INTERNATIONAL STANDARD

ISO 9013

Third edition
2017-02

Thermal cutting — Classification of thermal cuts — Geometrical product specification and quality tolerances

Coupage thermique — Classification des coupes thermiques — Spécification géométrique des produits et tolérances relatives à la qualité

Reference number
ISO 9013:2017(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword ... **iv**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **1**
3.1 General ... 1
3.2 Terms and definitions explained by figures ... 2
3.2.1 Terms related to the cutting process ... 2
3.2.2 Terms on the cut work piece ... 3
3.2.3 Cut types ... 4

4 Symbols ... **8**

5 Form and location tolerances ... **9**

6 Determination of the quality of cut surfaces ... **9**
6.1 General ... 9
6.2 Measuring ... 10
6.2.1 Measuring conditions ... 10
6.2.2 Measuring point ... 10
6.2.3 Procedure ... 11

7 Quality of the cut surface ... **12**
7.1 Characteristic values ... 12
7.2 Measuring ranges ... 12
7.2.1 General ... 12
7.2.2 Perpendicularity or angularity tolerance, *u* ... *12*
7.2.3 Mean height of the profile, *Rz*5 ... 13

8 Dimensional tolerances ... **15**
8.1 General ... 15
8.2 Dimensional tolerances on parts without finishing ... 18
8.3 Dimensional tolerances on parts with finishing ... 18
8.3.1 General ... 18
8.3.2 Machining allowance ... 19

9 Designation ... **19**

10 Information in technical documentation ... **20**
10.1 Indications of size ... 20
10.2 Indication of quality of cut surface and of tolerance class ... 20
10.2.1 On technical drawings ... 20
10.2.2 Title block of technical documentation ... 20

Annex A (informative) **Achievable cut qualities for different cutting processes** ... **21**

Annex B (informative) **Thermal cutting — Process principles** ... **26**

Bibliography ... **28**

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 (see 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 (see 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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 8, *Equipment for gas welding, cutting and allied processes*.

This third edition cancels and replaces the second edition (ISO 9013:2002), which has been technically revised.

Requests for official interpretations of any aspect of this document should be directed to the Secretariat of ISO/TC 44/SC 8 via your national standards body. A complete listing of these bodies can be found at www.iso.org.

Thermal cutting — Classification of thermal cuts — Geometrical product specification and quality tolerances

1 Scope

This document presents geometrical product specifications and quality tolerances for the classification of thermal cuts in materials suitable for oxyfuel flame cutting, plasma cutting and laser cutting. It is applicable to flame cuts from 3 mm to 300 mm, plasma cuts from 0,5 mm to 150 mm and laser cuts from 0,5 mm to 32 mm.

The geometrical product specifications are applicable if reference to this document is made in drawings or pertinent documents, e.g. delivery conditions. If this document were also to apply, by way of exception, to parts produced by other cutting processes, this would have to be agreed upon separately.

Flatness defects are not addressed as such in this document. The references are to the current standards for the materials used.

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 1302:2002, *Geometrical Product Specifications (GPS) — Indication of surface texture in technical product documentation*

ISO 3274, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Nominal characteristics of contact (stylus) instruments*

ISO 4288, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*

ISO 8015, *Geometrical product specifications (GPS) — Fundamentals — Concepts, principles and rules*

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 http://www.electropedia.org/

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

3.1 General

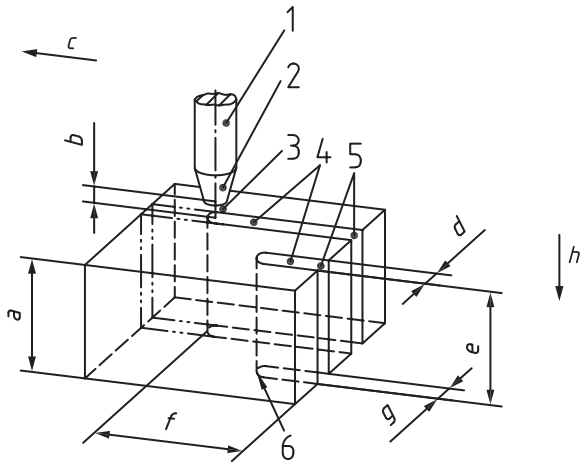
3.1.1
cutting
operation of cutting the work piece

3.1.2
cut
result of the cutting operation

3.2 Terms and definitions explained by figures

NOTE Figure 1 indicates the terms related to the cutting process of the work piece after the cutting process has started, Figure 2 indicates the terms for the finished work piece, Figure 3 shows a straight cut and Figure 4, a contour cut.

3.2.1 Terms related to the cutting process

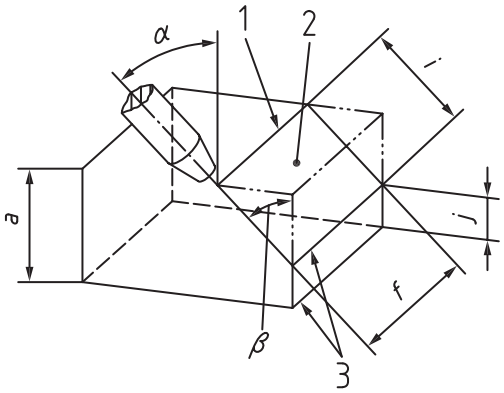


Key

1	torch/cutting head	*a*	work piece thickness
2	nozzle	*b*	nozzle distance
3	beam/flame/arc	*c*	advance direction
4	kerf	*d*	top kerf width
5	start of cut	*e*	cut thickness
6	end of cut	*f*	length of cut
		g	bottom kerf width
		h	cutting direction

Figure 1 — Terms related to the cutting process of the work piece

3.2.2 Terms on the cut work piece

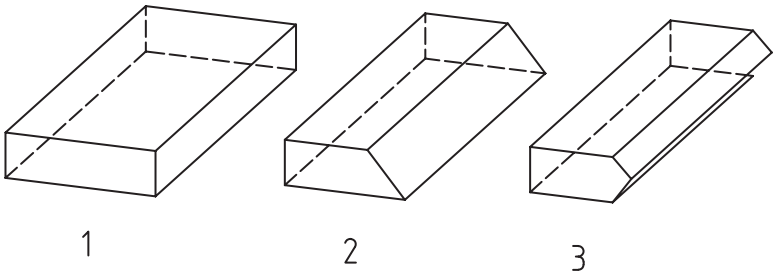


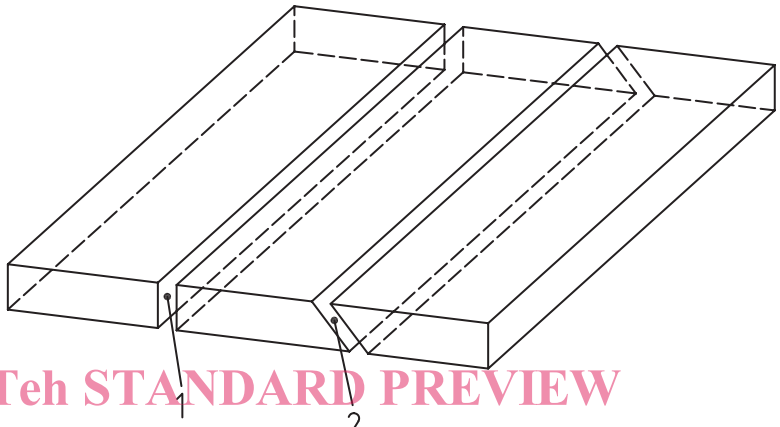
Key

1 upper edge of cut
2 cut surface
3 lower edge of cut
a work piece thickness
i cut thickness
j depth of root face
f length of cut
α torch set angle
β cut angle

Figure 2 — Terms on the finished work piece

3.2.3 Cut types

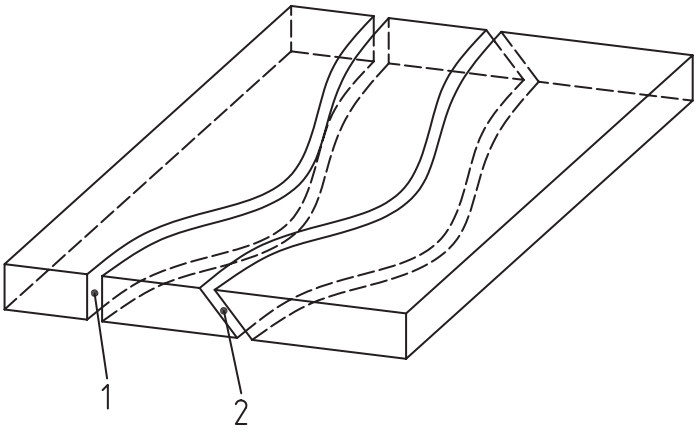




Key

1 vertical cut
2 bevel cut
3 bevel cut (double)

Figure 3 — Straight cut



Key

1 vertical cut
2 bevel cut

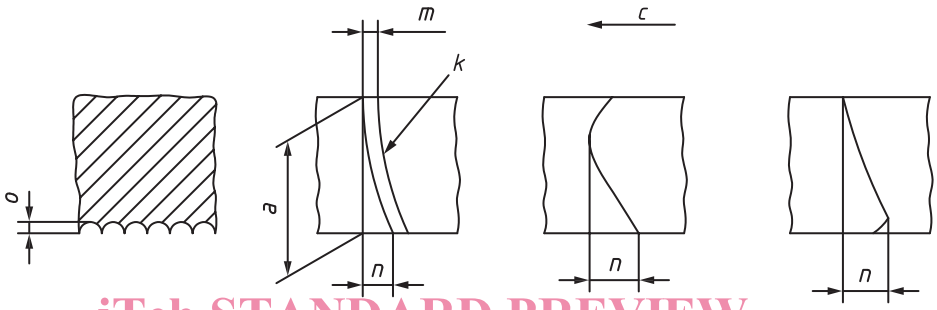
Figure 4 — Contour cut

3.3
cutting speed
length of cut completed per unit time

3.4
kerf width
width of the cut produced during a cutting process at the upper edge of cut or with existing melting of top edge immediately below, as caused by the cutting jet

3.5
drag
n
projected distance between the two edges of a drag line in the direction of cutting

Note 1 to entry: See Figure 5.



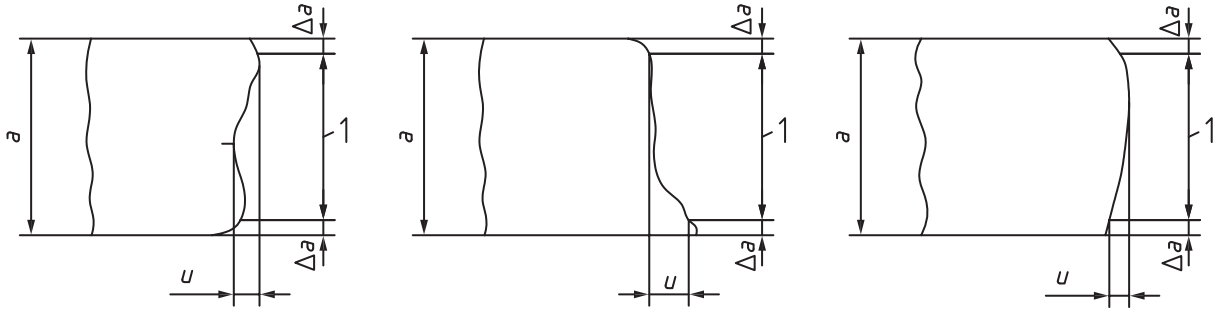
Key

a work piece thickness (reference line)
c advance direction
k drag line
m pitch of drag line
n drag
o groove depth

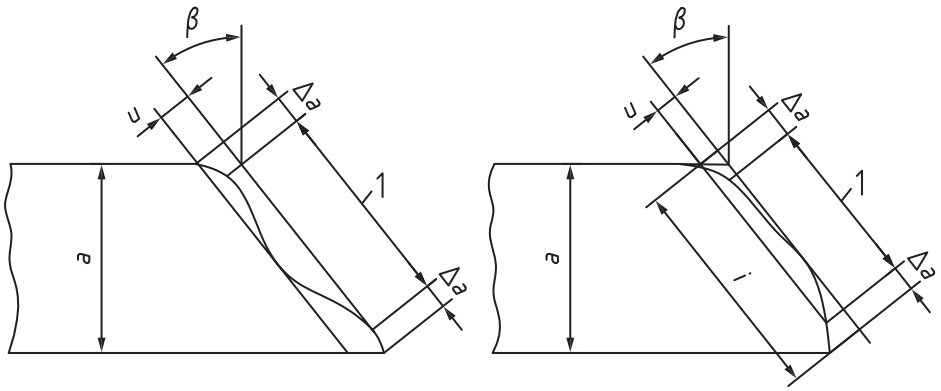
Figure 5 — Drag line

3.6
perpendicularity or angularity tolerance
u
distance between two parallel straight lines (tangents) between which the cut surface profile is inscribed and within the set angle (e.g. 90° in the case of vertical cuts)

Note 1 to entry: The perpendicularity or angularity tolerance includes not only the perpendicularity but also the flatness deviations. Figure 6 illustrates the areas in the cut surface to take into consideration to measure the perpendicularity or inclination tolerance, *u*, depending on the cutting process used.



a) Vertical cut



b) Bevel cut

Key

1 distance to calculate the area to determine the perpendicularity or angularity tolerance

a work piece thickness

Δ*a* thickness reduction

i cut thickness

u perpendicularity or angularity tolerance

β cut angle

NOTE The area to determine the perpendicularity or angularity tolerance is determined by multiplying the distance 1 with the length of cut (see Figure 2).

Figure 6 — Perpendicularity or angularity tolerances

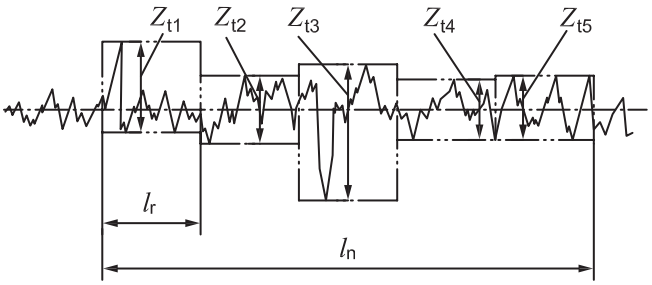
3.7
profile element height
Zt
sum of the height of the peak and depth of the valley of a profile element

[SOURCE: ISO 4287:2009, 3.2.12]

3.8
mean height of the profile
*Rz*5
arithmetic mean of the single profile elements of five bordering single measured distances

Note 1 to entry: See Figure 7.

Note 2 to entry: The index 5 in *Rz*5 was added to distinguish the arithmetic mean and the maximum height of profile of the five single profile elements.



Key

Zt_1 to Zt_5	single profile elements
ln	evaluation length
lr	single sampling length (1/5 of *ln*)

Figure 7 — Mean height of the profile

3.9
melting of top edge
r
measure characterizing the form of the upper edge of cut

Note 1 to entry: The latter may be a sharp edge, a molten edge or cut edge overhang.

Note 2 to entry: See Figure 8.

a) Sharp edge **b) Molten edge** **c) Cut edge overhang**

Figure 8 — Melting

3.10
burr
dross
metal residue sticking to the lower part of the cut

Note 1 to entry: During the thermal cutting process, creation of minor flash that sticks to the cut work piece associated with oxides or molten steel projections that drip and solidify on the lower edge of the work piece (see Figure 9).

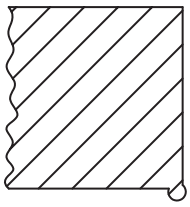
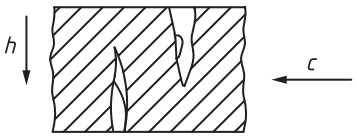


Figure 9 — Burr/dross

3.11
gouging
scourings or kerves of irregular width, depth and shape, preferably in the cutting direction, which interrupt an otherwise uniform cut surface

Note 1 to entry: See Figure 10.



Key

h cutting direction

c advance direction

Figure 10 — Gouging

3.12
start of cut
point of the work piece at which the cut begins

4 Symbols

Symbol	Term
a	work piece thickness
Δa	thickness reduction
A	assembly dimension
α	torch set angle
b	nozzle distance
B	programmed dimension of the cut part
β	cut angle
B_z	machining allowance
c	advance direction
d	top kerf width
e	cut thickness
f	length of cut
g	bottom kerf width
G_o	upper limit deviation
G_u	lower limit deviation
h	cutting direction
i	cut thickness
j	depth of root face
k	drag line
ln	evaluation length
lr	single sampling length
m	pitch of drag line
n	drag
o	groove depth
r	melting of top edge