SLOVENSKI PREDSTANDARD

OSIST prEN 14883:2004

april 2004

Varjenje plastomerov – Stroji in oprema za varjenje plastomerov z grelnim elementom

Welding of thermoplastics - Machines and equipment for welding of thermoplastics by heated element

ICS 25.160.30

Referenčna številka
OSIST prEN 14883:2004(en;fr;de)

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 14883

January 2004

ICS

English version

Welding of thermoplastics - Machines and equipment for welding of thermoplastics by heated element

Schweißen von Thermoplasten - Maschinen und Geräte für das Heizelementschweißen thermoplastischer Kunststoffe

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. prEN 14883:2004: E

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Foreword

This document prEN 14883:2004 has been prepared by Technical Committee CEN/TC 249 "Plastics", the secretariat of which is held by IBN.

This document is currently submitted to the CEN Enquiry.

1 Scope

This European Standard specifies the main performance requirements of the machines and equipment for welding by heated element of semi-finished products made from thermoplastics.

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 60068-2-32, E*nvironmental testing procedures — Part 2: Tests — Test Ed: Free fall.*

IEC 68-2-64, E*nvironmental testing— Part 2: Test methods — Test Fh: Vibration, broad-band random (digital control) and guidance.*

ISO 1302, *Geometrical Product Specification (GPS) — Indication of surface texture in technical product documentation.*

ISO TR 13950, *Plastics pipes and fittings — Automatic recognition systems for electrofusion.*

3 Definitions

For the purpose of this European Standard, the following definitions apply.

3.1
heating time
time that the components are in relation with the heating element at the appropriate temperature

3.2
heated tool welding machines
3.2.1
force transmission system
complete equipment necessary for creating and controlling the movement and the forces during planing, heating and welding

3.2.2
frictional resistance
necessary force to overcome the friction in the whole mechanism

3.2.3
frictional resistance during welding cycle
sum of the frictional resistance and the resistance due to the weight of the workpiece fixed in the movable clamp

3.2.4
joining distance (displacement)
distance of the two parts during welding

3.2.5
maximum working pressure
sum of the frictional resistance during the welding cycle and the fusion pressure for the maximum welding surface for which the welding machine is designed

3.2.6
changeover time
time between the start of the opening of the frame for the removal of the heated tool and the contact of the two parts at the start of the fusion cycle

3.3
electrofusion control box
unit controlling the output power to execute the fusion cycle as specified by the electrofusion fitting manufacturer

NOTE The output power can be expressed mainly by:

— voltage by time;

— current by time;

— energy under voltage;

— energy under current.

3.3.1
electrical characteristics
3.3.1.1
input voltage
Input voltage is divided in two classes:

— SVLV: Safety Very Low Voltage: up to 50 V;

— LV: Low Voltage: between 50 V and 240 V.

3.3.1.2
nominal output power classification
the output power is defined as the mathematical product of the amperage and the voltage measured at the voltage sense points at the fitting or the transition plug

For classification, the nominal output power of the electrofusion control box is defined as the maximum output power for continuous use (100 % duty cycle) at (23 ± 2)°C and during one hour for the maximum output voltage of the electrofusion control box.

The value of the nominal output power is the first code number of the electrofusion control box classification (see 8.1.1.1.2).

3.3.2
control box descriptions
— Monovalent, when the control box can only be used on one range of electrofusion fittings from one manufacturer;

— Polyvalent, when the control box can be used with more than one manufacturer range of electrofusion fittings.

Particular types of control boxes can be further described as follows:

3.3.2.1
preset control box
control box providing an output power where at least one of the fusion parameters is fixed in the process of the unit (voltage, current, energy, time)

NOTE Other parameters can be manually or automatically introduced. Depending upon the process, the control box can work for one or more electrofusion fittings manufacturers with their own specific characteristics.

3.3.2.2
universal control box
control box providing an output power where all the fusion parameters are automatically introduced from an external source (e.g. barcode, magnetic card, chip, ...) programmed by the electrofusion fittings manufacturer

NOTE The control box regulates in voltage and current.

3.3.2.3
multimode control box
control box providing an output power based on variable fusion parameters, automatic data introduction, polyvalent associated with at least one preset process

3.3.3
duty cycle
fixed period of time (T), composed of an on-load period (T1) and an off-load period (T2). Therefore T = T1+ T2

NOTE 1 The duty cycle may be expressed either directly in minutes, or as a percentage of the on-load period related to the total time (T).

NOTE 2 For all electrofusion control boxes with a nominal output power up to and including 2 kW the duty cycle is equal to 10 minutes. Thus for a 60 % duty cycle (say) T1 is equal to 6 minutes and T2 is equal to 4 minutes.

NOTE 3 For all electrofusion control boxes with a nominal output power greater than 2 kW the duty cycle is equal to 15 minutes. Thus for a 60 % duty cycle (say) T1 is equal to 9 minutes and T2 is equal to 6 minutes.

NOTE 4 An example of the duty cycle is shown in annex A. The graph is defined by the manufacturer for each electrofusion control box between 35 % and 100 % duty cycle at the reference voltages, as defined in 3.3.4. See also 8.4.5 Endurance.

3.3.4
voltage
voltage values quoted in this standard are defined as true RMS (Root Mean Square) values and not peak values

3.3.5
soft start
stepped increases over time periods in the order of seconds

4 General requirements on machine

4.1 Work-holding fixtures

Work-holding fixtures have the task of maintaining the parts to be welded in the form and position required for welding. The holding device shall fix the part so that the forces required for the welding can be transferred in full without any change in position of the workpieces in the clamping device. It shall be so constituted that the workpiece surfaces are not detrimentally affected. The work-holding fixtures have the task of maintaining alignment and initial form of the pieces.

4.2 Guide elements

The guide elements shall ensure that the fixed workpieces are aligned and do not change their position (slippage and bending) under the maximum working pressure. They shall be designed so that the required working pressures can be maintained under any operating conditions. This means in particular that the difference between friction in the static state and in movement shall be as small as possible so that even the low forces at the start of the joining process can be accurately transmitted.

The guide elements shall be easy running. This implies good for-life lubrication. If lubrication is manual, the lubricating points shall be clearly recognisable, visible and readily accessible.

4.3 Device for weld preparation

In the case of welding processes which require the machining of the surfaces to be joined, a device for plane-parallel machining is to be provided. Such devices shall not interfere with other operations of the machine.

4.4 Control devices

4.4.1 Pressure control

For conventional heated tool socket welding and electrofusion, pressure control is not necessary.

For heated tool butt welding, see 6.1.7.

4.4.2 Time control

Control of time (e.g. heating, melting, cooling) is essential for the production of high quality joints.

4.4.3 Temperature control

Temperature control of heated tools is essential for the production of high quality joints.

4.4.4 Distance control

Control of distance can be used to control trimming and/or joining distance.

4.4.5 Data retrieval

On microprocessor control units, data retrieval is possible.

A connector should be made available to download the data stored in memory.

The interface shall be of a standard type (e.g. PCMCIA, serial and/or parallel port, ...) to allow data downloading to other electronic devices, (e.g. PC, printer, ...).

4.4.6 Memory

The installed memory can be either an integral or removable part of the machine. The capacity of the memory shall be as defined by the end user according to the national rules.

4.5 Arrangement of the heated tool

The machine shall incorporate a facility for supporting the heating tool when in use. This support shall not affect transmission of interface forces across the heater tool and shall not prevent the heater tool from proper alignment during the heating operation. After the heating process, the detachment and withdrawal of the heated tool from the joining surfaces shall take place as rapidly as possible so that the permissible changeover time is not exceeded. Special devices for the detachment of the heated tool may be provided.

4.6 Marking

The operating instructions shall contain the characteristic data of the machine and describe the function to the extent required to ensure satisfactory work.

Descriptions of external connections and maintenance instructions shall form part of the operating instructions.

Minimum required marking on the machine are:

— manufacturer's identification;

— type;

— serial number;

— manufacturing period;

— input voltage and frequency.

All displays shall be clearly visible both in bright sunlight and in poor light conditions.

4.7 Maintenance

In order to maintain a high standard, it is recommended that all machines be inspected, adjusted and serviced once a year. This should be carried out by the machine manufacturer or the authorised representative.

4.8 Extreme temperature conditions

The manufacturer shall demonstrate that his machine fulfils the requirements of this standard between -10 °C and + 40 °C for an operating temperature range as defined e.g. by national standards or rules.

The welding machine can be equipped with a temperature sensing element for measurement of ambient temperature. The temperature sensing lead can be a part of the welding machine or separate for manual control by the operator.

External temperature sensing elements shall be mechanically protected.

5 General requirements on heated tools

Where the heated tool is an integral part of the machine, it should be easily accessible in order to carry out a cleaning operation.

During the heating time, it shall be possible to clearly observe the formation of the weld bead.

The maximum temperature setting of the heater tool shall not cause degradation of the surface coating.

Indirect heat output, via a heat conductor, is transmitted from embedded electric heaters through a conductor of heat to the surface of the heated tool.

5.1 Design

Heated tools shall be designed to accommodate the shape and dimensions to the joining surfaces.

The effective area is considered to be that portion of the heated tool within which the temperature and the heat to be transmitted can be regulated within the specified range.

5.2 Materials

Heating tools shall be made of materials giving good thermal-conductivity or thermal radiation and shall be able to withstand normal site handling. They should be corrosion resistant and free of voids.

5.3 Surface quality of heated tool with contact

The surface of the heated tool shall prevent adhesion of molten material, allow damage free cleaning and shall be able to withstand normal site handling.

This can be attained, for example, by coating the surface with coloured PTFE (Polytetrafluoroethylene) or with other surface treatment. The colour of the PTFE coating shall be such that after the tool has been used for welding operations, the presence of any surplus material on the tool shall be readily visible, regardless of any degradation of the material.

PTFE spray shall not be used. Such a coating can be transferred to the fusion-interface during the welding procedure.

Heated tools freshly covered or recoated with PTFE shall be preheated to their working temperature for at least three hours before operation.

The coating shall be capable of withstanding for one hour a temperature of not less than 270 °C.

The roughness values for PTFE coating or covering shall be $R_t \leq 16$ µm and $R_a \leq 6{,}3$ µm and the roughness class is N9, according to ISO 1302.

Customary coating thicknesses are usually 30 µm to 50 µm and PTFE glass cloth in thicknesses from 200 µm to 300 µm.

Pre-copper platings and galvanisations containing copper may not be used in direct contact.

5.4 Minimum output of the heated tool

The minimum output of the heated tool depends on the conditions of application as well as on the particular make.

The thermal capacity and heat transfer efficiency of the heated tool shall be such that the temperature drop during the initial contact with the workpieces shall not be greater than 10 °C, within the effective area.

It shall level out again during the heating period to not greater than half the amount of the initial temperature drop from the set value.

During the cooling period of the fusion cycle the temperature of the heated tool shall return to the set value.

5.5 Minimum temperature range

5.5.1 Heated tool with contact

The heated tool shall be continuously adjustable over the required temperature range within the effective areas:

— from 180 °C to 260 °C in heated tool butt welding;

— from 230 °C to 270 °C in heated tool socket welding;

(after 30 minutes heat up time at ambient temperature (23 ± 2) °C in still air).