



	DIN EN ISO 10042	<u>DIN</u>
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draft**Welding -****Arc welded joints on aluminum and its alloys - Assessment groups of irregularities (ISO/DIS 10042:2017); German and English version prEN ISO 10042:2017****Welding -**

Arc-welded joints in aluminum and its alloys -

Quality levels for imperfections (ISO/DIS 10042:2017);

German and English version prEN ISO 10042:2017

Soudage -

Assemblages en aluminium et alliages d'aluminium soudés à l'arc -

Niveaux de qualité par rapport aux défauts (ISO/DIS 10042:2017);

Version allemande et anglaise prEN ISO 10042:2017

Application warning

This draft standard with publication date 2017-04-21 is submitted to the public for review and comment.

As the intended standard may deviate from the present version, the application of this draft must be specifically agreed.

Comments are requested

- Preferably online in the DIN draft standards portal at www.din.de/go/entwuerfe or for DKE draft standards also in the DKE draft standards portal at www.entwuerfe.normenbibliothek.de, if reproduced there;
- or as a file by e-mail to nas@din.de, preferably in the form of a table. The template for this table can be found on the Internet at www.din.de/go/stellungnahmen-norm-entwuerfe or for comments on DKE draft standards at www.dke.de/stellungnahme;
- or in paper form to the DIN Standards Committee for Welding and Allied Processes (NAS), 10772 Berlin, Burggrafenstr. 6, 10787 Berlin.

Recipients of this draft standard are requested to provide with their comments any relevant patent rights of which they are aware and to provide supporting documentation.

Total length 59 pages

DIN Standards Committee for Welding and Allied Processes (NAS)

National foreword

This document (prEN ISO 10042:2017) has been prepared by Technical Committee ISO/TC 44 "Welding and allied processes" in collaboration with Technical Committee CEN/TC 121 "Welding and allied processes", the secretariat of which is held by DIN (Germany).

The responsible national standardization body is the working committee NA 092-00-19 AA "Welding of aluminium and other light metals (DVS AG W 6)" in the DIN Standards Committee on Welding and Allied Processes (NAS).

For the avoidance of doubt in the translation, the original English version is attached. The terms of use for the German text of the draft standard also apply equally to the English text.

For the international standards cited in this document, reference is made below to the corresponding German standards:

ISO 2553	see DIN EN ISO 2553
ISO 4063	see DIN EN ISO 4063
ISO 6520-1	see DIN EN ISO 6520-
ISO 13919-2	see DIN EN ISO 13919-2
ISO 17635	see DIN EN ISO 17635

Changes

The following changes have been made to DIN EN ISO 10042:2006-02:

- a) Serial numbers from ISO 4063 deleted in application area;
- b) Table 1, 1.3: Serial number according to ISO 6520-1 changed from "2012 - uniformly distributed porosity" to "2018 - surface porosity";
- c) Table 1, 1.8: New image and change to assessment groups B and C;
- d) Table 1, 1.9: Change to assessment group C;
- e) Table 1, 1.14: additional image inserted;
- f) Table 1, 1.15: Change to valuation group D;
- g) Table 1, 1.18: new image and image deleted, reference to 6520-1-5013 "Root notch" deleted;
- h) Table 1, 1.19 to 1.21: Irregularities Values from ISO 5817 added: Lug defects, ignition point, spatter;
- i) Table 1, 2.2: Changes to assessment groups B and C;
- j) Table 1, 2.10: Changes to assessment groups C and D;
- k) Table 1, 2.11: one old image deleted and new images inserted, requirements for "butt joint (through-welded)";
- l) Table 1, 2.12: new image inserted with new requirements, changes to assessment groups C and D;
- m) Standard editorially revised.

National Annex NA **(informative)**

References

DIN EN ISO 2553, *Welding and allied processes - Symbolic representation in drawings - Welded joints*

DIN EN ISO 4063, *Welding and allied processes - List of processes and classification numbers*

DIN EN ISO 6520-1, *Welding and allied processes - Classification of geometric irregularities in metallic materials - Part 1: Fusion welding*

DIN EN ISO 13919-2, *Welding - Electron beam and laser beam welded joints - Guideline for assessment groups for irregularities - Part 2: Aluminum and its weldable alloys*

DIN EN ISO 17635, *Non-destructive testing of welded joints - General rules for metallic materials*

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- *Draft* -

Welding - Arc welded joints on aluminum and its alloys - Assessment groups of irregularities (ISO/DIS 10042:2017)

Soudage - Assemblages en aluminium et alliages d'aluminium soudés à l'arc - Niveaux de qualité par rapport aux défauts (ISO/DIS 10042:2017)

Welding - Arc-welded joints in aluminum and its alloys - Quality levels for imperfections (ISO/DIS 10042:2017)

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Contents

This template enables the use of standard MS Word functions and formatting. If desired, these can be used to automatically update the table of contents and to apply automatic numbering. Delete table of contents if not required.

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European foreword

This document (prEN ISO 10042:2017) has been prepared by Technical Committee ISO/TC 44 "Welding and allied processes" in collaboration with Technical Committee CEN/TC 121 "Welding and allied processes", the secretariat of which is held by DIN.

This document is currently submitted for parallel survey. This document will replace EN ISO 10042:2005.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association and supports essential requirements of the EU Directives.

For the connection with EU directives, see informative Annex ZA, B, C or D, which is part of this document.

Recognition note

The text of ISO/DIS 10042:2017 has been approved by CEN as prEN ISO 10042:2017 without any modification.

Foreword

ISO (the International Organization for Standardization) is a worldwide association of national standards organizations (ISO member organizations). The preparation of International Standards is normally carried out by ISO Technical Committees. Any member organization that has an interest 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 participate in the work. ISO works closely with the International Electrotechnical Commission (IEC) on all electrotechnical issues.

The procedures used in the development of this document and those intended for further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the acceptance criteria required for the various ISO document types should be observed. This document has been prepared in accordance with the design rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some elements of this document may infringe patent rights. ISO is not responsible for identifying some or all of the patent rights involved. Details of all patent rights identified during the development of the document can be found in the introduction and/or in the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is provided as information for the benefit of users and does not constitute an endorsement.

An explanation of the meaning of ISO-specific terms and expressions related to conformity assessment and information on ISO's compliance with the World Trade Organization (WTO) principles on Technical Barriers to Trade (TBT) can be found at the following link: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 44/SC 10. The

main changes to ISO 10042:2005 are as follows:

- a) Serial numbers from ISO 4063 deleted in application area;
- b) Table 1, 1.3: Serial number according to ISO 6520-1 changed from "2012 - uniformly distributed porosity" to "2018 - surface porosity";
- c) Table 1, 1.8: New image and change to assessment groups B and C;
- d) Table 1, 1.9: Change to assessment group C;
- e) Table 1, 1.14: additional image inserted;
- f) Table 1, 1.15: Change to assessment group D;
- g) Table 1, 1.18: new image and image deleted, reference to 6520-1-5013 "Root notch" deleted;
- h) Table 1, 1.19 to 1.21: Irregularities Values from ISO 5817 added: Lug defects, ignition point, spatter;
- i) Table 1, 2.2: Changes to assessment groups B and C;

- j) Table 1, 2.10: Changes to assessment groups C and D;
- k) Table 1, 2.11: an old image deleted and new images inserted, requirements for "butt joint (through-welded)";
- l) Table 1, 2.12: new image inserted with new requirements, changes to assessment groups C and D;
- m) Standard editorially revised.

Introduction

This International Standard should be used for reference in the preparation of application rules and/or application standards. It contains a simplified selection of irregularities on arc welded joints with designations according to ISO 6520-1.

Some irregularities according to ISO 6520-1 were used directly and others as groups. The basic ordinal numbering system according to ISO 6520-1 was applied.

The purpose of this International Standard is to define typical irregularities that can be expected in the course of normal production. It can be used in a quality system for the manufacture of shop-welded joints. It specifies three groups of values for the dimensions from which a selection can be made for a particular application. The evaluation group required in individual cases should be determined by the application standard or by the responsible designer together with the manufacturer, user and/or other bodies concerned. The evaluation group must be defined before the start of production, preferably at the quotation or order stage. Additional information may be required in special cases.

The evaluation groups according to this International Standard provide basic reference data and do not relate to any specific application. They refer to the welds in production and not to the whole product or component. It is therefore possible that different evaluation groups are prescribed for individual welds on the same component or product.

Normally, it can be assumed that the tolerance values for irregularities can be determined for a single weld seam by defining an evaluation group. In some cases, however, it may be necessary to define different evaluation groups for different irregularities in the same weld.

When selecting the evaluation groups for a particular application, the design conditions, the subsequent processes (e.g. surface treatment), the types of stress (e.g. static, dynamic), the operating conditions (e.g. temperature, environment) and the consequences of defects should be taken into account. Economic factors are also important and should include not only the cost of welding, but also the cost of inspection, testing and repair.

Although this International Standard contains various types of irregularities that apply to arc welding processes according to Section 1, only those that are relevant to the process and application in question need be considered.

The irregularities are indicated with their actual size and their detection and evaluation may require the use of one or more non-destructive testing methods. The detection and sizing of irregularities depends on the test methods and the extent of the test as specified in the application standard or contract.

The procedures for the detection of irregularities are not covered by this International Standard. However, ISO 17635 contains information on interactions between the assessment groups and the acceptability limits for various non-destructive testing methods.

This International Standard can be used directly for the visual inspection of welds. It does not specify recommended methods for detection or sizing by other non-destructive methods. It should be borne in mind that in the application of these limits it is necessary to establish appropriate criteria for non-destructive testing methods such as ultrasonic, radiographic and other methods,

penetration test, there are difficulties. Therefore, additional recommendations for assessment, examination and testing may be necessary.

The specified values for irregularities of weld seams take into account normal welding practice. Requirements for smaller (stricter) values, as specified in evaluation group B, may require additional manufacturing processes, e.g. smoothing with the TIG process, grinding.

Queries concerning the official interpretation of the contents of this International Standard should be addressed to the ISO/TC 44/SC 10 Secretariat via the relevant national standards institute. A complete list of these institutes can be obtained from www.iso.org.

1 Area of application

This International Standard contains assessment groups of irregularities on arc welded joints made of aluminum and its alloys. It applies to material thicknesses greater than 0.5 mm and covers full penetration butt welds and all types of fillet welds. The principles of this International Standard may also be applied to partially through-welded butt welds.

ISO 13919-2 contains assessment groups for beam-welded joints.

The three evaluation groups are defined in such a way that they allow a wide range of applications in welding production. They are designated by the code letters B, C and D. Evaluation group B corresponds to the highest requirements for the finished weld seam. The evaluation groups refer to the production quality and not to the fitness for use (see 3.2) of the finished product.

This International Standard applies to:

- all welded joints, e.g. butt welds, fillet welds and pipe branches;
- the following welding processes:
 - Metal inert gas welding (MIG welding); USA: gas metal arc welding
 - Tungsten inert gas welding (TIG welding); USA: gas tungsten arc welding
 - Plasma welding;
- manual, mechanized and automatic welding;
- all welding positions.

Metallurgical aspects, e.g. grain size, hardness, are not covered by this International Standard.

2 Normative references

The following documents, which are cited in this document in part or in full, are required for the application of this document. For dated references, only the referenced edition applies. For undated references, the latest edition of the referenced document (including all amendments) applies.

ISO 2553, *Welding and allied processes - Symbolic representation on drawings - Welded joints*

ISO 4063, *Welding and allied processes - Nomenclature of processes and reference numbers*

ISO 6520-1, *Welding and allied processes - Classification of geometric imperfections in metallic materials - Part 1: Fusion welding*

3 Terms

The following terms apply to the application of this document.

3.1

Evaluation group

Description of the quality of a weld based on the type, size and number of selected irregularities

3.2

Suitability for use

Property of a product, process or service to fulfill a specific purpose under specific conditions

3.3

Short irregularities

Irregularities are considered short irregularities if, for welds 100 mm or longer, the total length of the irregularities does not exceed 25 mm in a section of 100 mm containing most of the irregularities;

if the weld is shorter than 100 mm, irregularities are considered short irregularities if their total length does not exceed 25 % of the length of the weld

3.4

Systematic irregularity

Irregularities that are repeated at regular intervals in the weld seam over the examined weld seam length; the dimensions of the individual irregularities are within the allowable limits

3.5

Cross-sectional area

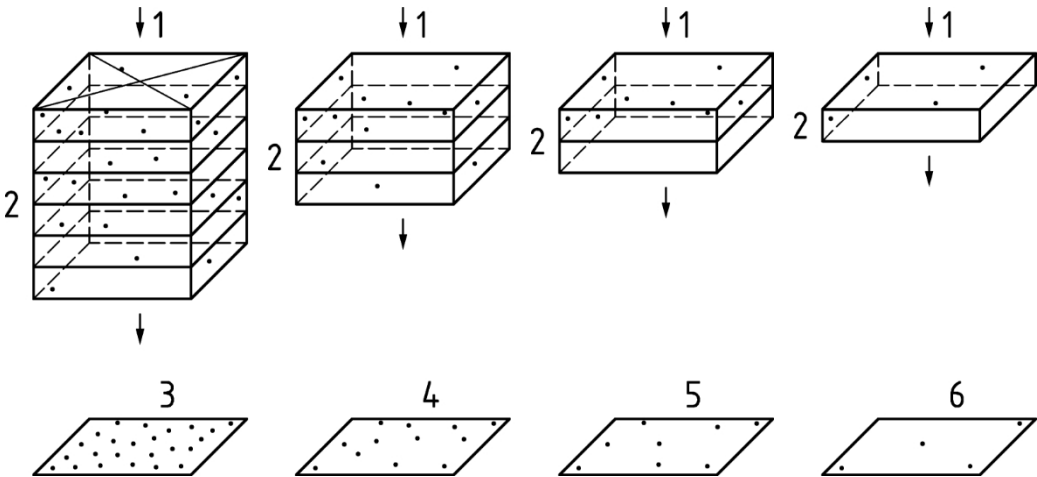
Fracture surface or grinding plane to be considered

3.6

Projected area

Surface on which the irregularities distributed over the volume of the weld seam under consideration are mapped two-dimensionally

NOTE In contrast to the cross-sectional area, the occurrence of irregularities in the radiographic image depends on the thickness of the weld seam (see Figure 1).



Legend

1	X-ray beam direction	3	6-fold thickness	5	2-fold thickness
2	4 pores per unit volume	4	3-fold thickness	6	1-fold thickness

Figure 1 - Radiographic images of samples with identical pore frequency per unit volume

4 Symbols

The following symbols are used in Table 1:

- A* Surface surrounding the pores;
- a* Nominal dimension of fillet weld thickness (see also ISO 2553);
- b* Width of the seam rise;
- d* Pore diameter;
- d_A* Diameter of the surface surrounding the pores;
- d_{Ac}* Diameter of the envelope curve around the entire pore area;
- h* Height or width of an irregularity;
- l* Length of an irregularity in the longitudinal direction of the weld;
- l_p* Length of the projected area or cross-sectional area;
- s* Nominal dimension of the butt weld thickness (see also ISO 2553);
- t* Wall or sheet thickness (nominal size);
- w_p* Width of the weld seam or width or height of the cross-sectional area;
- z* Side length of a fillet weld (see also ISO 2553).

5 Assessment of irregularities

The limits for irregularities are contained in Table 1.

If microscopic testing is used to detect irregularities, only those irregularities that can be detected with a maximum magnification of ten times may be taken into account. This does not apply to microcracks (see Table 1, 2.2).

Systematic irregularities are only permitted in assessment group D, provided that the other requirements in Table 1 are met.

A weld seam should normally be assessed separately according to the individual types of irregularities (see Table 1, 1.1 to 3.2).

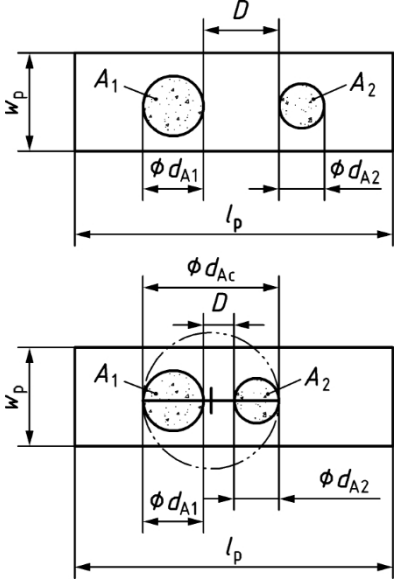
If different types of irregularities occur in a seam cross-section, special assessments are necessary (see multiple irregularities in Table 1, 4.1).

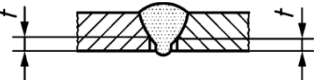
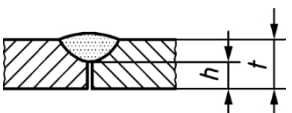
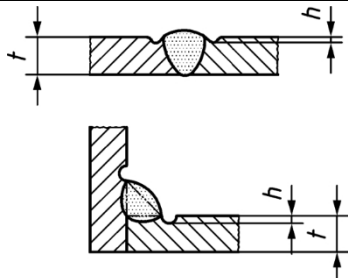
The limits for multiple irregularities (see Table 1) only apply in cases where the requirements for a single irregularity are not exceeded.

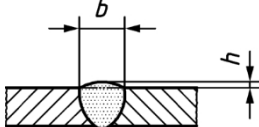
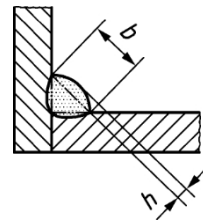
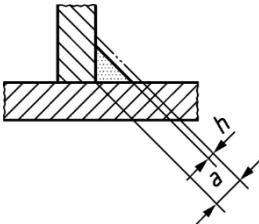
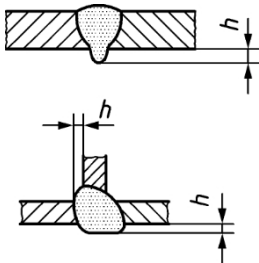
Every two adjacent irregularities with a distance smaller than the main dimension of the smaller irregularity are to be regarded as one irregularity.

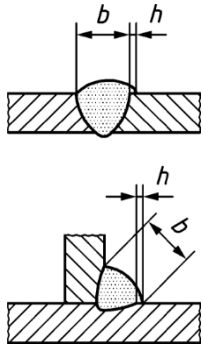
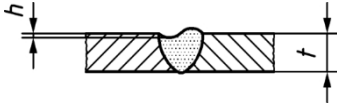
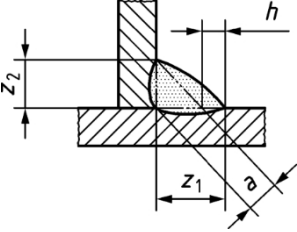
Table 1 - Limits for irregularities

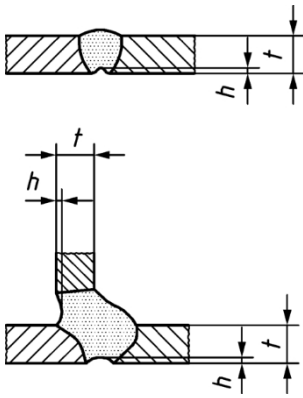
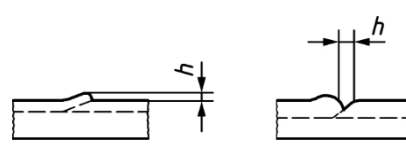
No.	Serial no. according to ISO 6520-1	Identification of the irregularity	Remarks	t mm	Limit values for irregularities in valuation groups		
					D	C	B
1 Surface irregularities							
1.1	100	Tear	-	$\geq 0,5$	Not permitted	Not permitted	Not permitted
1.2	104	End crater crack	h = height <i>or</i> width	$\geq 0,5$	$h \leq 0.4s$ or $0.4a$ $l \leq 0.4s$ or $0.4a$	Not permitted	Not permitted
1.3	2018	Surface porosity	See Appendix A for examples of porosity assessment.	$\geq 0,5$	$\leq 2 \%$	$\leq 1 \%$	$\leq 0,5 \%$

No.	Serial no. according to ISO 6520-1	Identification of the irregularity	Remarks	t mm	Limit values for irregularities in valuation groups		
					D	C	B
1.4	2013	Pore nest	 <p>The entire pore area within a pore nest is represented by an envelope curve with the diameter d_A. For all pores in the envelope, the requirements for a single pore are met. The permissible pore area must be locally limited. The possibility that other irregularities are concealed by the pore nest must be taken into account. If D is less than d_{A1} or d_{A2}, whichever is smaller, then the diameter d_{Ac} of the envelope curve around the entire pore area can be formed with $d_{Ac} = d_{A1} + d_{A2} + D$. Systematic pore nests are not permitted.</p>	$\geq 0,5$	$d_A \leq 25 \text{ mm}$ or $d_{A,max} \leq w_p$ d_A corresponds to d_{A1} , d_{A2} or d_{Ac} , as appropriate, what applies	Not permitted	Not permitted
1.5	2014	Pore line	-	$\geq 0,5$	Not permitted	Not permitted	Not permitted

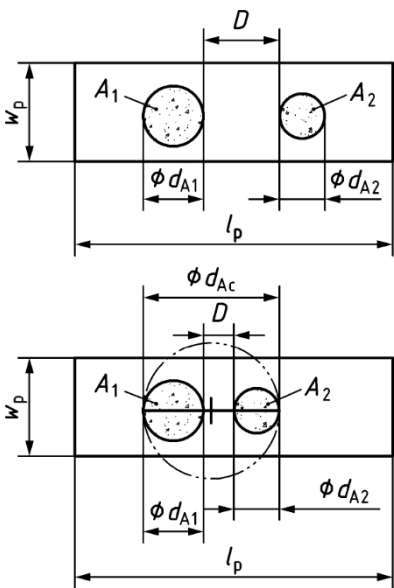
No.	Serial no. according to ISO 6520-1	Identification of the irregularity	Remarks	t mm	Limit values for irregularities in valuation groups		
					D	C	B
1.6	2017	Surface pore	Maximum dimension of a single pore:	0.5 to 3 > 3	$d \leq 0.3s$ or $0.3a$ $d \leq 0.4s$ or $0.4a$ max. 3 mm	$d \leq 0.2s$ or $0.2a$ $d \leq 0.3s$ or $0.3a$ max. 1.5 mm	$d \leq 0.1s$ or $0.1a$ $d \leq 0.2s$ or $0.2a$ max. 1 mm
1.7	2025	Open end crater blowhole	-	$\geq 0,5$	$h \leq 0.4t$ max. 3 mm	$h \leq 0.2t$ max. 1.5 mm	Not permitted
1.8	401	Binding error		$\geq 0,5$	Short irregular opportunities $h \leq 0.1s$ or $0.1a$ max. 3 mm	Not permitted	Not permitted
1.9	4021	Insufficient root penetration		$\geq 0,5$	Short irregularities, but no systematic irregularities. opportunities $h \leq 0.2t$ max. 2 mm	Not permitted	Not permitted
1.10	5011	Continuous single-edge notch		0.5 to 3 > 3	$h \leq 0.2t$ $h \leq 0.2t$ but max. 1 mm	$h \leq 0.1t$ $h \leq 0.1t$ but max. 0.5 mm	Not permitted Not permitted
	5012	Non-continuous notch (short irregularity)	Soft weld seam transition is required. 5012 is not considered a systematic irregularity.	0.5 to 3 > 3	$h \leq 0.2t$ $h \leq 0.2t$ but max. 1.5 mm	$h \leq 0.1t$ $h \leq 0.1t$ but max. 1 mm	$h \leq 0.1t$ $h \leq 0.1t$ but max. 0.5 mm

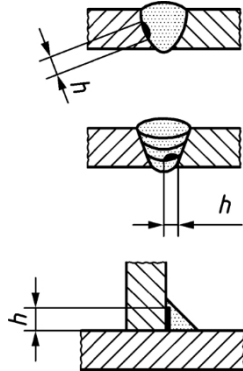
No.	Serial no. according to ISO 6520-1	Identification of the irregularity	Remarks	t mm	Limit values for irregularities in valuation groups		
					D	C	B
1.11	502	Excessive seam camber (butt seam)	Soft weld seam transition is required. 	$\geq 0,5$	$h \leq 1.5 \text{ mm} + 0,2b$ max. 10 mm	$h \leq 1.5 \text{ mm} + 0,15b$ max. 8 mm	$h \leq 1.5 \text{ mm} + 0,1b$ max. 6 mm
1.12	503	Excessive seam camber (fillet weld)		$\geq 0,5$	$h \leq 1.5 \text{ mm} + 0,3b$ max. 5 mm	$h \leq 1.5 \text{ mm} + 0,15b$ max. 4 mm	$h \leq 1.5 \text{ mm} + 0,1b$ max. 3 mm
1.13	5213	Fillet weld thickness too small	Does not apply to processes with demonstrably greater penetration depth. 	$\geq 0,5$	Short irregularities		
					$h \leq 0.3a$ max. 2 mm	$h \leq 0.2a$ max. 1.5 mm	$h \leq 0.1a$ max. 1 mm
1.14	504	Excessive root elevation		$\geq 0,5$	$h \leq 5 \text{ mm}$	$h \leq 4 \text{ mm}$	$h \leq 3 \text{ mm}$

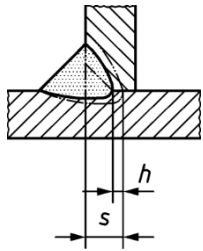
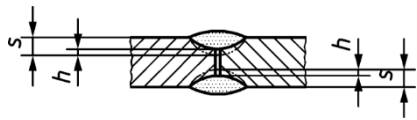
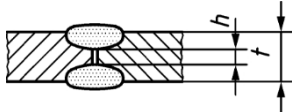
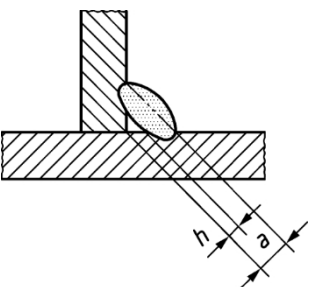
No.	Serial no. according to ISO 6520-1	Identification of the irregularity	Remarks	t mm	Limit values for irregularities in valuation groups		
					D	C	B
1.15	506	Overlap		$\geq 0,5$	Short irregularities permitted, whereby $h \leq 0.2b$	Not permitted	Not permitted
1.16	509	Lost weld metal	Soft weld seam transition is required.	$\geq 0,5$	Short irregularities		
	511	Top layer camber			$h \leq 0.2t$ max. 2 mm	$h \leq 0.1t$ max. 1 mm	$h \leq 0.05t$ max. 0.5 mm
1.17	512	Excessive asymmetry of the fillet weld (leg length too uneven)	In cases where no asymmetrical fillet weld is specified. 	$\geq 0,5$	$h \leq 3 \text{ mm} + 0,3a$	$h \leq 2 \text{ mm} + 0,25a$	$h \leq 1.5 \text{ mm} + 0,2a$

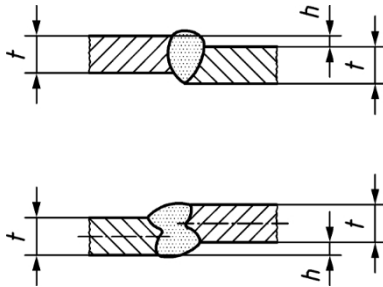
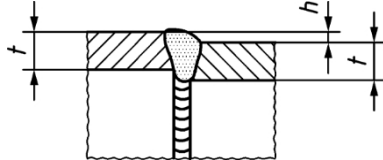
No.	Serial no. according to ISO 6520-1	Identification of the irregularity	Remarks	t mm	Limit values for irregularities in valuation groups		
					D	C	B
1.18	515	Root relapse	Soft weld seam transition is required. 	$\geq 0,5$	Short irregularities		
					$h \leq 0.2t$ max. 1.5 mm	$h \leq 0.1t$ max. 1 mm	$h \leq 0.05t$ max. 0.5 mm
1.19	517	Attachment error		$\geq 0,5$	Permissible The limit value depends on the type of Irregularity, which is due to the approach came about.	Not permitted	Not permitted
1.20	601	Ignition point	-	$\geq 0,5$	Permitted for short irregular opportunities	Not permitted	Not permitted
1.21	602	Splash	-	$\geq 0,5$	Admissibility depends on the application, z. e.g. material, corrosion protection	Admissibility depends on the application, z. e.g. material, corrosion protection	Admissibility depends on the application, z. e.g. material, corrosion protection

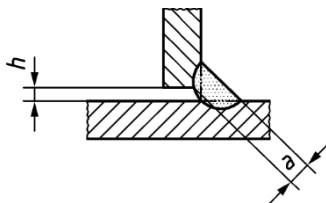
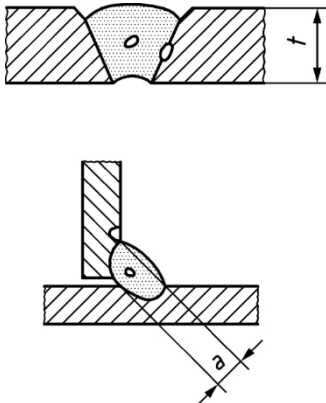
No.	Serial no. according to ISO 6520-1	Identification of the irregularity	Remarks	t mm	Limit values for irregularities in valuation groups		
					D	C	B
2 Internal irregularities							
2.1	100	Tear	All types of cracks except microcracks and end crater cracks.	$\geq 0,5$	Not permitted	Not permitted	Not permitted
2.2	1001	Microcrack	A crack that is usually only visible under a microscope ($\times 50$).	$\geq 0,5$	Permitted	max. 0.6 mm \times 0.02 mm with max. 4 irregular opportunities per 2 mm \times 2 mm	max. 0.4 mm \times 0.01 mm with max. 3 irregular opportunities per 2 mm \times 2 mm
2.3	2011	Pore	Largest dimension of a single pore.	$\geq 0,5$	$d \leq 0.4s$ or $0.4a$ but max. 6 mm	$d \leq 0.3s$ or $0.3a$ but max. 5 mm	$d \leq 0.2s$ or $0.2a$ but max. 4 mm
2.4	2012	Evenly distributed porosity	The porosity is assessed on the basis of the cross-sectional area. See examples in Appendix A.	$\geq 0,5$	$\leq 6\%$	$\leq 2\%$	$\leq 1\%$
			Irregularities are assessed on the basis of the projected area. See examples in Appendix A.	0.5 to 3 > 3 to 12 > 12 to 30 > 30	$\leq 6\%$ $\leq 10\%$ $\leq 15\%$ $\leq 20\%$	$\leq 2\%$ $\leq 4\%$ $\leq 6\%$ $\leq 8\%$	$\leq 1\%$ $\leq 2\%$ $\leq 3\%$ $\leq 4\%$

No.	Serial no. according to ISO 6520-1	Identification of the irregularity	Remarks	t mm	Limit values for irregularities in valuation groups		
					D	C	B
2.5	2013	Pore nest	 <p>The entire pore area within a pore nest is represented by an envelope curve with the diameter d_A. The conditions for the individual pore must be observed for the pores in the envelope. The permissible pore area must be locally limited. The possibility that other irregularities are concealed must be taken into account. If D is less than d_{A1} or d_{A2}, whichever is smaller, the throughput must be d_{Ac} of the envelope curve must be formed around the entire pore area with $d_{Ac} = d_{A1} + d_{A2} + D$. Systematic pore nests are not permitted.</p>	$\geq 0,5$	$d_A \leq 25 \text{ mm}$ or $d_{A,max} \leq w_p$	$d_A \leq 20 \text{ mm}$ or $d_{A,max} \leq w_p$	$d_A \leq 15 \text{ mm}$ or $d_{A,max} \leq w_p/2$
2.6	2014	Pore line	-	$\geq 0,5$	Short irregularities permitted	Not permitted	

No.	Serial no. according to ISO 6520-1	Identification of the irregularity	Remarks	t mm	Limit values for irregularities in valuation groups		
					D	C	B
2.7	2015 2016	Gas duct Hose pore	-	$\geq 0,5$	$l \leq 0.4s$ or $0.4a$ but max. 6 mm	$l \leq 0.3s$ or $0.3a$ but max. 4 mm	$l \leq 0.2s$ or $0.2a$ but max. 3 mm
2.8	303	Oxide inclusion	If there are several oxide inclusions $l_1, l_2, l_3, \dots, l_n$ are present, these are added together: $l = l_1 + l_2 + l_3 + \dots + l_n$.	$\geq 0,5$	Short irregularities		
					$l \leq s$ or a max. 10 mm	$l \leq 0.5s$ or $0.5a$ max. 5 mm	$l \leq 0.2s$ or $0.2a$ max. 3 mm
2.9	3041	Tungsten inclusion	-	$\geq 0,5$	$l \leq 0.4s$ or $0.4a$ but max. 6 mm	$l \leq 0.3s$ or $0.3a$ but max. 4 mm	$l \leq 0.2s$ or $0.2a$ but max. 3 mm
2.10	401	Binding error		$\geq 0,5$	Short irregularities permissible $h \leq 0.4b$ or $0.4a$ but max. 3 mm	Short irregularities permissible $h \leq 0.2b$ or $0.2a$ but max. 2 mm	Not permitted

No.	Serial no. according to ISO 6520-1	Identification of the irregularity	Remarks	t mm	Limit values for irregularities in valuation groups		
					D	C	B
2.11	402	Insufficient welding penetration		$\geq 0,5$	Short irregularities, but no systematic irregularities		Not permitted
					$h \leq 0.4s$ max. 4 mm	$h \leq 0.2s$ max. 2 mm	
				$\geq 0,5$	Short irregularity $h \leq 0.2t$ but max. 2 mm	Not permitted	Not permitted
2.12	4021	Insufficient root penetration for fillet welds		$\geq 0,5$	Short irregularities		
					$h \leq 0.4a$ max. 4 mm	$h \leq 0.2a$ max. 2 mm	$h \leq 0.1a$ max. 1 mm

No.	Serial no. according to ISO 6520-1	Identification of the irregularity	Remarks	t mm	Limit values for irregularities in valuation groups		
					D	C	B
3 Irregularities in the seam geometry							
3.1	507	Edge offset	<p>The limit values refer to the deviations from the perfect position. Unless otherwise specified, the perfect position is given if the center lines match (see also section 1). t refers to the smaller thickness.</p>  <p>Sheets and longitudinal weld seams</p>	$\geq 0,5$	$h \leq 0.4t$ max. 8 mm	$h \leq 0.3t$ max. 4 mm	$h \leq 0.2t$ max. 2 mm
			 <p>Circumferential weld seams</p>				

No.	Serial no. according to ISO 6520-1	Identification of the irregularity	Remarks	t mm	Limit values for irregularities in valuation groups		
					D	C	B
3.2	617	Poor fit with fillet welds	<p>A gap between the parts that are connected.</p>  <p>Gaps that exceed the permissible limit may be compensated for in special cases by increasing the fillet weld thickness. become.</p>	$\geq 0,5$	$h \leq 1 \text{ mm} + 0,2a$ max. 5 mm	$h \leq 0.5 \text{ mm} + 0,15a$ max. 4 mm	$h \leq 0.5 \text{ mm} + 0,1a$ max. 3 mm
4 Multiple irregularities							
4.1	-	Multiple irregularities in the cross-section		$\geq 0,5$	The sum of the permissible individual irregularities must not exceed in any cross-section:		
					$0.4t$ or $0.4a$	$0.3t$ or $0.3a$	$0.2t$ or $0.2a$

Appendix A (informative)

Examples for determining the percentage of porosity

Figures A.1 to A.10 show different percentages of porosity. These should support the evaluation of porosity on projected surfaces (radiographic images) or cross-sectional surfaces.

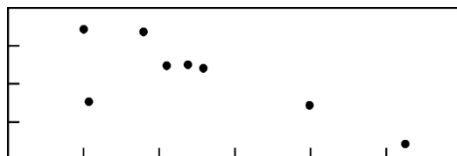


Figure A.1 - 0.5 %

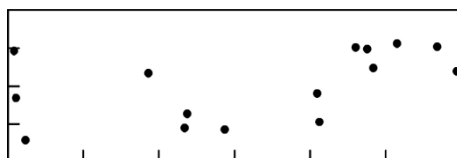


Figure A.2 - 1 %



Figure A.3 - 2 %

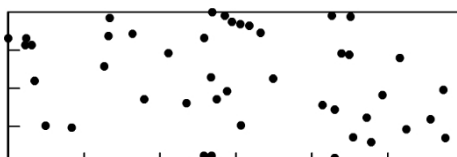


Figure A.4 - 3 %

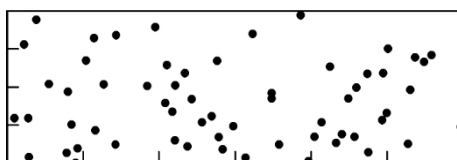


Figure A.5 - 4 %

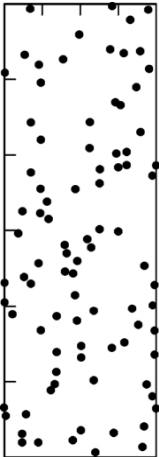


Figure A.6 - 6
%

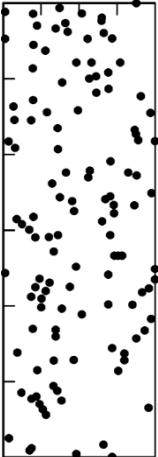


Figure A.7 - 8
%

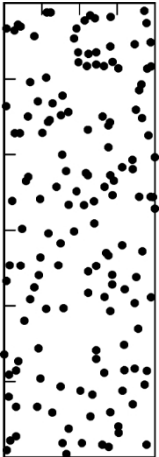


Figure A.8 - 10
%

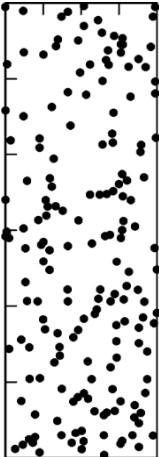


Figure A.9 - 15
%

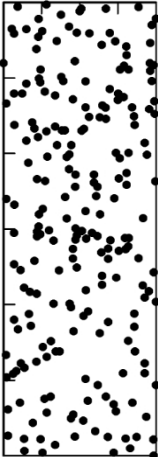


Figure A.10 - 20
%

Appendix B (informative)

Further information and guidelines for the application of this International Standard

This International Standard specifies the requirements for three assessment groups of irregularities in welded joints made of aluminum and its alloys for fusion welding processes (except beam welding) according to the field of application and for weld thicknesses ≥ 0.5 mm. It can be used for other arc welding processes and weld thicknesses if necessary.

Components are very often manufactured for different applications but under similar requirements. However, the same requirements should be applied to identical components produced in different workshops to ensure that the same criteria are applied to the work carried out. The uniform application of this International Standard is one of the basic requirements for a quality assurance system for use in the manufacture of welded structures.

If multiple irregularities are combined, there is a theoretical possibility that individual irregularities may overlap. In such a case, the summation of all permissible deviations should be limited on the basis of the values defined for the various irregularities, i.e. the limit value of a single irregularity, e.g. for a single pore, should not be exceeded.

This International Standard may be used in conjunction with a catalog of realistic pictorial representations showing the size of allowable imperfections for the various assessment groups by means of photographs showing the cover and root side and/or reproductions of radiographs and micrographs showing the cross-section of the weld. An example of such a catalog is *Reference radiographs for the assessment of weld imperfections according to ISO 10042* [3]. This catalog may be used with reference charts to assess the various imperfections and may be consulted when opinions differ, e.g. on the permissible size of imperfections.

References

- [1] ISO 13919-2, *Welding - Electron and laser beam welded joints - Guidance on quality levels for imperfections - Part 2: Aluminum and its weldable alloys*
- [2] ISO 17635, *Non-destructive testing of welds - General rules for fusion welds in metallic materials*
- [3] *Reference radiographs for the assessment of weld imperfections according to ISO 10042*, published by the International Institute of Welding (IIW) and Deutscher Verlag für Schweißen und verwandte Verfahren, Düsseldorf

Contents

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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. www.iso.org/directives

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 44/SC 10.

ADD INFORMATION ABOUT REPLACED STANDARDS AND OTHER PARTS AS NECESSARY

Main changes to the previous edition:

- a) reference numbers from ISO 4063 deleted in the Scope;
- b) Table 1, 1.3: reference number ISO 6520-1 changed from "2012 - uniformly distributed porosity " to "2018 - surface porosity";
- c) Table 1, 1.8: new figure and change to quality level B and C;
- d) Table 1, 1.9: change to quality level C;
- e) Table 1, 1.14: additional figure;
- f) Table 1, 1.15: change to quality level D;
- g) Table 1, 1.18: new figure and figure deleted, reference to 6520-1-5013 "shrinkage groove" deleted;
- h) Table 1, 1.19 to 1.21, : imperfections added with values from ISO 5817: poor restart, stray arc, spatter;
- i) Table 1, 2.2: changes to quality levels B and C;

- j) Table 1, 2.10: changes to quality levels C and D;
- k) Table 1, 2.11: one old figure deleted and new figures introduced, requirements for "Butt joint (full penetration)";
- l) Table 1, 2.12: new figure introduced with new requirements, changes to quality levels C and D;
- m) standard editorially revised.

Introduction

This International Standard should be used as a reference in drafting application codes and/or other application standards. It contains a simplified selection of arc welding imperfections based on the designations given in ISO 6520-1.

Some imperfections described in ISO 6520-1 have been used directly and some have been grouped together. The basic numerical referencing system from ISO 6520-1 has been used.

The purpose of this International Standard is to define the dimensions of typical imperfections which might be expected in normal fabrication. It may be used within a quality system for the production of 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 responsible designer in conjunction with the manufacturer, user and/or other parties concerned. The quality level will have to be prescribed before the start of production, preferably at the enquiry or order stage. For special purposes, additional details may be prescribed.

The quality levels given in this International Standard provide basic reference data and are not specifically related to any particular application. They refer to the types of welded joint in 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.

It would normally be expected that for a particular welded joint the dimensional limits for imperfections could all be covered by specifying one quality level. In some cases, it may be necessary to specify different quality levels for different imperfections in the same welded joint.

The choice of quality level for any application should take account of design considerations, subsequent processing (e.g. surfacing), mode of stressing (e.g. static, dynamic), service conditions (e.g. temperature, environment) and consequences of failure. Economic factors are also important and should include not only the cost of welding but also of inspection, test and repair.

Although this International Standard includes types of imperfection relevant to the arc welding 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, and their detection and evaluation may require the use of one or more methods of non-destructive testing. The detection and sizing of imperfections is dependent on the inspection methods and the extent of testing specified in the application standard or contract.

This International Standard does not address the methods used for the detection of imperfections. However, ISO 17635 contains a correlation between the quality level and acceptance level for different NDT methods.

This International Standard is directly applicable to visual examination of welds and does not include details of recommended methods of detection or sizing by other non-destructive means. It should be

considered that there are difficulties in using these limits to establish appropriate criteria applicable to non-destructive testing methods such as ultrasonic, radiographic and penetrant testing and they may need to be supplemented by requirements for inspection, examination and testing.

The values given for imperfections are for welds produced using normal welding practice. Requirements for smaller (more stringent) values as stated in quality level B may include additional manufacturing processes, e.g. grinding, TIG dressing.

Requests for official interpretation of any aspect of this International Standard should be directed to the secretariat of ISO/TC 44/SC 10 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

Welding - Arc-welded joints in aluminum and its alloys - Quality levels for imperfections

1 Scope

This International Standard specifies quality levels for imperfections in arc-welded joints in aluminum and its alloys. It applies to material thicknesses above 0.5 mm. It covers full-penetration butt welds and all fillet welds. The principles of this International Standard may also be applied to partial-penetration butt welds.

Quality levels for beam-welded joints are presented in ISO 13919-2.

Three quality levels are given in order to permit application to a wide range of welded constructions. They are designated by symbols B, C and D. Quality level B corresponds to the highest requirement on the finished weld. The quality levels refer to production quality and not to the fitness for purpose (see 3.2) of the product manufactured.

This International Standard applies to:

- all types of weld, e.g. butt welds, fillet welds and branch connections;
- the following welding processes:
 - metal inert gas welding (MIG welding); gas metal arc welding /USA/,
 - tungsten inert gas welding (TIG welding); gas tungsten arc welding /USA/,
 - plasma arc welding;
- manual, mechanized and automatic welding;
- all welding positions.

Metallurgical aspects, e.g. grain size, hardness, are not covered by this International Standard.

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 2553, *Welding and allied processes - Symbolic representation on drawings - Welded joints*

ISO 4063, *Welding and allied processes - Nomenclature of processes and reference numbers*

ISO 6520-1, *Welding and allied processes - Classification of geometric imperfections in metallic materials - Part 1: Fusion welding*

3 Terms and definitions

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

3.1

quality level

description of the quality of a weld on the basis of type, size and amount of selected imperfections

3.2

fitness for purpose

ability of a product, process or service to serve a defined purpose under specific conditions

3.3

short imperfections

in cases when the weld is 100 mm long or longer, imperfections are considered to be short imperfections if, in the 100 mm which contains the greatest number of imperfections, their total length is not greater than 25 mm;

in cases when the weld is less than 100 mm long, imperfections are considered to be short imperfections if their total length is not greater than 25 % of the length of the weld

3.4

systematic imperfection

imperfection that is repeatedly distributed in the weld over the weld length to be examined, the size of each individual imperfection being within the specified limits

3.5

cross-sectional area

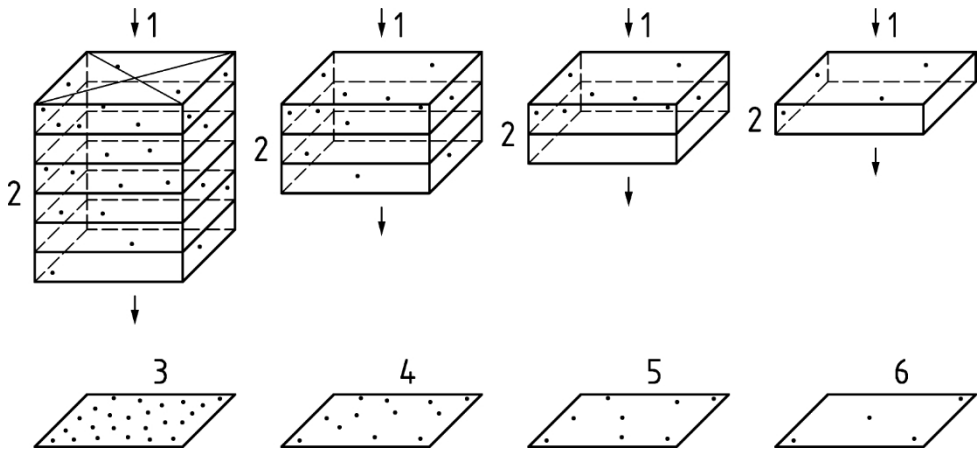
area to be considered after fracture or sectioning

3.6

projected area

area where imperfections distributed along the volume of the weld under consideration are imaged two-dimensionally

NOTE In contrast to the cross-sectional area, the occurrence of imperfections is dependent on the weld thickness when exposed radiographically (see Figure 1).



Key

- | | | |
|---------------------------|--------------------|--------------------|
| 1 direction of X-rays | 3 6-fold thickness | 5 2-fold thickness |
| 2 4 pores per volume unit | 4 3-fold thickness | 6 1-fold thickness |

Figure 1 - Radiographic films of specimens with identical occurrence of pores per volume unit

4 Symbols

The following symbols are used in Table 1:

A area surrounding a gas pore

a nominal throat thickness of a fillet weld (see also ISO 2553)

b width of weld reinforcement

d diameter of a gas pore

d_A diameter of area surrounding a gas pore

d_{Ac} diameter of circle surrounding total gas pore area

h height or width of an *imperfection* l length of imperfection in longitudinal direction of weld

l_p length of projected or cross-sectional area

s nominal butt weld thickness (see also ISO 2553)

t wall or plate thickness (nominal size)

w_p width of weld or width or height of cross-sectional area

z leg length of a fillet weld (see also ISO 2553)

5 Assessment of imperfections

Limits on imperfections are given in Table 1.

If for the detection of imperfections micro-examination is used, only those imperfections which can be detected with a maximum of ten-fold magnification shall be considered. Excluded from this are microcracks (see Table 1, 2.2).

Systematic imperfections are only permitted in quality level D, provided other requirements of Table 1 are fulfilled.

A welded joint should usually be assessed for each individual type of imperfection separately (see Table 1, 1.1 to 3.2).

Different types of imperfection occurring at any cross-section of the joint need special consideration (see multiple imperfections in Table 1, 4.1).

The limits on multiple imperfections (see Table 1) are only applicable in cases where the requirements for a single imperfection are not exceeded.

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

Table 1 - Limits on imperfections

No.	Reference No. in ISO 6520-1	Designation of imperfection	Remarks	t mm	Limits on imperfections for quality levels		
					D	C	B
1 Surface imperfections							
1.1	100	Crack	-	≥ 0,5	Not permitted	Not permitted	Not permitted
1.2	104	Crater crack	h = height <i>or</i> width	≥ 0,5	$h \leq 0.4s$ or $0.4a \leq 0.4s$ or $0.4a$	Not permitted	Not permitted
1.3	2018	Surface porosity	For the assessment of the porosity, see examples given in Annex A	≥ 0,5	≤ 2 %	≤ 1 %	≤ 0,5 %

Table 1 (continued)

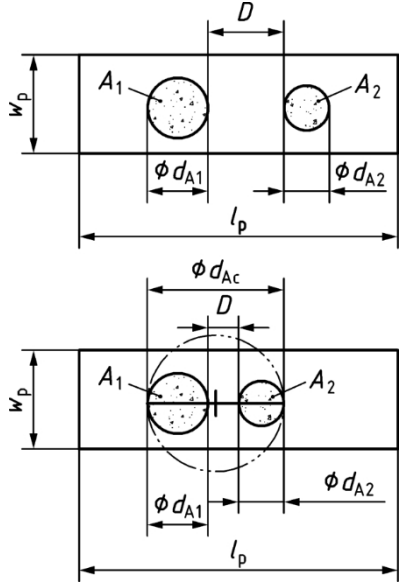
No.	Reference No. in ISO 6520-1	Designation of imperfection	Remarks	t mm	Limits on imperfections for quality levels		
					D	C	B
1.4	2013	Clustered (localized) porosity	<div></div> <p>The total gas pore area within the cluster is represented by a circle of diameter d_A surrounding all the gas pores. The requirements for a single gas pore shall be met by all the gas pores within this circle.</p> <p>A permitted porous area shall be local. The possibility of the pore cluster masking other imperfections shall be taken into consideration.</p> <p>If D is less than d_{A1} or d_{A2}, whichever is smaller, then the total gas pore area is represented by a circle of diameter d_{Ac}, where $d_{Ac} = d_{A1} + d_{A2} + D$.</p> <p>Systematic clustered porosity is not permitted.</p>	$\geq 0,5$	$d_A \leq 25$ mm or $d_{A,max} \leq w_p$ d_A corresponds to d_{A1} , d_{A2} or d_{Ac} whichever is applicable	Not permitted	Not permitted

Table 1 (continued)

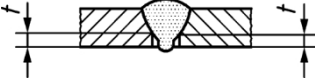
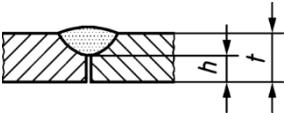
No.	Reference No. in ISO 6520-1	Designation of imperfection	Remarks	t mm	Limits on imperfections for quality levels		
					D	C	B
1.5	2014	Linear porosity	-	≥ 0,5	Not permitted	Not permitted	Not permitted
1.6	2017	Surface pore	Maximum dimension of a single gas pore:	0.5 to 3 > 3	$d \leq 0.3s$ or $0.3a$ $d \leq 0.4s$ or $0.4a$ max. 3 mm	$d \leq 0.2s$ or $0.2a$ $d \leq 0.3s$ or $0.3a$ max. 1.5 mm	$d \leq 0.1s$ or $0.1a$ $d \leq 0.2s$ or $0.2a$ max. 1 mm
1.7	2025	End crater pipe	-	≥ 0,5	$h \leq 0.4t$ max. 3 mm	$h \leq 0.2t$ max. 1.5 mm	Not permitted
1.8	401	Lack of fusion (incomplete fusion)		≥ 0,5	Short imperfections $h \leq 0.1s$ or $0.1a$ max. 3 mm	Not permitted	Not permitted
1.9	4021	Incomplete root penetration		≥ 0,5	Short imperfections but no systematic imperfections. $h \leq 0.2t$ max. 2 mm	Not permitted	Not permitted

Table 1 (continued)

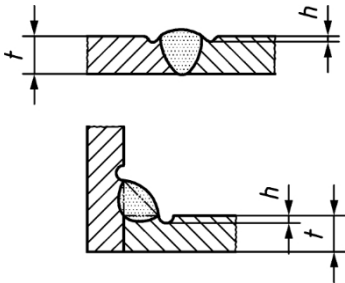
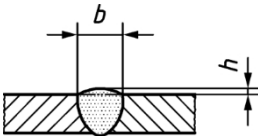
No.	Reference No. in ISO 6520-1	Designation of imperfection	Remarks	<i>t</i> mm	Limits on imperfections for quality levels		
					D	C	B
1.10	5011	Continuous undercut		0.5 to 3	$h \leq 0.2t$	$h \leq 0.1t$	Not permitted
				> 3	$h \leq 0.2t$ but max. 1 mm	$h \leq 0.1t$ but max. 0.5 mm	Not permitted
	5012	Intermittent undercut (short imperfection)	Smooth transition required. 5012 is not regarded as a systematic imperfection.	0.5 to 3 > 3	$h \leq 0.2t$ $h \leq 0.2t$ but max. 1.5 mm	$h \leq 0.1t$ $h \leq 0.1t$ but max. 1 mm	$h \leq 0.1t$ $h \leq 0.1t$ but max. 0.5 mm
1.11	502	Excess weld metal	Smooth transition required. 	≥ 0,5	$h \leq 1.5 \text{ mm} + 0.2b$ max. 10 mm	$h \leq 1.5 \text{ mm} + 0.15b$ max. 8 mm	$h \leq 1.5 \text{ mm} + 0.1b$ max. 6 mm

Table 1 (continued)

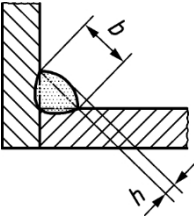
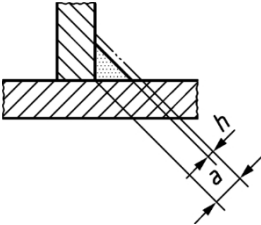
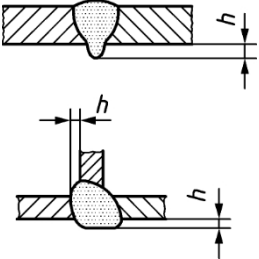
No.	Reference No. in ISO 6520-1	Designation of imperfection	Remarks	t mm	Limits on imperfections for quality levels		
					D	C	B
1.12	503	Excessive convexity		≥ 0,5	$h \leq 1.5 \text{ mm} + 0.3b$ max. 5 mm	$h \leq 1.5 \text{ mm} + 0.15b$ max. 4 mm	$h \leq 1.5 \text{ mm} + 0.1b$ max. 3 mm
1.13	5213	Insufficient throat thickness	Not applicable to processes proven to give greater depth of penetration. 	≥ 0,5	Short imperfections		
					$h \leq 0.3a$ max. 2 mm	$h \leq 0.2a$ max. 1.5 mm	$h \leq 0.1a$ max. 1 mm
1.14	504	Excess penetration		≥ 0,5	$h \leq 5 \text{ mm}$	$h \leq 4 \text{ mm}$	$h \leq 3 \text{ mm}$

Table 1 (continued)

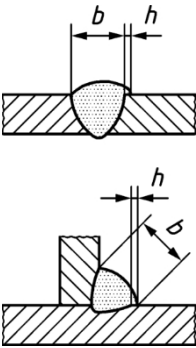
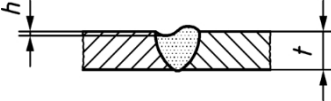
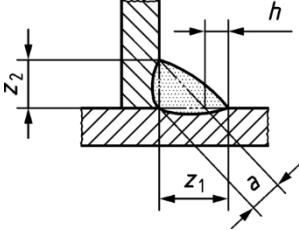
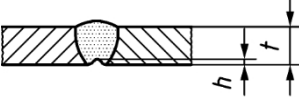
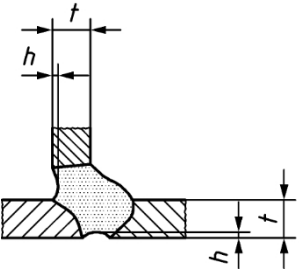
No.	Reference No. in ISO 6520-1	Designation of imperfection	Remarks	t mm	Limits on imperfections for quality levels		
					D	C	B
1.15	506	Overlap		≥ 0,5	Short imperfections permitted, but $h \leq 0.2b$	Not permitted	Not permitted

Table 1 (continued)

No.	Reference No. in ISO 6520-1	Designation of imperfection	Remarks	t mm	Limits on imperfections for quality levels		
					D	C	B
1.16	509 511	Sagging Incompletely filled groove	Smooth transition required. 	≥ 0,5	Short imperfections		
					$h \leq 0.2t$ max. 2 mm	$h \leq 0.1t$ max. 1 mm	$h \leq 0.05t$ max. 0.5 mm
1.17	512	Excessive asymmetry of fillet weld (excessive unequal leg length)	In cases where an asymmetric fillet weld has not been specified. 	≥ 0,5	$h \leq 3 \text{ mm} + 0.3a$	$h \leq 2 \text{ mm} + 0.25a$	$h \leq 1.5 \text{ mm} + 0.2a$
1.18	515	Root concavity	Smooth transition required.  	≥ 0,5	Short imperfections		
					$h \leq 0.2t$ max. 1.5 mm	$h \leq 0.1t$ max. 1 mm	$h \leq 0.05t$ max. 0.5 mm

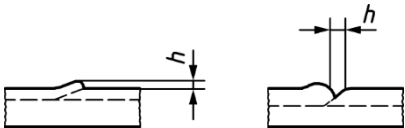
1.19	517	Poor restart		$\geq 0,5$	Permitted The limit depends on the type of imperfection occurred due to restart.	Not permitted	Not permitted
1.20	601	Stray arc	-	$\geq 0,5$	Permitted for short imperfections	Not permitted	Not permitted
1.21	602	Spatter	-	$\geq 0,5$	Acceptance depends on application, e.g. material, corrosion protection	Acceptance depends on application, e.g. material, corrosion protection	Acceptance depends on application, e.g. material, corrosion protection

Table 1 (continued)

No.	Reference No. in ISO 6520-1	Designation of imperfection	Remarks	t	Limits on imperfections for quality levels		
				mm	D	C	B
2 Internal imperfections							
2.1	100	Crack	All types of crack except microcracks and crater cracks.	≥ 0,5	Not permitted	Not permitted	Not permitted
2.2	1001	Microcrack	A crack usually only visible under the microscope (×50)	≥ 0,5	Permitted	max. 0.6 mm x 0.02 mm but max 4 imperfections per 2 mm x 2mm	max. 0.4 mm x 0.01 mm but max 3 imperfections per 2 mm x 2mm
2.3	2011	Gas pore	Maximum dimension of a single gas pore.	≥ 0,5	$d \leq 0.4s$ or 0.4a but max. 6 mm	$d \leq 0.3s$ or 0.3a but max. 5 mm	$d \leq 0.2s$ or 0.2a but max. 4 mm
2.4	2012	Uniformly distributed porosity	The assessment of porosity is done with respect to the cross-sectional area. See examples given in Annex A.	≥ 0,5	≤ 6 %	≤ 2 %	≤ 1 %
			The assessment of imperfections is done with respect to the projected area. See examples given in Annex A.	0.5 to 3	≤ 6 %	≤ 2 %	≤ 1 %
				> 3 to 12	≤ 10 %	≤ 4 %	≤ 2 %
				> 12 to 30	≤ 15 %	≤ 6 %	≤ 3 %
				> 30	≤ 20 %	≤ 8 %	≤ 4 %

Table 1 (continued)

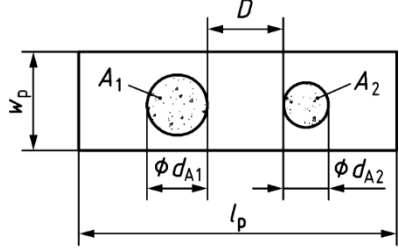
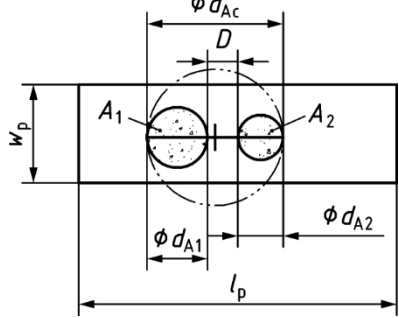
No.	Reference No. in ISO 6520-1	Designation of imperfection	Remarks	t mm	Limits on imperfections for quality levels		
					D	C	B
2.5	2013	Clustered (localized) porosity	<div></div> <div></div> <p>The total gas pore area within the cluster is represented by a circle of diameter dA surrounding all the gas pores. The requirements for a single gas pore shall be met by all the gas pores within this circle.</p> <p>A permitted porous area shall be local. The possibility of the pore cluster masking other imperfections shall be taken into consideration.</p> <p>If D is less than d_{A1} or d_{A2}, whichever is smaller, then the total gas pore area is represented by a circle of diameter d_{Ac}, where $d_{Ac} = d_{A1} + d_{A2} + D$.</p> <p>Systematic clustered porosity is not permitted.</p>	$\geq 0,5$	$dA \leq 25$ mm or $dA_{,max} \leq wp$	$dA \leq 20$ mm or $dA_{,max} \leq wp$	$dA \leq 15$ mm or $dA_{,max} \leq wp/2$

Table 1 (continued)

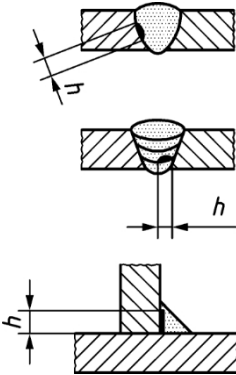
No.	Reference No. in ISO 6520-1	Designation of imperfection	Remarks	t mm	Limits on imperfections for quality levels		
					D	C	B
2.6	2014	Linear porosity	-	≥ 0,5	Short imperfections permitted	Not permitted	
2.7	2015 2016	Elongated cavity Wormhole	-	≥ 0,5	$l \leq 0.4s$ or $0.4a$ but max. 6 mm	$l \leq 0.3s$ or $0.3a$ but max. 4 mm	$l \leq 0.2s$ or $0.2a$ but max. 3 mm
2.8	303	Oxide inclusion	If several oxide inclusions $l_1, l_2, l_3, \dots, l_n$ exist in one cross-section, they are summed: $l = l_1 + l_2 + l_3 + \dots + l_n$.	≥ 0,5	Short imperfections		
					$l \leq s$ or a max. 10 mm	$l \leq 0.5s$ or $0.5a$ max. 5 mm	$l \leq 0.2s$ or $0.2a$ max. 3 mm
2.9	3041	Tungsten inclusion	-	≥ 0,5	$l \leq 0.4s$ or $0.4a$ but max. 6 mm	$l \leq 0.3s$ or $0.3a$ but max. 4 mm	$l \leq 0.2s$ or $0.2a$ but max. 3 mm
2.10	401	Lack of fusion (incomplete fusion)		≥ 0,5	Short imperfections permitted $h \leq 0.4b$ or $0.4 a$ but max. 3 mm	Short imperfections permitted $h \leq 0.2b$ or $0.2a$ but max. 2 mm	Not permitted

Table 1 (continued)

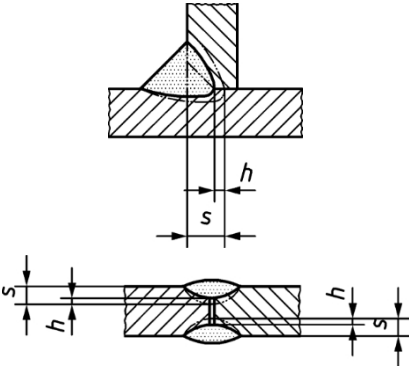
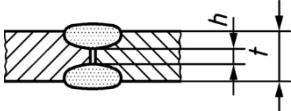
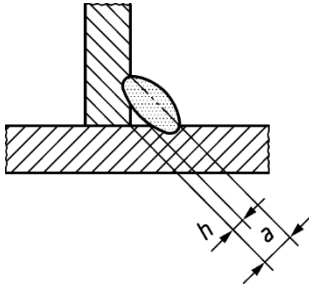
No.	Reference No. in ISO 6520-1	Designation of imperfection	Remarks	t mm	Limits on imperfections for quality levels		
					D	C	B
2.11	402	Lack of penetration (incomplete penetration)		$\geq 0,5$	Short imperfections, but not systematic imperfections		Not permitted
				$\geq 0,5$	Short imperfection: $h \leq 0.2 t$, but max. 2 mm	Not permitted	
2.12	4021	Incomplete penetration root for fillet welds		$\geq 0,5$	Short imperfections		
					$h \leq 0.4a$ max. 4 mm	$h \leq 0.2a$ max. 2 mm	$h \leq 0.1a$ max. 1 mm

Table 1 (continued)

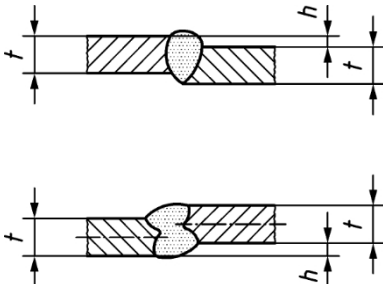
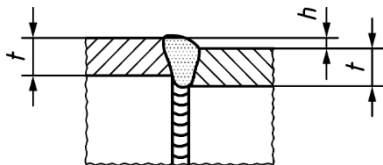
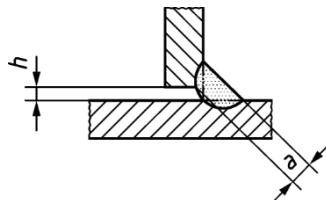
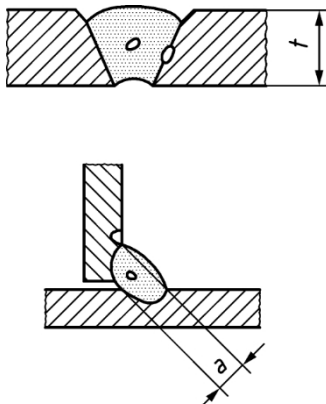
No.	Reference No. in ISO 6520-1	Designation of imperfection	Remarks	<i>t</i>	Limits on imperfections for quality levels		
				mm	D	C	B
3 Imperfections in joint geometry							
3.1	507	Linear misalignment	<p>The limits relate to deviations from the correct position. Unless otherwise specified, the correct position is that when the centerlines coincide (see also Clause 1).</p> <p><i>t</i> refers to the smaller thickness.</p> 	≥ 0,5	$h \leq 0.4t$ max. 8 mm	$h \leq 0.3t$ max. 4 mm	$h \leq 0.2t$ max. 2 mm
			Plates and longitudinal welds				
							
Circumferential welds							

Table 1 (continued)

No.	Reference No. in ISO 6520-1	Designation of imperfection	Remarks	t mm	Limits on imperfections for quality levels					
					D	C	B			
3.2	617	Incorrect root gap for fillet welds	<p>Gap between the parts to be joined.</p>  <p>Gaps exceeding the relevant limit may in certain cases be compensated for by a corresponding increase in the throat thickness.</p>	$\geq 0,5$	$h \leq 1 \text{ mm} + 0.2a$ max. 5 mm	$h \leq 0.5 \text{ mm} + 0.15a$ max. 4 mm	$h \leq 0.5 \text{ mm} + 0.1a$ max. 3 mm			
4 Multiple imperfections										
4.1	-	Multiple imperfections in any cross-section		$\geq 0,5$	The sum of the acceptable individual imperfections in any cross-section shall not exceed: <table><tr><td>$0.4t$ or $0.4a$</td><td>$0.3t$ or $0.3a$</td><td>$0.2t$ or $0.2a$</td></tr></table>			$0.4t$ or $0.4a$	$0.3t$ or $0.3a$	$0.2t$ or $0.2a$
$0.4t$ or $0.4a$	$0.3t$ or $0.3a$	$0.2t$ or $0.2a$								

Annex A (informative)

Examples of the determination of the percent porosity

Figures A.1 to A.10 illustrate different percent (%) porosities. They are intended to assist in the assessment of porosity in projected areas (radiographs) or in cross-sectional areas.

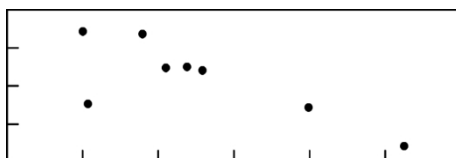


Figure A.1 - 0.5 %

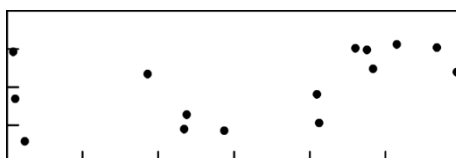


Figure A.2 - 1 %

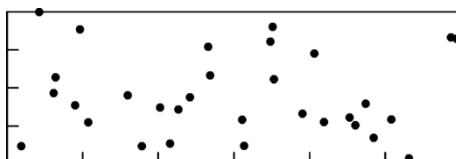


Figure A.3 - 2 %

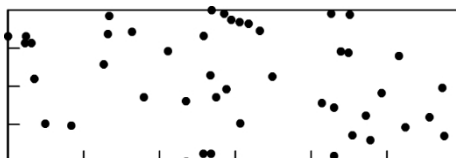


Figure A.4 - 3 %

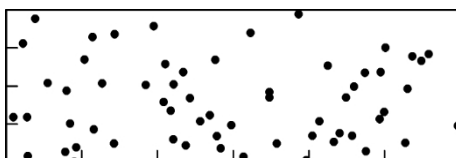


Figure A.5 - 4 %



Figure A.6 - 6 %

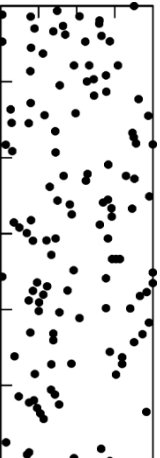


Figure A.7 - 8 %

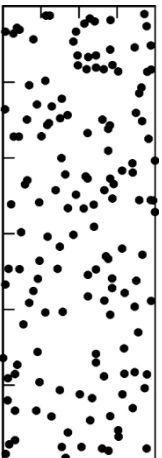


Figure A.8 - 10 %

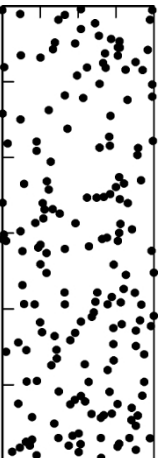


Figure A.9 - 15 %

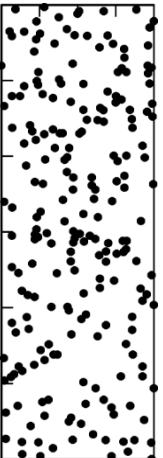


Figure A.10 - 20 %

Annex B (informative)

Additional information and guidelines for users of this International Standard

This International Standard specifies requirements for three quality levels for imperfections in welded joints of aluminum and its alloys produced by arc welding processes (beam welding excluded), as specified in the scope, and for weld thicknesses ≥ 0.5 mm. It may be used, where applicable, for other arc welding processes and weld thicknesses.

Components are very often produced for different applications, but to similar requirements. The same requirements should, however, apply to identical components produced in different workshops to ensure that work is carried out using the same criteria. The consistent application of this International Standard is one of the fundamental cornerstones of a quality assurance system for use in the production of welded structures.

When summing multiple imperfections, there is a theoretical possibility of individual imperfections being superimposed. In such a case, the summation of all permitted deviations should be restricted by the values specified for the various imperfections, i.e. the limit for a single imperfection, e.g. a single pore, should not be exceeded.

This International Standard may be used in conjunction with a catalogue of realistic illustrations showing the sizes of the permissible imperfections for the various quality levels by means of photographs showing the face and root side and/or reproductions of radiographs and of photomacrographs showing the cross-section of the weld. An example of such a catalogue is *Reference radiographs for the assessment of weld imperfections according to ISO 10042* [3]. This catalogue may be used with reference cards to assess the various imperfections and may be employed when opinions differ as to the permissible size of imperfections.

Bibliography

- [1] ISO 13919-2, *Welding - Electron and laser beam welded joints - Guidance on quality levels for imperfections - Part 2: Aluminum and its weldable alloys*
- [2] ISO 17635, *Non-destructive testing of welds - General rules for fusion welds in metallic materials*
- [3] *Reference radiographs for the assessment of weld imperfections according to ISO 10042*, published by the International Institute of Welding (IIW) and Deutscher Verlag für Schweißen und verwandte Verfahren, Düsseldorf