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Plastics — Joining of thermoplastic moulded components — Specification of variables for thermal joining processes

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Foreword

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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 61, *Plastics*, Working Group WG4, *Plastics joining*.

Introduction

This document has been developed to help organizations better understand and implement controls with the following thermal joining processes through the use of thermal joining process specifications:

- ultrasonic welding/staking/spot welding;
- infrared welding;
- hot gas convection welding;
- linear vibration welding;
- orbital vibration welding;
- spin welding;
- laser welding;
- hot plate welding;
- heat staking: hot air;
- heat staking: electrical; and
- heat staking: infrared.

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Plastics — Joining of thermoplastic moulded components — Specification of variables for thermal joining processes

1 Scope

This document specifies the minimum essential variables in order to produce a component of the required consistency and quality for the following thermal joining processes:

- ultrasonic welding/staking/spot welding;
- infrared welding;
- hot gas convection welding;
- linear vibration welding;
- orbital vibration welding;
- spin welding;
- laser welding;
- hot plate welding;
- heat staking: hot air;
- heat staking: electrical; and
- heat staking: infrared (IR).

This document defines the thermal joining process specification (TJPS) for each of the thermal joining processes listed above, to ensure that all the essential variables are properly considered, including the qualified range of each variable in order to establish and maintain component quality at an acceptable level.

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.

EN ISO 472, *Plastics - Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 472 and the following apply.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

component

joined sub-components

**3.2
dimensional report**

full measurement report on product before welding including flatness at weld joint

**3.3
essential variable**

joining condition that influences the quality of the joint and requires qualification

**3.4
joining organization**

organization responsible for the serial production joining and maintenance of quality

**3.5
joining procedure**

specified course of action to be followed in making a joint, including the joining process(es), reference to materials, preparation, pre-heating (if necessary), control of process parameters and necessary equipment to be used

**3.6
joining process**

method of softening or melting to obtain a permanent joint

**3.7
joining process qualification record
JPQR**

record comprising all data of mechanical test results for the specified range of each essential variable needed for qualification of a TJPS, used by the joining organization as part of the sign-off documentation

**3.8
joint**

junction of two sub-components

**3.9
part moisture content**

amount of moisture content in parent material at the time of welding

**3.10
process report**

document confirming that the sub-component has been manufactured using the correct moulding process parameters, conditions, material grade, masterbatch reference, masterbatch percentage, and regrind percentage

**3.11
sub-component**

part to be joined

**3.12
thermal joining process specification
TJPS**

document that has been qualified and provides the required variables of the joining procedure to ensure repeatability during production

**3.13
visual examination acceptance criteria document**

document specifying imperfections on sub-components that affect the functionality of the joint; e.g. weld lines, burn marks, surface contamination

**3.14
welding**

process of uniting softened surfaces of materials, generally with the aid of heat

3.15**work instruction**

simplified TJPS, suitable for joining process owner

4 Technical content of thermal joining process specification (TJPS)**4.1 General**

A TJPS shall provide the minimum information specified in 4.2 to 4.5 required to make a joint of acceptable quality, as part of the component manufacturing quality agreement between the joining organization and the customer.

TJPSs cover a certain range for each essential variable. The range of each essential variable shall be qualified using a JPQR, and the procedure for measuring each variable shall conform to agreed specifications.

NOTE 1 Example templates of TJPSs are given in Annex A to Annex K. Worked example TJPSs for hot plate welding and heat staking: electrical are given in Annex L and Annex M, respectively.

NOTE 2 A work instruction can be prepared for each specific, applicable TJPS as part of detailed production planning.

NOTE 3 When completing the TJPS the technical support/manual/documentation of the joining process equipment manufacturer or service supplier should be consulted.

4.2 Related to the joining organization

- a) identification of the joining organization;
- b) TJPS reference number/revision;
- c) signature of the person responsible for approval, appointed by the joining organization

NOTE The responsibilities, knowledge, skills and competence for the person responsible for approval are set out in PD CEN/TR 16862^[1].

4.3 Related to the sub-component(s)

- a) sub-component material:
 - 1) material supplier name;
 - 2) designation of the material(s) and reference standard(s), if any, or an alternative identification if a reference standard does not exist;
 - 3) moisture content;
 - 4) regrind percentage;
 - 5) masterbatch reference and masterbatch percentage;
- b) dimensional report;
- c) process report;
- d) customer component/part number;
- e) supplier component/part number;
- f) visual examination acceptance criteria document number

4.4 Common to all joining processes

- a) joint preparation;
- b) ambient temperature;
- c) sub-component temperature;
- d) joining process qualification record (JPQR)

4.5 Specific to a joining process

4.5.1 Ultrasonic welding/staking/spot welding

- a) joining process(es): welding, staking or spot welding;
- b) machine type (fixed or handheld);
- c) frequency;
- d) power rating;
- e) maximum tool temperature;
- f) tool face amplitude/amplitude profile;
- g) down speed;
- h) trigger force (if applicable)/(not handheld);
- i) pre-trigger/touch (yes/no) (not handheld);
- j) pre-trigger amplitude (if applicable)/(not handheld);
- k) joining force/force profile (not handheld);
- l) meltdown/collapse/weld displacement (not handheld);
- m) joining or welding time;
- n) hold/cooling time;
- o) weld energy.

NOTE A template for the TJPS for ultrasonic welding/staking/spot welding is given in [Annex A](#).

4.5.2 Infrared welding

- a) emitter condition;
- b) distance of sub-components from IR source;
- c) pre-heat/soak temperature (or power);
- d) pre-heat/soak time;
- e) full heat temperature/power;
- f) full heat time;
- g) removal of heating to sub-component contact time/changeover time;
- h) welding force;

- i) meltdown/collapse/weld displacement;
- j) cooling time.

NOTE A template for the TJPS for infrared welding is given in [Annex B](#).

4.5.3 Hot gas convection welding

- a) gas flow rate;
- b) gas temperature;
- c) gas feed type;
- d) distance between sub-components and tool;
- e) heating time;
- f) removal of heating to sub-component contact time/changeover time;
- g) welding force;
- h) meltdown/collapse/weld displacement;
- i) cooling time.

NOTE A template for the TJPS for hot gas convection welding is given in [Annex C](#).

4.5.4 Linear vibration welding

- a) frequency;
- b) amplitude/amplitude profile;
- c) IR pre-heat time (if applicable);
- d) IR pre-heat power (if applicable);
- e) IR pre-heat changeover time (if applicable);
- f) welding force/force profile;
- g) meltdown/collapse/weld displacement;
- h) welding time;
- i) hold/cooling time.

NOTE A template for the TJPS for linear vibration welding is given in [Annex D](#).

4.5.5 Orbital vibration welding

- a) frequency;
- b) amplitude/amplitude profile;
- c) welding force/force profile;
- d) meltdown/collapse/weld displacement;
- e) welding time;
- f) hold/cooling time