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**Welding — Acceptance inspection of  
electron beam welding machines —**

**Part 6:**

**Measurement of stability of spot position**

*Soudage — Essais de réception des machines de soudage par faisceau  
d'électrons —*

*(Partie 6: Mesure de la stabilité de la position de la tache focale)*

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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 member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 14744 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 14744-6 was prepared by the European Committee for Standardization (CEN) in collaboration with ISO Technical Committee TC 44, *Welding and allied processes*, Subcommittee SC 10, *Unification of requirements in the field of metal welding*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this standard, read "...this European Standard..." to mean "...this International Standard...".

ISO 14744 consists of the following parts, under the general title *Welding — Acceptance inspection of electron beam welding machines*:

- Part 1: Principles and acceptance conditions
- Part 2: Measurement of accelerating voltage characteristics
- Part 3: Measurement of beam current characteristics
- Part 4: Measurement of welding speed
- Part 5: Measurement of run-out accuracy
- Part 6: Measurement of stability of spot position

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## Foreword

The text of EN ISO 14744-6:2000 has been prepared by Technical Committee CEN/TC 121 "Welding", the secretariat of which is held by DS, in collaboration with Technical Committee ISO/TC 44 "Welding and allied processes".

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by October 2000, and conflicting national standards shall be withdrawn at the latest by October 2000.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

This draft European Standard is composed of the six following parts:

- Part 1: Principles and acceptance conditions;
- Part 2: Measurement of accelerating voltage characteristics;
- Part 3: Measurement of beam current characteristics;
- Part 4: Measurement of welding speed;
- Part 5: Measurement of run-out accuracy;
- Part 6: Measurement of stability of spot position.

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## 1 Scope

This standard is intended for use when the stability of spot stability of welding machines complying with EN ISO 14744-1 is to be measured in connection with an acceptance inspection. It provides essential information to the procedure and apparatus to be used for making the measurements.

The stability of the spot position is a particularly significant parameter for prolonged welding applications and for electron beam welding with automatic devices positioning the workpiece. In such applications, the welding machine shall be able to reproduce, over prolonged periods and without additional correction of the position being required, a given beam-to-joint alignment. The purpose of measurement is to check whether and to what extent the electron beam generated by a welding machine keeps within the range of limit deviations specified for the spot position.

## 2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN ISO 14744-1:2000

Welding – Acceptance inspection of electron beam welding machines – Part 1: Principles and acceptance conditions (ISO 14744-1 : 2000)

EN ISO 14744-3

Welding – Acceptance inspection of electron beam welding machines – Part 3: Measurement of beam current (ISO 14744-3 : 2000)

ISO 1302

Technical drawings – Method of indicating surface texture

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## 3 Terms and definitions

For the purposes of this European Standard, the following term and definition applies.

### 3.1

#### Spot position

geometrical position of the electron beam when it impinges on the workpiece surface (weld point) with respect to a system of coordinates perpendicular to the axis of the beam

## 4 Test arrangement

### 4.1 General

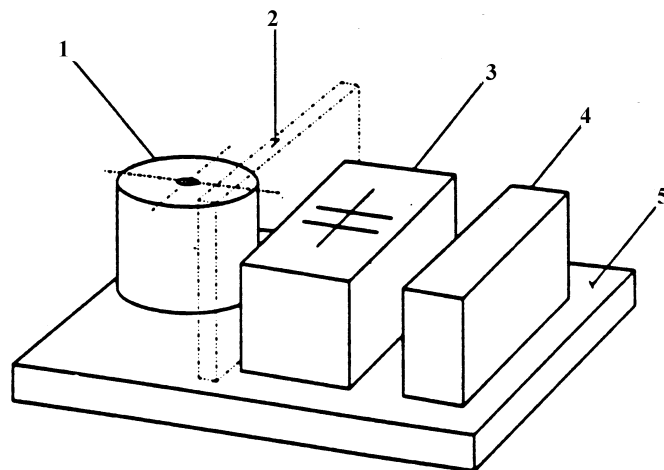
During the specified test period, the electron beam, at a given power, transmits its energy to a heatsink A or to a Faraday cup as described in EN ISO 14744-3 (see figure 1). For the actual measurement, a specially prepared workpiece, B, shall be positioned in the beam axis and the beam power adjusted to the welding task (small melt spots or melt runs).

The beam focal distance employed shall be the maximum practical in the work chamber.

The heatsink or the Faraday cup and the workpiece B shall be arranged relative to each other so as to prevent any thermal interaction.

To determine the beam current required for the measurement, as is normal in welding practice, a third workpiece, C, of the same height as workpiece B shall be provided (see figure 1).

To avoid beam deflection, the workpieces and devices used shall be made of non-magnetizable materials.



**Key**

- 1 Heatsink or Faraday cup
- 2 Screen (to prevent possible thermal interaction)
- 3 Workpiece B with coordinate axis, fixed to the work table
- 4 Workpiece C
- 5 Work table

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**Figure 1 - Test arrangement for measuring the stability of spot position**

**4.2 Workpiece preparation**

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The surface of workpiece B intended to be measured shall have a roughness value,  $R_a$ , equal to  $1,6 \mu\text{m}$  as specified in ISO 1302.

**5 Measurement procedure**

**5.1 Welding machine with optical viewing system**

**5.1.1 General**

The measurement shall be carried out with the welding machine set as specified in 6.5 of EN ISO 14744-1:2000. No modifications, particularly no adjustments, shall be made to the welding machine between the steps described in the following subclauses.

**5.1.2 Welding machine with a CNC work table**

Measurements shall be carried out in the following way:

- 1) before starting the measurements, the settings necessary to obtain a small melt spot shall be determined for the selected focal distance on workpiece C, see figure 1;
- 2) then the first spot  $P_1$  shall be melted on workpiece B by programming in the CNC-position:

$$x_1 = 0,000 \text{ mm};$$

$$y_1 = 0,000 \text{ mm};$$



3) The next spots  $P_2$  and  $P_3$  shall be melted at the coordinates:

$x_2 = 5,000$  mm;  
 $y_2 = 0,000$  mm; and

$x_3 = 0,000$  mm;  
 $y_3 = 5,000$  mm; see figure 2.

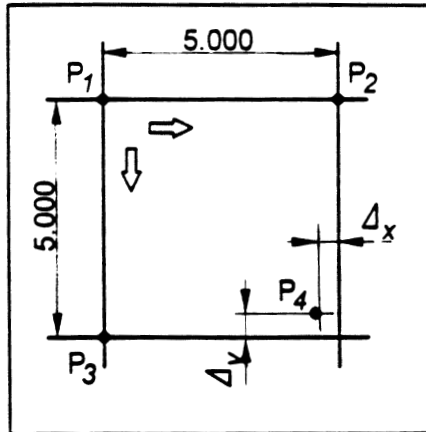


Figure 2 - Spot welds arrangement with CNC work table  
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To avoid backlash it is important to move the work table only in the same X- or Y-direction to reach the ( $\Rightarrow \Downarrow$ ) positions.

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4) heatsink A or Faraday cup shall be positioned in the beam axis. The welding machine shall be switched on, interrupted and be set and maintained at the power and operating time specified in EN ISO 14744-1:2000 in 6.5;

5) workpiece B shall be positioned with table coordinates:

$x_4 = 5,000$  mm;  
 $y_4 = 5,000$  mm;

and the fourth spot shall be melted.

6) using the reference spots  $P_1$ ,  $P_2$  and  $P_3$  workpiece B shall be positioned in the X- and Y-direction of a workshop travelling microscope. The coordinates  $x_4'$  and  $y_4'$  of the spot center  $P_4$  shall be measured.

The deviation from the correct position  $x_4$ ,  $y_4$  shall be calculated as follows:

$$\Delta r' = \sqrt{\Delta x^2 + \Delta y^2}$$

where  $\Delta x = x_4' - x_4$   
 $\Delta y = y_4' - y_4$

If a focal distance other than 300 mm has been used for melting the spots, the value  $\Delta r'$  thus obtained shall be converted proportionally on  $\Delta r$  to  $A_F = 300$  mm.