bar = $10^5$ N/m$^2$ = 100 kPa.

The cooling liquid circuit shall be tight at a pressure of 1 000 kPa (10 bar) for 10 min for the type test. This test is not performed during the routine test.

Compliance is checked by leak-tightness and flow check.

### 11.3.5 Dynamic behaviour of the output terminals

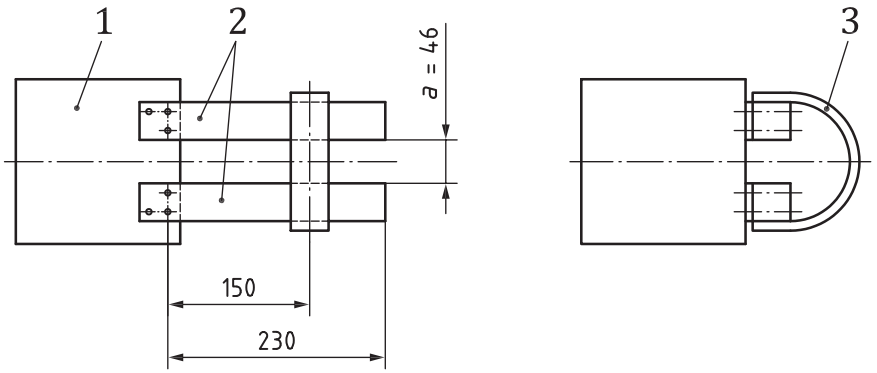
The transformer-rectifier shall withstand the dynamic loads produced by a repetitive flow of welding or test current no less than three times the secondary permanent output current, $I_{2p}$, in the test configuration shown in Figure 1.

The duty cycle shall be 1 % and the weld time shall be 60 ms.

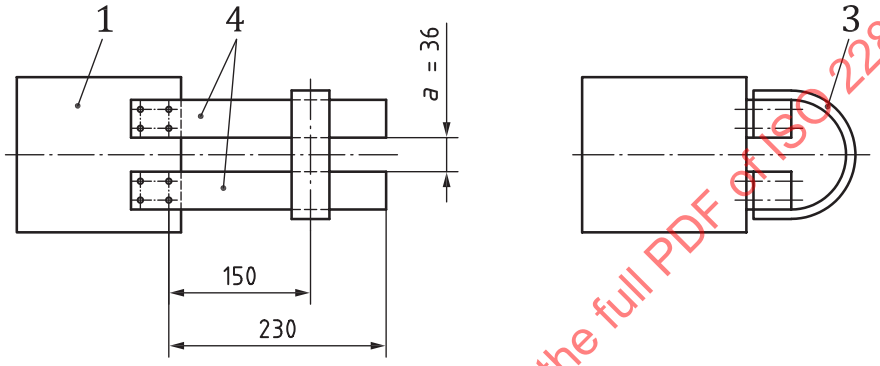
The number of cycles shall be 2 500.

The dimension, $a$, shall be measured before and after the test has been performed. The deformation of the output terminals shall not cause the dimension, $a$, to change by more than 20 %.

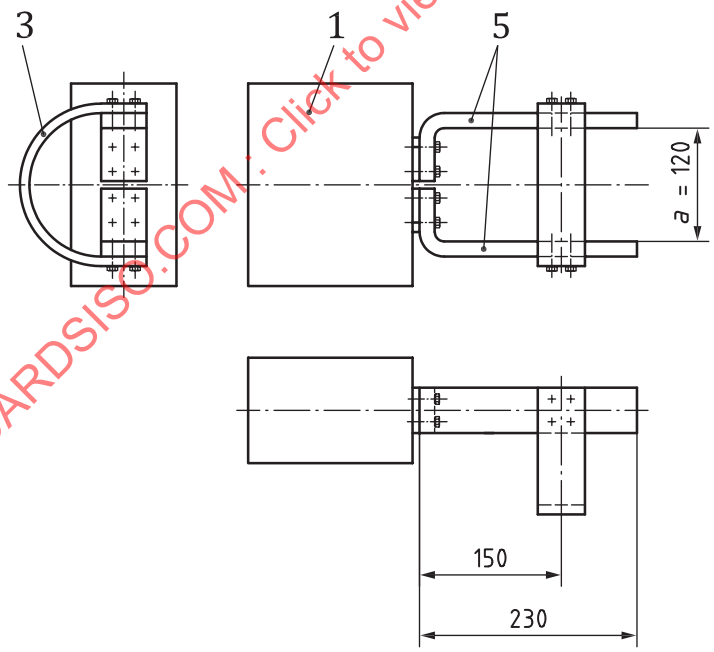
Dimensions in millimetres



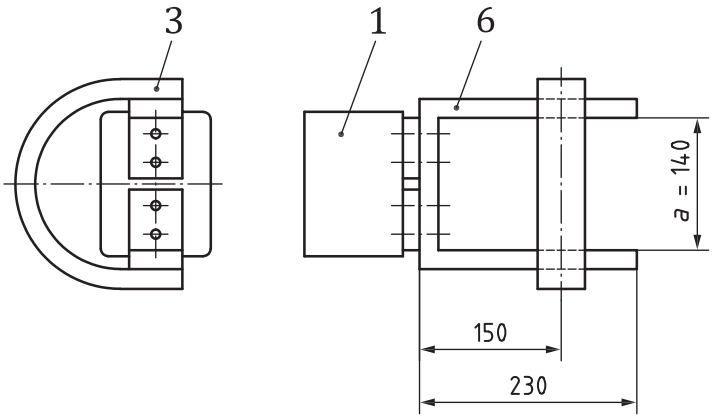

**a) Types J1, J2 and H**




**b) Types J3 and J4**




**c) Types N and P**




**d) Type S**

**Key**

1 transformer
2 copper bars 30 mm × 30 mm
3 flexible shunt
4 copper bars 40 mm × 40 mm
5 copper bars 20 mm × 50 mm
6 copper bars 25 mm × 60 mm

**Figure 1 — Dynamic type test set up**

### 11.3.6 Mechanical strength

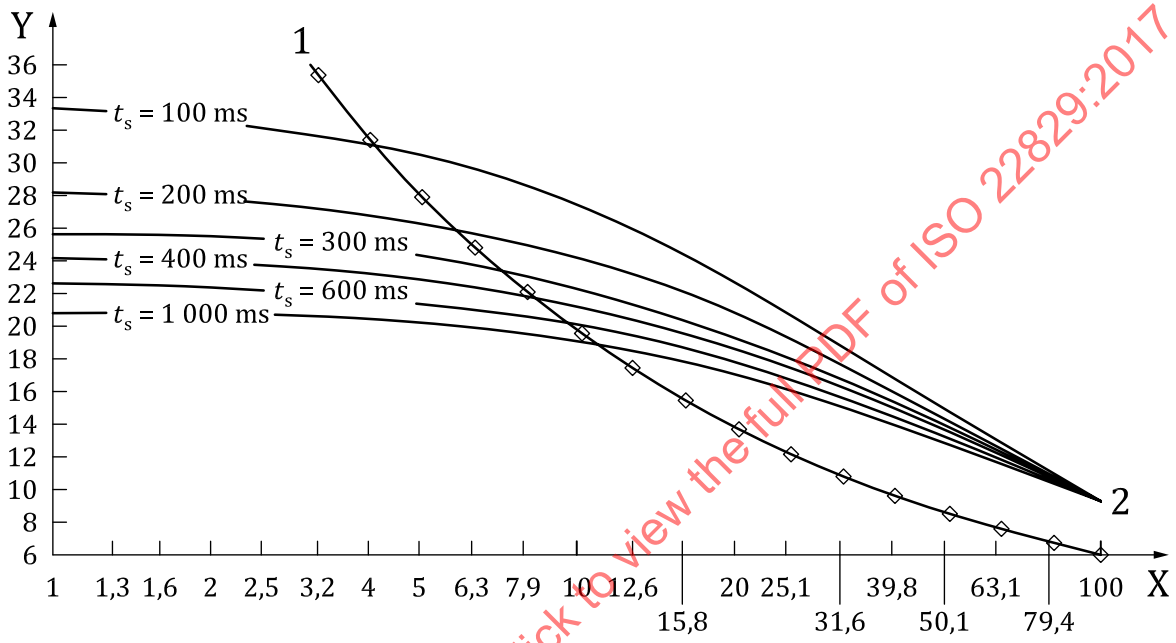
The transformer shall be solidly secured on two plates through the four M8 or M10 mounting holes of two opposite sides. A tensile load of 10 kN shall be progressively applied on both sides, such that the maximum loading is reached after 1 min and maintained for an additional 1 min. The test shall be repeated on the other two sides.

After testing, the transformer shall exhibit no permanent deformation or visible damage.

# Annex A
(informative)

# Relationship between output current and duty factor

Figure A.1 shows an example of a set of curves showing the output direct current, $I_{2d}$, from a transformer-rectifier unit relative to its duty factor for 10 000 000 cycles.




Water flow rate in the transformer: 6 l/min

Input water temperature: 30 °C

Permanent output current, $I_p$: 6,3 kA

Supply voltage: $U_{1N}$

**Key**

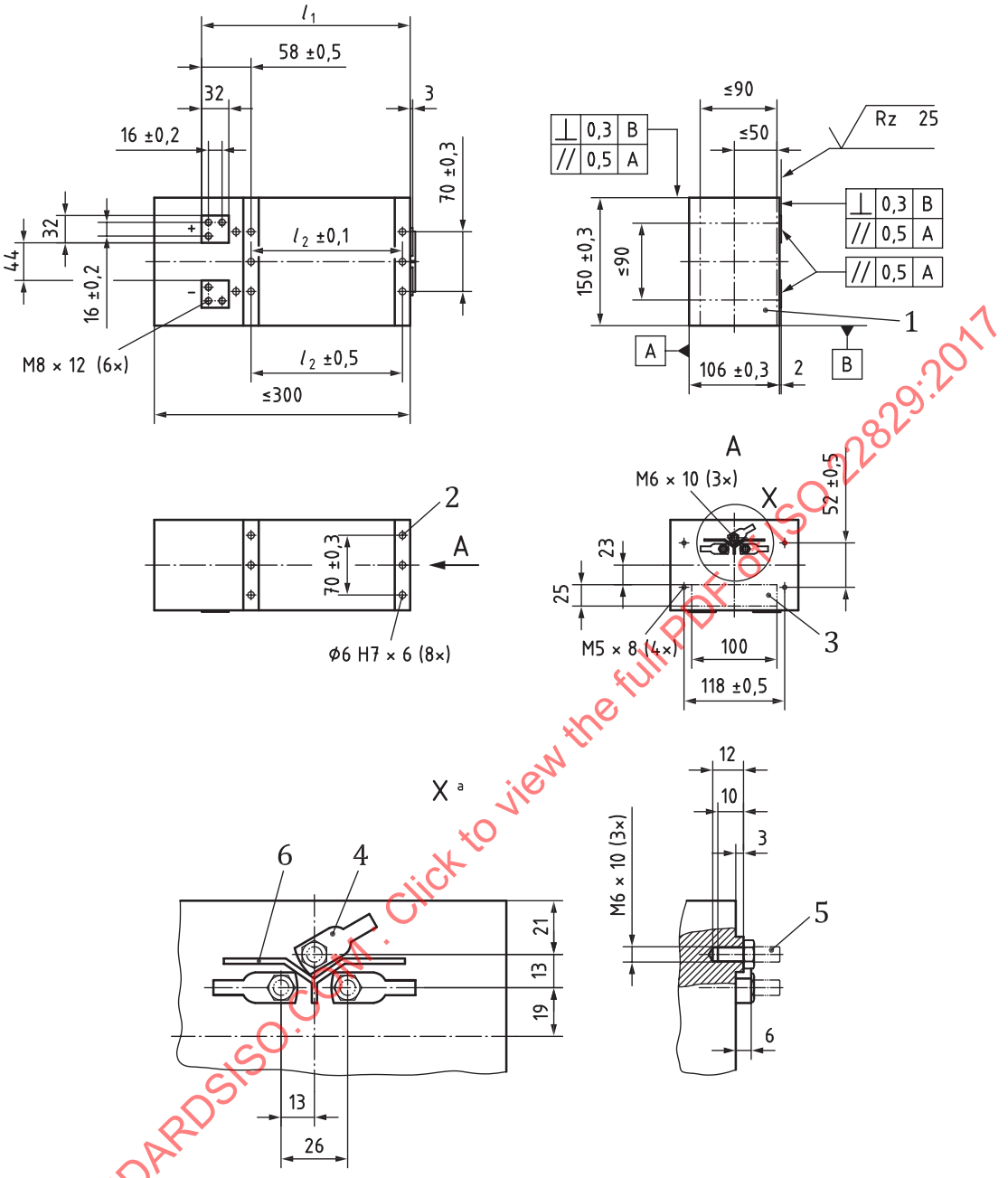
1 transformer characteristic curve
2 diode characteristic curves
X duty factor of diodes and transformer, in %
Y maximum welding current, in kA
$t_s$ on time

**Figure A.1 — Combined duty factor of diodes and transformer — Example of a set of curves for a type J2 unit with an integration period of 2 s**

# Annex B
(normative)

# Dimensions of transformers

Dimensions in millimetres



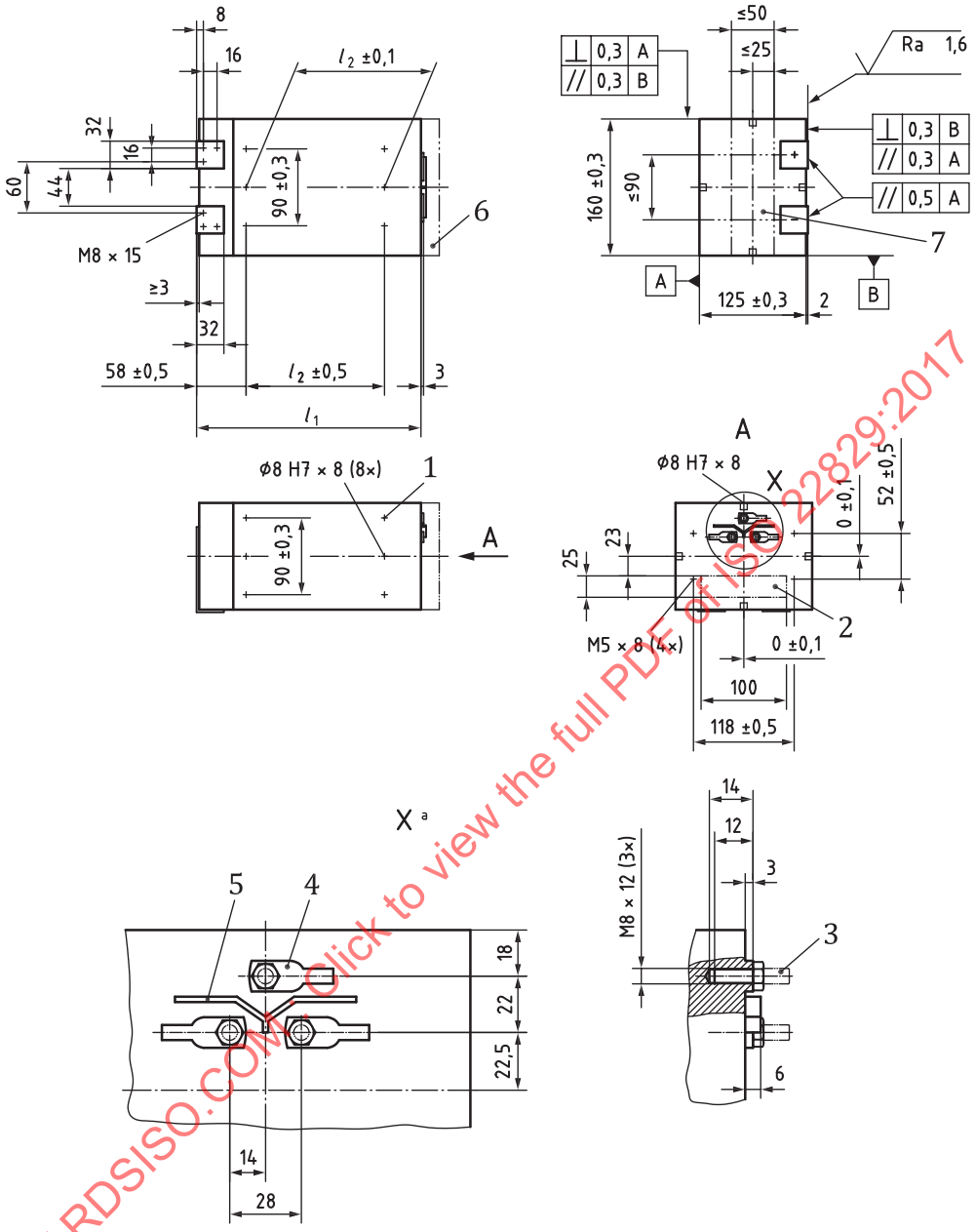

**Key**

1 area in which two cooling circuit connections are to be located, $R_p$ 1/4 × 10 mm (see ISO 7-1)
2 16 × M8 × 12, fitted with steel inserts[a]
3 output area for T, M and U
4 Ø 6 mm lug, 10 mm$^2$ cable
5 Ø 6 mm contact pin
6 insulating barrier

[a] Wire type insert not acceptable.

**Figure B.1 — Dimensions of transformers of types H1 and H2**

Dimensions in millimetres



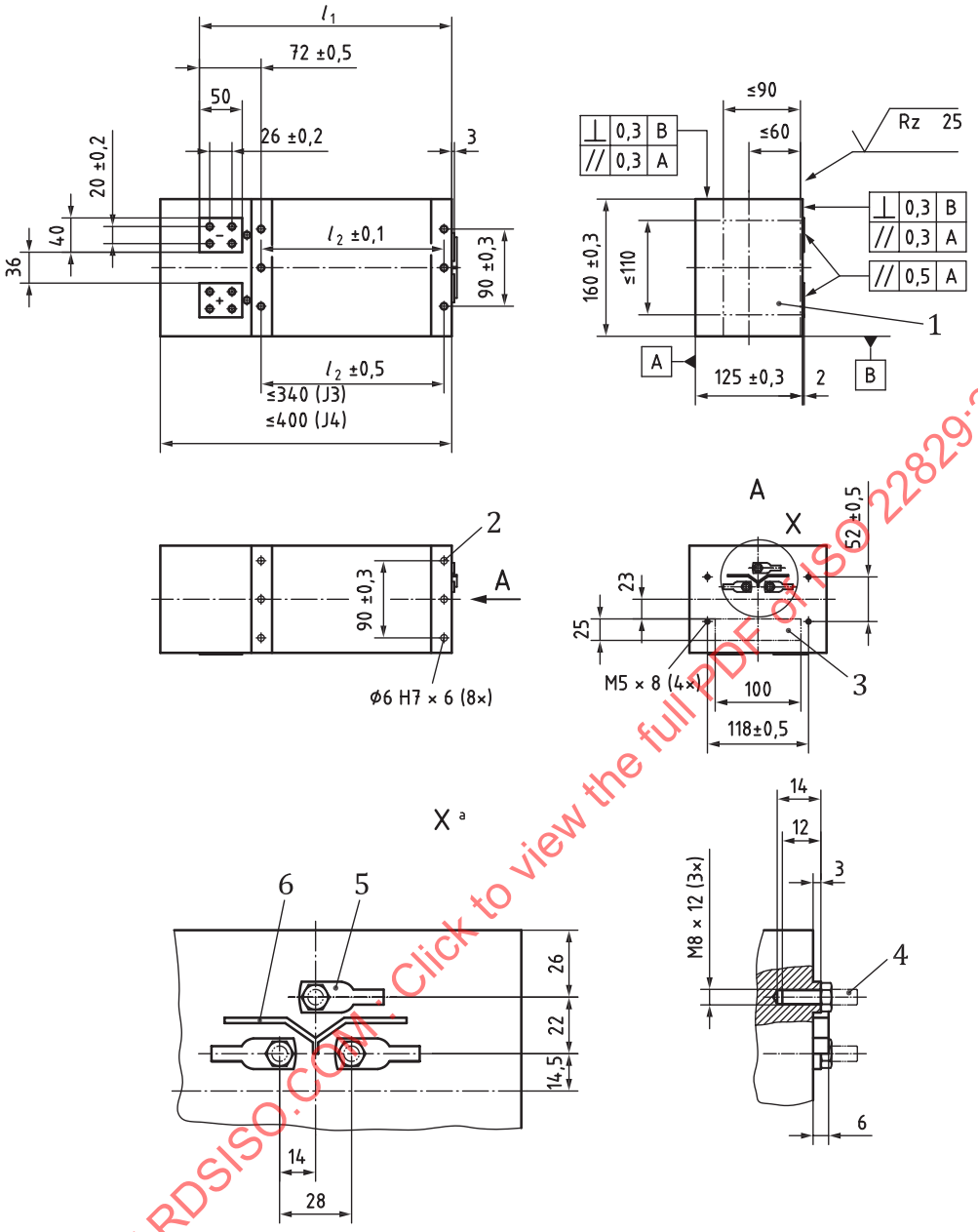

**Key**

1 16 × M10 × 15, fitted with steel inserts[a]
2 output area for T, M and U
3 Ø 8 mm contact pin
4 Ø 8 mm lug, 16 mm$^2$ cable
5 insulating barrier
6 connection box
7 area in which two cooling circuit connections are to be located, $R_p$ 1/4 × 10 mm (see ISO 7-1)

[a] Wire type insert not acceptable.

**Figure B.2 — Dimensions of transformers of types J1 and J2**

Dimensions in millimetres




**Key**

1 area in which two cooling circuit connections are to be located, $R_p$ 1/4 × 10 mm (see ISO 7-1)
2 16 × M8 × 12, fitted with steel inserts[a]
3 output area for T, M and U
4 Ø 8 mm contact pin
5 Ø 8 mm lug, 16 mm² cable
6 insulating barrier
a Wire type insert not acceptable.

**Figure B.3 — Dimensions of transformers of types J3 and J4**