SLOVENSKI STANDARD
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Nepravilnosti v zvarjenih spojih plastomerov - Stopnje kakovosti

Imperfections in thermoplastics welded joints - Quality levels

Unregelmäßigkeiten an Schweißverbindungen von thermoplastischen Kunststoffen - Bewertungsgruppen

Défauts dans les assemblages soudés en thermoplastiques - Niveaux de qualité

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Imperfections in thermoplastics welded joints - Quality levels

Défauts dans les assemblages soudés en thermoplastiques - Niveaux de qualité

Unregelmäßigkeiten an Schweißverbindungen von thermoplastischen Kunststoffen - Qualitätsstufen

This European Standard was approved by CEN on 12 April 2021.

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 16296:2021) has been prepared by Technical Committee CEN/TC 249 “Plastics”, the secretariat of which is held by NBN.

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of an identical text or by endorsement, at the latest by November 2021, and conflicting national standards shall be withdrawn at the latest by November 2021.

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

This document supersedes EN 16296:2012.

In comparison with the previous edition, the following technical modifications have been made:

— the PA polyamide thermoplastic material has been added in Table 1 — Thermoplastic materials;

— in Tables 3 to 8:

  — the designation 1AAAA of the quality levels for “cracks” has been deleted to be consistent with EN 14728:2019;

  — the numbers and designations have been updated to be aligned with EN 14728:2019 as the texts for the quality levels.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This document is used as a reference in the drafting of application codes and/or other application standards. It contains a simplified selection of imperfections based on the designations and illustrations given in EN 14728, *Imperfections in thermoplastic welds — Classification*.

Some imperfections according to EN 14728 have been used directly and some have been grouped together. The basic numerical referencing system from EN 14728 has been used.

The purpose of this document is to define quality levels based on typical imperfections, which might occur in normal fabrication. It is applicable for use within a quality system for the production of factory welded joints. It provides three sets of dimensional values from which a selection can be made for a particular application.

The quality levels given in this document are intended to provide basic reference data and are not specifically related to any particular application. They refer to the types of welded joints in a fabrication and not to the complete product or component itself. It is possible, therefore, that different quality levels are applied to individual welded joints in the same product or component.

This document is directly applicable to visual examination of welds or test specimens. The need for detection is not the subject of this document and this document does not include details of recommended methods of detection and sizing.

1 Scope

This document specifies quality levels for imperfections in thermoplastics welded joints that have cooled to ambient temperature and is applicable to material thickness above 2,0 mm.

Three quality levels are specified in order to permit application for a wide range of welded fabrication. They are designated by symbols B, C and D, where B is the most stringent. The quality levels refer to production quality and not to the fitness-for-purpose (see 3.2) of the manufactured product.

The quality level necessary are expected to be defined by the application standard or by the fabricator in conjunction with the user and/or other parties concerned. The level is expected to be prescribed before the start of production, preferably at the enquiry or order stage.

This document applies to the following thermoplastic materials in Table 1:

Table 1 — Thermoplastic materials

Abbreviation	Material description
ABS	Acrylonitrile-butadiene-styrene plastic
ECTFE	Ethylene-chlorotrifluoroethylene copolymer
FEP	Fluorinated ethylene propylene
PA-U	Unplasticized polyamide
PB	Polybutylene
PE	Polyethylene
PFA	Perfluoroalkoxy
PP-B	Polypropylene block copolymer
PP-H	Polypropylene homopolymer
PP-R	Polypropylene random copolymer
PVC-C	Chlorinated polyvinyl chloride
PVC-U	Unplasticized polyvinyl chloride (rigid PVC)
PVDF	Polyvinylidene fluoride

and to the following welding processes:

— heated tool welding;

— electrofusion socket welding;

— hot gas welding using filler rod only;

— extrusion welding;

— solvent welding of pipes.

2 Normative reference

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1
quality level
description of the qualities of a weld on the basis of type, size and number or frequency of selected imperfections

3.2
fitness-for-purpose
ability of a product, process or service to serve a defined purpose under specific conditions

4 Quality levels

4.1 Classification

Three quality levels are defined as B, C and D in order to permit application for a wide range of welded fabrications (see Table 2).

Table 2 — Quality levels for weld imperfections

Symbol	Requirement
B	Stringent
C	Intermediate
D	Moderate

The purpose of this document is to define quality levels based on typical imperfections, which might occur in normal fabrications and are classified in EN 14728 [1]. It may be used within a quality system for the production of factory welded joints. It provides three sets of dimensional values from which a selection can be made for a particular application. The quality level necessary in each case should be defined by the application standard or the fabricator in conjunction with the user and/or other parties concerned. The level should be prescribed before the start of production, preferably at the enquiry or order stage.

For pressure pipe systems, it is recommended that at least level B be chosen.

For specific applications, some requirements more stringent than level B might need to be prescribed and shall be defined between the contracting parties as quality level A.

4.2 Choice of quality level

For the choice of the quality level, the following factors, among others, shall be taken into account:

— mechanical loading (static, dynamic);

— environment (media, temperature);

— material properties (ductile, brittle);

— manufacturing conditions (workshop, construction site, welding in constrained condition);

— operating conditions;

— potential danger in the event of failure;

— design considerations.

Economic factors are also important and should include not only the cost of welding but also the cost of inspection, test and repair.

5 Requirements for welded joints

Although this document includes types of imperfections relevant to the processes given in Clause 1, only those which are applicable to the process and application in question need to be considered.

Imperfections are quoted in terms of their actual dimensions. However, their detection and evaluation could require the use of one or more methods of non-destructive testing. It should be noted that the detection and sizing of imperfections is dependent on the inspection methods and the extent of testing specified in the application standard or contract.

The indication provided by non-destructive testing should not be used directly for the evaluation of quality levels. Therefore, it needs to be supplemented by requirements for examinations, inspection and testing.

The requirements for the quality levels in Table 2 (B, C and D) are listed as follows:

— heated tool butt welds: Table 3;

— heated tool socket welds: Table 4;

— electrofusion socket welds: Table 5;

— hot gas welds: Table 6;

— extrusion welds: Table 7;

— solvent socket welds: Table 8.

Different types of imperfection occurring simultaneously at any cross-section of the joint need special consideration.

Any two adjacent imperfections separated by a distance less than the major dimension of the smaller imperfection shall be considered as a single imperfection.

In certain circumstances, it is necessary to machine the completed weld. In this case, the weld shall be examined both before and after machining.

Table 3 — Definition of quality levels for heated tool butt welds

Number	Designations	Level B	Level C	Level D
2BAAA	Gas cavity	Isolated cavities permissible if diameter ≤ 5 % of wall thickness	Permissible if diameter of largest cavity ≤ 10 % of wall thickness	Permissible if diameter of largest cavity ≤ 15 % of wall thickness
2CAAI	Shrinkage cavity	Isolated cavities permissible if diameter ≤ 5 % of wall thickness	Permissible if diameter of largest cavity ≤ 10 % of wall thickness	Permissible if diameter of largest cavity ≤ 15 % of wall thickness
2MAAA	Surface bubble	Permissible if, when the weld bead is removed, there is no evidence of gas cavities at the weld interface	Permissible if, when the weld bead is removed, there is no evidence of gas cavities at the weld interface	Permissible if, when the weld bead is removed, there is no evidence of gas cavities at the weld interface
3AAAA	Particulate inclusion	Isolated and/or multiple inclusions permissible if sum of maximum dimensions ≤ 5 % of wall thickness	Isolated and/or multiple inclusions permissible if sum of maximum dimensions ≤ 10 % of wall thickness	Isolated and/or multiple inclusions permissible if sum of maximum dimensions ≤ 15 % of wall thickness
3JAAI	Parent material inclusion	Not permissible	Not permissible	Not permissible
3KAAA	Degraded polymer	Not permissible	Not permissible	Not permissible
4BAAA	Lack of fusion	Not permissible	Not permissible	Not permissible
4QBAF	Groove in upset or reinforcement	Not permissible if below surface of parent material	Not permissible if below surface of parent material	Not permissible if below surface of parent material
4WAAA	Cold fusion	Not permissible	Not permissible	Not permissible
5CAAA	Incorrect weld profile	Mechanical testing of sample welds is recommended	Mechanical testing of sample welds is recommended	Mechanical testing of sample welds is recommended
5EIAA[b]	Linear misalignment	Permissible if misalignment is not greater than 10 % of the wall thickness	Permissible if misalignment is not greater than 15 % of the wall thickness	Permissible if misalignment is not greater than 20 % of the wall thickness

Number	Designations	Level B	Level C	Level D
5EJAA[b]	Angular misalignment	Permissible if misalignment is not greater than 1,0°	Permissible if misalignment is not greater than 1,5°	Permissible if misalignment is not greater than 2,0°
5GAAA	Irregular width	To be agreed between contracting parties	To be agreed between contracting parties	To be agreed between contracting parties
6DAAA	Excessive width	To be agreed between contracting parties	To be agreed between contracting parties	To be agreed between contracting parties
6HAAA[a]	Excessive asymmetry of welds	Permissible if smaller half of weld bead is not less than 70 % of larger half of weld bead at any point around the circumference	Permissible if smaller half of weld bead is not less than 60 % of larger half of weld bead at any point around the circumference	Permissible if smaller half of weld bead is not less than 50 % of larger half of weld bead at any point around the circumference
6MAAA	Insufficient upset material	To be agreed between contracting parties	To be agreed between contracting parties	To be agreed between contracting parties
7BAAA	Thermal damage outside of welding	Not permissible	Not permissible	Not permissible
7VAAA	Excessive toe in	To be agreed between contracting parties	To be agreed between contracting parties	To be agreed between contracting parties
9CAAA	Tool mark	Locally permissible if the notch depth is less than 10 % of the wall thickness	Locally permissible if the notch depth is less than 10 % of the wall thickness	Locally permissible if the notch depth is less than 15 % of the wall thickness

[a] To be agreed between contracting parties when welding materials with different melt flow rates.

[b] For mitred joints the requirements should be agreed between the contracting parties.

NOTE Some of the data in this table can also be found in DVS 2202 [2].