INTERNATIONAL STANDARD

ISO 9013

Second edition
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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

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Contents

Page

Foreword iv

1 Scope 1

2 Normative references 1

3 Terms and definitions 2
3.1 General 2
3.2 Terms and definitions explained by figures 2

4 Symbols 7

5 Form and location tolerances 8

6 Determination of the quality of cut surfaces 8
6.1 General 8
6.2 Measuring 9

7 Quality of the cut surface 11
7.1 Characteristic values 11
7.2 Measuring ranges 12

8 Dimensional tolerances 15
8.1 General 15
8.2 Dimensional tolerances on parts without finishing 16
8.3 Dimensional tolerances on parts with finishing 17

9 Designation 18

10 Information in technical documentation 18
10.1 Indications of size 18
10.2 Indication of quality of cut surface and of tolerance class 18

Annex A (informative) Achievable cutting qualities for different cutting processes 20

Annex B (informative) Principles of process 23

Bibliography 25

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

ISO 9013 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 8, *Equipment for gas welding, cutting and allied processes*.

This second edition cancels and replaces the first edition (ISO 9013:1992), which has been technically revised.

Annexes A and B of this International Standard are for information only.

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

1 Scope

This International Standard applies to 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 1 mm to 150 mm and to laser cuts from 0,5 mm to 40 mm. This International Standard includes geometrical product specifications and quality tolerances.

The geometrical product specifications are applicable if reference to this International Standard is made in drawings or pertinent documents, e.g. delivery conditions.

If this International Standard is also to apply, by way of exception, to parts which are produced by different cutting processes (e.g. high-pressure water jet cutting), this has to be agreed upon separately.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 1101:1983, *Technical drawings — Geometrical tolerancing — Tolerancing of form, orientation, location and run-out — Generalities, definitions, symbols, indications on drawings*

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

ISO 2553, *Welded, brazed and soldered joints — Symbolic representation on drawings*

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

ISO 4287:1997, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 4288:1996, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Rules and procedures for the assessment of surface texture*

ISO 8015, *Technical drawings — Fundamental tolerancing principle*

3 Terms and definitions

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

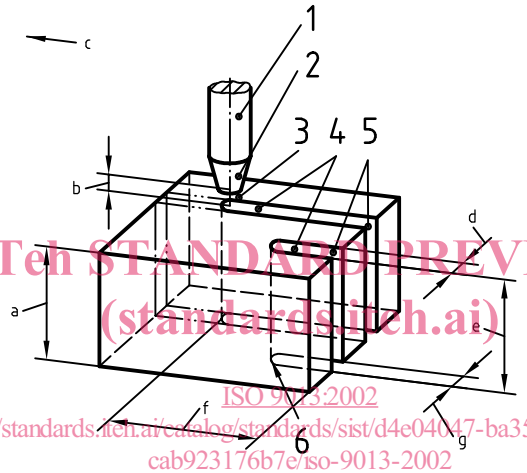
3.1 General

Nouns referring to the cutting operation will be formed by using the key word “cutting” (e.g. advance cutting direction); nouns referring to the cut carried out will be formed by using the key word “cut” (e.g. cut surface).

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 on the started work piece



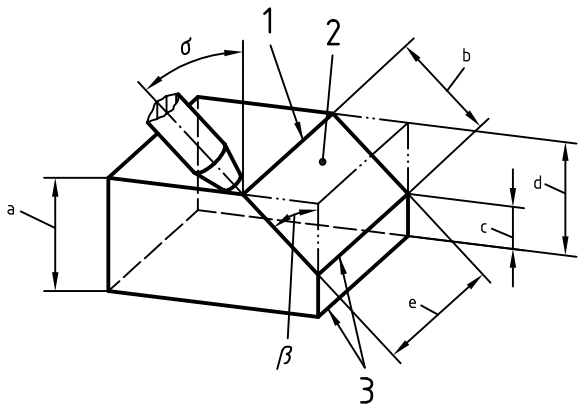
Key

1 Torch
2 Nozzle
3 Beam/flame/arc
4 Kerf
5 Start of cut
6 End of cut

a Work piece thickness
b Nozzle distance
c Advance direction
d Top kerf width
e Cut thickness
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 finished work piece

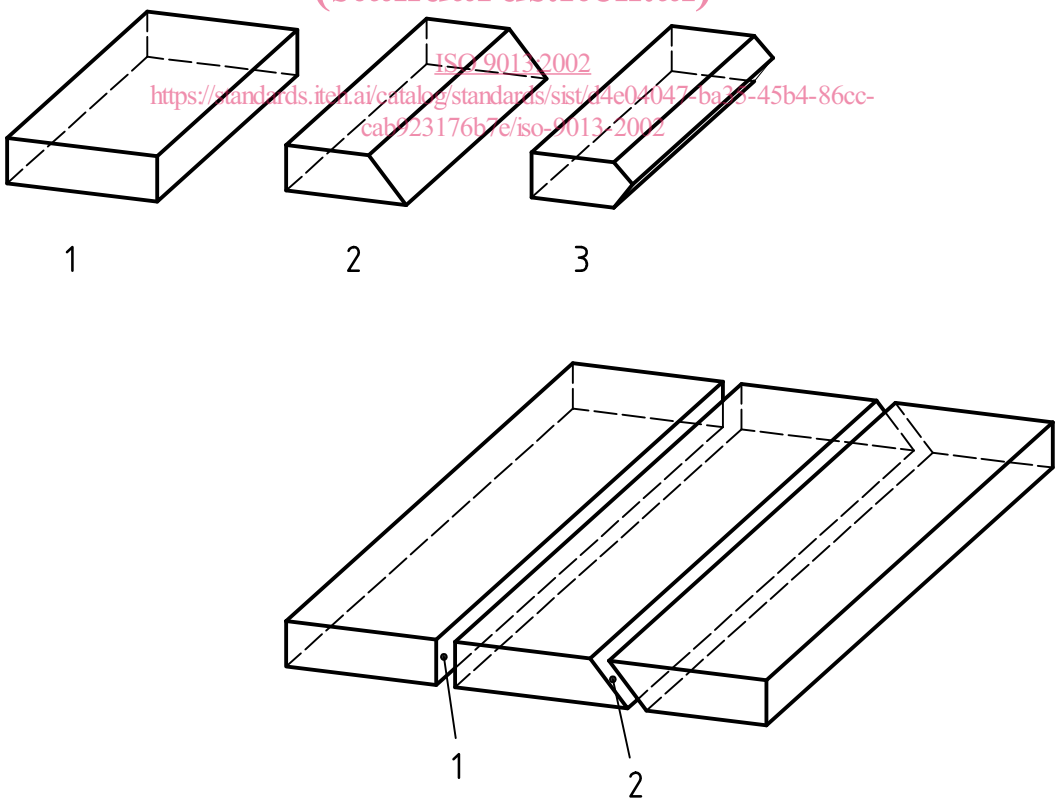


Key

1 Upper edge of cut
2 Cut surface
3 Lower edge of cut
a Work piece thickness
b Cut thickness (first possibility)
c Depth of root face/cut thickness (first possibility)
d Cut thickness (second possibility)
e Length of cut

Figure 2 — Terms on the finished work piece

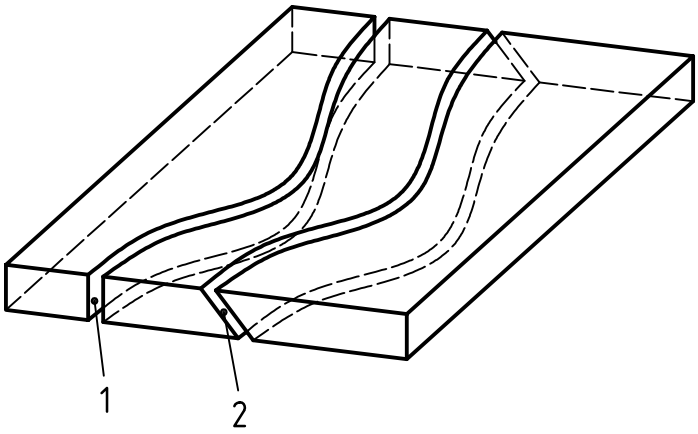
3.2.3 Cutting types



Key

1 Vertical cut
2 Bevel cut
3 Bevel cut (double)

Figure 3 — Straight cut



Key

1 Vertical cut

2 Bevel cut

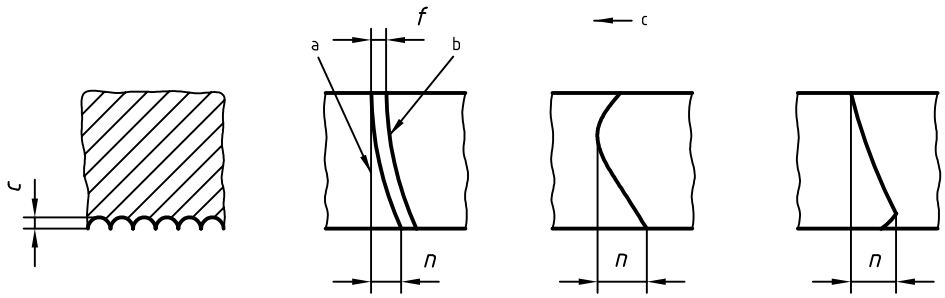
Figure 4 — Contour cut

3.3
cutting speed
relative speed between tool, e.g. flame blowpipe, and work piece

3.4
kerf width
distance of the cut surfaces 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 points of a drag line in the direction of cutting

See Figure 5.



a Reference line

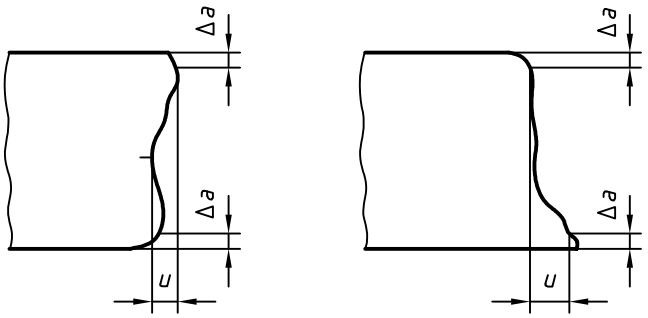
b Drag line

c Advance direction

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 The perpendicularity or angularity tolerance includes not only the perpendicularity but also the flatness deviations. Figures 6 and 7 show the maximum effective deviations within the tolerance class.



a) Vertical cut

b) Bevel cut

Figure 6 — Perpendicularity and angularity tolerances

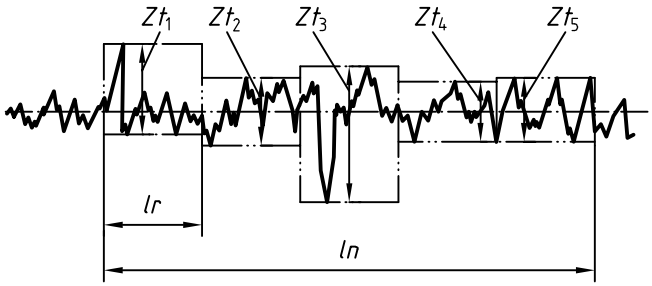
3.7
profile element height
Zt
sum of the height of the peak and depth of the valley of a profile element

[ISO 4287:1997]

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

See Figure 7.

NOTE 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.



where

Zt_1 to Zt_5 represent single profile elements;

ln is the evaluation length;

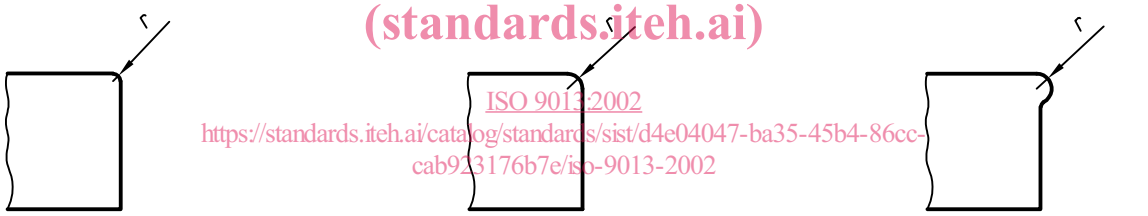
lr is the single sampling length (1/5 of ln).

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 The latter may be a sharp edge, a molten edge or cut edge overhang.

See Figure 8.

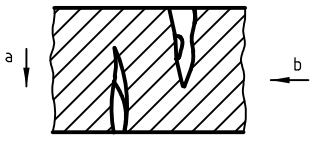


a) Sharp edge **b) Molten edge** **c) Cut edge overhang**

Figure 8 — Melting

3.10
gouging
scourings or kerves of irregular width, depth and shape, preferably in the direction of the cut thickness, which interrupt an otherwise uniform cut surface

See Figure 9.



a Cutting direction

b Advance direction

Figure 9 — Gouging

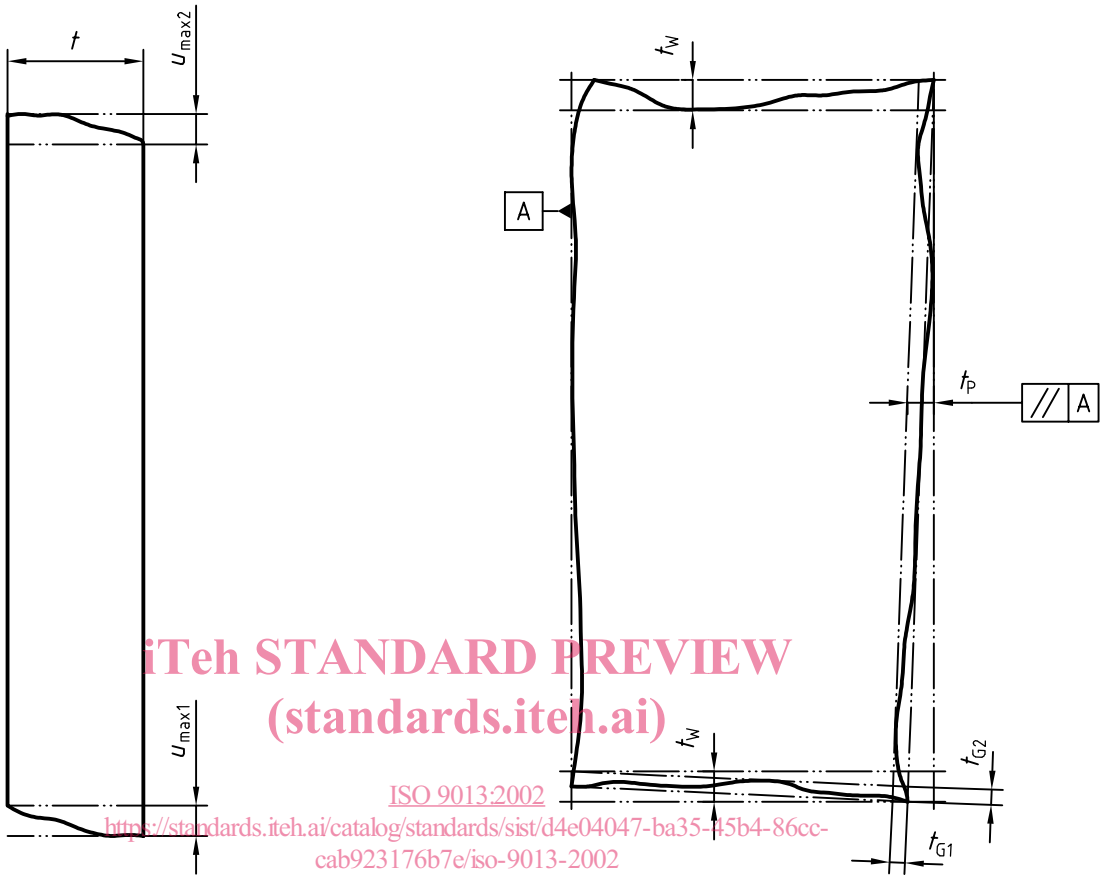
4 Symbols

For the purposes of this International Standard, the following symbols for dimensional indications apply.

Symbol	Term
a	Cut thickness
Δa	Thickness reduction
B_z	Machining allowance
c	Groove depth
f	Pitch of drag line
G_o	Upper limit deviation
G_u	Lower limit deviation
ln	Evaluation length
lr	Single sampling length
n	Drag
r	Melting of top edge
$Rz5$	Mean height of the profile
t	Work piece thickness
t_G	Straightness tolerance
t_P	Tolerance of parallelism
t_W	Perpendicularity tolerance
u	Perpendicularity or angularity tolerance
Zt	Profile element height
β	Angle of bevel of cut
σ	Nozzle (setting) angle

5 Form and location tolerances

Figure 10 shows the maximum deviations within the tolerance zone.



a) Through thickness **b) Flat**

where

u is the perpendicularity tolerance (see 14.8 of ISO 1101:1983) in cutting direction;

t_W is the perpendicularity tolerance (see 14.8 of ISO 1101:1983) for cut width referred to A;

t_P is the parallelism tolerance (see 14.7 of ISO 1101:1983) for cut width referred to A on sheet level;

t_{G1} is the straightness tolerance (see 14.1 of ISO 1101:1983) for cut length;

t_{G2} is the straightness tolerance (see 14.1 of ISO 1101:1983) for cut width.

Figure 10 — Form and location tolerances shown by the example of a sheet plate

6 Determination of the quality of cut surfaces

6.1 General

These requirements serve the purpose of indicating measuring procedures and measuring instruments by means of which it is possible to determine and evaluate the characteristic values of cut surfaces.

When choosing the measuring instruments, care has to be taken that the error limits are not above 20 % of the values of the characteristic values to be measured. Tables 1 and 2 indicate the precision and coarse measuring instruments for the characteristic values.