May 1995

	Welding and allied processes Quality classification and dimensional tolerances for thermally cut (oxygen/fuel gas flame) surfaces (ISO 9013 : 1992) English version of DIN EN ISO 9013	DIN EN ISO 9013

This standard incorporates the English version of ISO 9013.

ICS 25.160.10

Supersedes parts of DIN 2310-1 and DIN 2310-3, November 1987 editions.

Descriptors: Welding, thermal cutting, quality, tolerances.

Schweißen und verwandte Verfahren; Güteeinteilung und Maßtoleranzen für autogene Brennschnittflächen (ISO 9013 : 1992)

European Standard EN ISO 9013: 1995 has the status of a DIN Standard.

A comma is used as the decimal marker.

National foreword

This standard has been published in accordance with a decision taken by CEN/TC 121 to adopt, without alteration, International Standard ISO 9013 as a European Standard.

The responsible German body involved in its preparation was the *Normenausschuß Schweißtechnik* (Welding Standards Committee).

It should be noted that the symbol R_{y5} to denote the ten point height of irregularities has been substituted for R_z (cf. subclause 5.1). The quality of cut faces continues to be assessed on the basis of DIN 2310-2.

The DIN Standards corresponding to the International Standards referred to in clause 2 are as follows:

ISO Standard	DIN Standard
ISO 1302	DIN ISO 1302
ISO 4287-1	DIN 4762
ISO 8015	DIN ISO 8015

Amendments

DIN 2310-1 and DIN 2310-3, November 1987 editions, have been superseded by the specifications of EN ISO 9013 which is identical to ISO 9013.

Previous editions

DIN 2310-1: 1965-02, 1975-02, 1987-11; DIN 2310-3: 1975-02, 1987-11.

Standards referred to

(and not included in **Normative references**)

DIN 2310-2 Thermal cutting; determination of quality of cut faces

DIN 4762 Surface roughness; concepts, surface and its parameters (identical to ISO 4287-1 : 1984)

EN comprises 10 pages.

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN ISO 9013

March 1995

ICS 25.160.10

Descriptors: Welding, thermal cutting, quality, tolerances.

English version

Welding and allied processes

Quality classification and dimensional tolerances of thermally cut (oxygen/fuel gas flame) surfaces
(ISO 9013 : 1992)

Soudage et techniques connexes; niveaux de qualité et tolérances dimensionnelles des surfaces découpées thermiquement (à la flamme d'oxygène/gaz de chauffe) (ISO 9013 : 1992)

Schweißen und verwandte Verfahren; Güteeinteilung und Maßtoleranzen für autogene Brennschnittflächen (ISO 9013 : 1992)

This European Standard was approved by CEN on 1995-01-09 and is identical to the ISO Standard as referred to.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Ref. No. EN ISO 9013:199

Foreword

International Standard

ISO 9013:1992 Welding and allied processes; quality classification and dimensional tolerances of thermally cut (oxygen/fuel gas flame) surfaces

which was prepared by ISO/TC 44 "Welding and allied processes" of the International Organization for Standardization, has been adopted by Technical Committee CEN/TC 121 "Welding" as a European Standard.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, and conflicting national standards withdrawn, by September 1995 at the latest.

In accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard:

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

Endorsement notice

The text of the International Standard ISO 9013:1992 was approved by CEN as a European Standard without any modification.

1 Scope

This International Standard is valid for materials suitable for oxygen cutting and for workpiece thicknesses from 3 mm to 300 mm. It applies to cut metal surfaces produced by oxygen/fuel gas flame cutting and requires quality classification and dimensional tolerances.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1302:1978, *Technical drawings — Method of indicating surface texture on drawings.*

ISO 4287-1:—[1], *Surface roughness — Terminology — Part 1: Surface and its parameters.*

ISO 8015:1985, *Technical drawings — Fundamental tolerancing principle.*

3 Basis of process

3.1 Process

Oxygen cutting refers to those thermal cutting processes in which the cutting kerf is created such that

— the material in the kerf is primarily oxidized;

— oxidized products are driven out of the kerf by a high velocity oxygen jet.

3.2 Prerequisites

The material shall be heated at the point of reaction to a temperature at which it reacts spontaneously with oxygen (ignition temperature). The process shall deliver sufficient thermal energy such that areas of the material in the cutting direction are heated up to this ignition temperature. The ignition temperature shall be below the melting temperature of the material. Cutting slag shall be liquid enough to be driven out of the cutting kerf by the oxygen jet.

3.3 Material

The prerequisites given in 3.2 are fulfilled by pure iron, low-alloyed and some alloyed steels as well as by titanium and some titanium alloys. The cutting process is detrimentally affected by alloying elements, except manganese, and increasingly so with increasing content of the alloying element e.g. chromium, carbon, molybdenum or silicon. Therefore, among others, high-alloyed CrNi-steels or silicon steels and cast iron cannot be oxygen cut without special steps. These materials can be cut with other thermal cutting processes, e.g. by metal powder oxygen cutting or plasma arc cutting.

4 Designation

The designation of a flame cut surface shall comprise the following information in the order given:

a) description block, e.g. "flame cut";

b) a reference to this International Standard;

c) the indication of quality containing perpendicularity and angularity tolerance and permissible ten point height of irregularity according to 5.1 or 5.2;

d) the indication of tolerance class according to clause 6.

EXAMPLE

An oxygen flame cut surface with quality I and tolerance class A is designated as follows:

Flame cut ISO 9013 - IA

5 Quality of flame cut edge (face)

5.1 Factors and explanations

For the classification of quality of flame cut edges (faces), the following factors are used:

a) perpendicularity tolerance, u (see figure 1) or angularity tolerance, u (see figure 2);

b) ten point height of irregularities, R_{y5} (see figure 3).

The following factors may be used for visual evaluation:

c) drag, n (see figure 4);

d) melting of top edge, r (see figure 5).

Perpendicularity or angularity tolerance, u, is the distance between two parallel straight lines (contacting lines) that limit the cut face profile at the theoretically correct angle (i.e. at 90° for square edge cuts).

The contacting lines are situated in a plane normal to both the workpiece surface and to the cut face.

The perpendicularity tolerance and the angularity tolerance include deviations from straightness and flatness.

Ten point height of irregularities, R_{y5}, is the mean of the absolute values of the heights of the five highest profile peaks and the depths of the five deepest profile valleys within the sampling length (from ISO 4287-1).

Drag, n, is the projected distance between the two edges of a drag line in the direction of cutting (see figure 4).

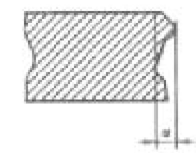


Figure 1 — Perpendicularity tolerance

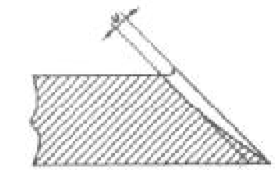
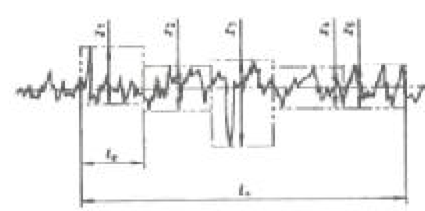


Figure 2 — Angularity tolerance



KEY

l_t is the roughness sampling length

Z_1 to Z_5 are individual profile departures

l_e is the individual sampling length (one fifth of l_t)

Figure 3 — Ten point height of irregularities

1) To be published. (Revision of ISO 4287-1:1984)

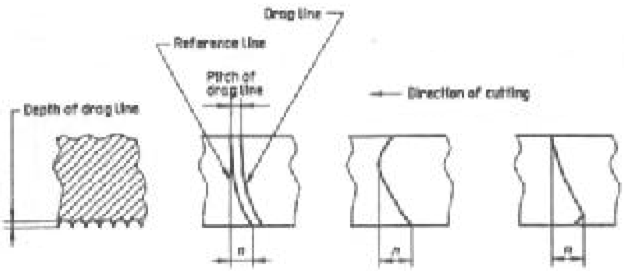


Figure 4 — Drag line

Melting of the top edge, r, is the factor characterizing the shape of the top edge of a cut, such as a sharp edge, a rounded edge with overhang or a train of fused beads with overhang (see figure 5).

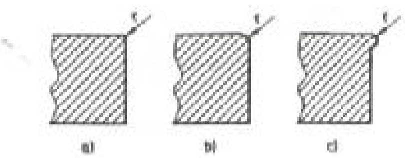


Figure 5 — Melting of top edge

The cut face profile used for the definition of perpendicularity tolerance and angularity tolerance shall be reduced by the value of Δa as given in table 1 from both the top and the bottom of the cut face (see figure 6).

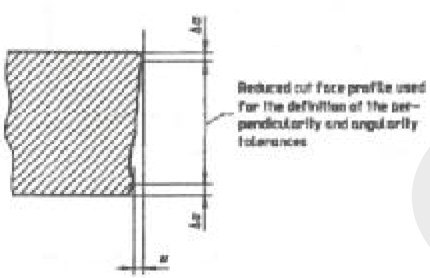


Figure 6 — Definition of measuring area for perpendicularity and angularity tolerances

Table 1 — Values of Δa for various cutting thicknesses, a

Dimensions in millimetres

Cutting thickness, a	Δa
$3 \leqslant a \leqslant 6$	0,3
$6 < a \leqslant 10$	0,6
$10 < a \leqslant 20$	1,0
$20 < a \leqslant 40$	1,5
$40 < a \leqslant 100$	2,0
$100 < a \leqslant 150$	3,0
$150 < a \leqslant 200$	5,0
$200 < a \leqslant 250$	8,0
$250 < a \leqslant 300$	10,0

Individual defects, e.g. gougings, are not considered for the definition of quality grades in this International Standard.

In the case of multiple bevel cutting, e.g. for single-V, double V, or double bevel cuts or K-cuts, each cutting surface is to be classified separately.

For a classification of the quality of cut surfaces in accordance with table 2, the reduction of the profile for the perpendicularity and angularity tolerance u and for the permissable ten point height of irregularities R_{y5} as described above is not necessary. The definition, however, has been maintained to point out the possibility of achieving these very small deviations and also in order to demonstrate the capabilities of the process.

5.2 Quality of cut surfaces

The cut surfaces are classified as either quality I or quality II in accordance with table 2. The perpendicularity and angularity tolerance, u, and the ten point height of irregularities, R_{y5}, are given as functions of cutting thickness, a, in figures 7 and 8. Enlarged projections of u and R_{y5} for cutting thicknesses up to 20 mm are given in figures A.1 and A.2 (see annex A).

5.3 Agreed-upon quality

Following prior agreement or in order to take application conditions into consideration one may deviate from quality classifications I and II. To describe the agreed-upon quality, the fields for the perpendicularity and angularity tolerance, u, and the ten poin height of irregularities, R_{y5}, are to be laid down ir the sequence u, R_{y5}. In cases where no value for the field is to be specified, insert "0" (zero).

EXAMPLE 1

Field 1 for u

Field 1 for R_{y5}

Code: 11

EXAMPLE 2

Field 2 for u

0 for R_{y5} (i.e. no value specified)

Code: 20

Table 2 — Quality classifications

Quality classification of cut surface	Perpendicularity and angularity tolerance, u, in accordance with figure 7	Ten point height of irregularities, R_{y5}, in accordance with figure 8
I	Fields 1 and 2	Fields 1 and 2
II	Fields 1 to 3	Fields 1 to 3

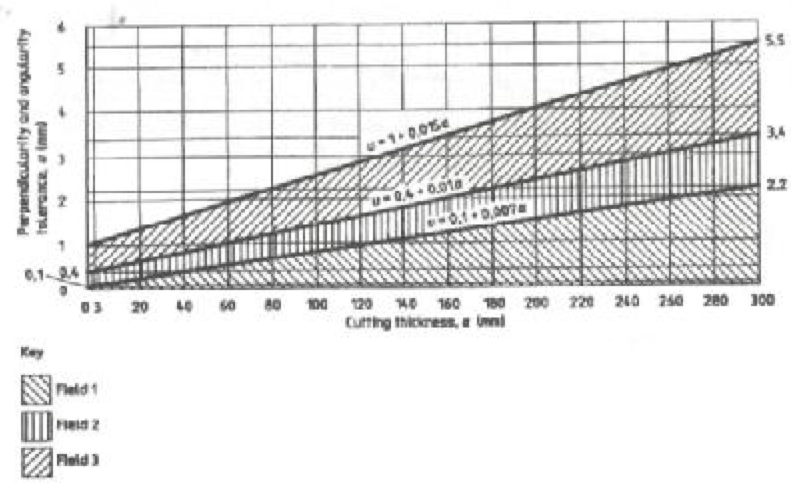


Figure 7 — Perpendicularity and angularity tolerance, u

6 Dimensional tolerances

Dimensions shown in drawings are nominal dimensions. The actual dimensions are to be measured on cleaned cutting surfaces. The limit deviations given in tables 3 and 4 are valid for dimensions without a tolerance indication when drawings or other documents (e.g. delivery conditions) refer to this International Standard. Limit deviations in table 3 are only valid for the workpiece thicknesses given in the table and on parts on which the ratio of length to width is no more than 4:1 and for which the minimum total circumference is 350 mm.

For workpieces where the ratio between length and width is more than 4:1, the tolerances have to be agreed upon between manufacturer and user in accordance with this International Standard.

The given limit deviations are based on the principle of independency specified in ISO 8015, in which the dimensional and geometrical tolerances are valid independently of each other. The part of the tolerance caused by perpendicularity and angularity deviations in the direction of the cutting jet shall be within the limit deviations. If other dimensional and geometrical tolerances, e.g. straightness tolerance or perpendicularity tolerance in cutting longitudinal direction, should be maintained, a particular agreement shall be reached.

For parallel straight line cuts with perpendicular cut surfaces being cut simultaneously, the limit deviations of table 4 are valid.

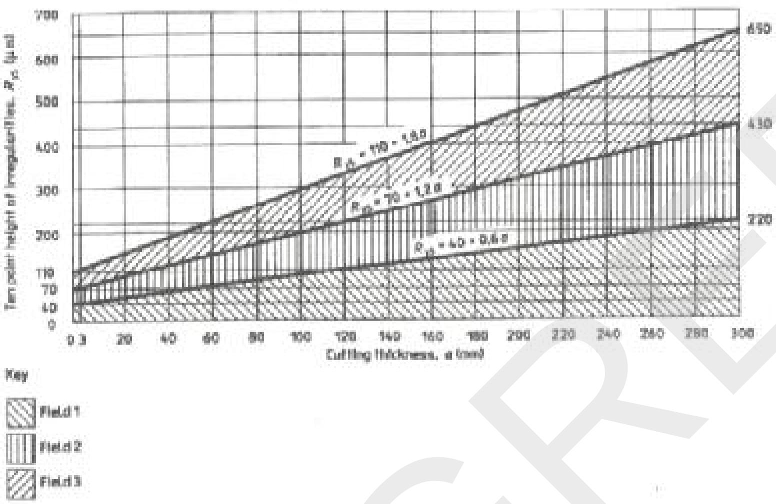


Figure 8 — Permissible ten point height of irregularities, R_{y5}

Table 3 — Limit deviations for nominal dimensions

Dimensions in millimetres

Tolerance class	Workpiece thickness, *t*	Limit deviations for nominal dimensions: 35 up to 315	315 up to 1 000	1 000 up to 2 000	2 000 up to 4 000
A	$3 < t \leq 12$	± 1,0	± 1,5	± 2,0	± 3,0
	$12 < t \leq 50$	± 0,5	± 1,0	± 1,5	± 2,0
	$50 < t \leq 100$	± 1,0	± 2,0	± 2,5	± 3,0
	$100 < t \leq 150$	± 2,0	± 2,5	± 3,0	± 4,0
	$150 < t \leq 200$	± 2,5	± 3,0	± 3,5	± 4,5
	$200 < t \leq 250$	—	± 3,0	± 3,5	± 4,5
	$250 < t \leq 300$	—	± 4,0	± 5,0	± 6,0
B	$3 < t \leq 12$	± 2,0	± 3,5	± 4,5	± 5,0
	$12 < t \leq 50$	± 1,5	± 2,5	± 3,0	± 3,5
	$50 < t \leq 100$	± 2,5	± 3,5	± 4,0	± 4,5
	$100 < t \leq 150$	± 3,0	± 4,0	± 5,0	± 6,0
	$150 < t \leq 200$	± 3,0	± 4,5	± 6,0	± 7,0
	$200 < t \leq 250$	—	± 4,5	± 6,0	± 7,0
	$250 < t \leq 300$	—	± 5,0	± 7,0	± 8,0

Table 4 — Limit deviations for simultaneously-cut parallel straight line cuts

Dimensions in millimetres

Tolerance class	Workpiece thickness, *t*	Limit deviations for nominal dimensions up to 10 000
F	$10 < t \leq 100$	± 0,2
G	$6 < t \leq 100$	± 0,5
H	$6 < t \leq 100$	± 1,5

7 Information in technical documents

7.1 Cutting quality and tolerance class

7.1.1 Representation on technical drawings

The required quality and tolerance class produced by flame cutting shall be given in accordance with ISO 1302 as shown in figure 9.

KEY

1 Reference to this International Standard i.e. ISO 9013

2 Quality classification in accordance with clause 5

3 Tolerance class in accordance with clause 6

Figure 9 — Representation on technical drawings

When agreed-upon deviations from this International Standard are desired, this has to be indicated specifically (see also 5.3).

EXAMPLE 1

Quality classification I and tolerance class A are required. The representation is shown in figure 10.

Figure 10

EXAMPLE 2

An agreed-upon quality with code 23 (field 2 for u, field 3 for R_{y5}) and tolerance class A are required. The representation is shown in figure 11.

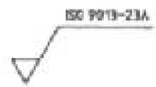


Figure 11

7.1.2 Representation in the title block of technical documents

The required quality classification and tolerance class together with a reference to this International Standard shall be given as follows:

EXAMPLE

Quality classification II and tolerance class G are required.

ISO 9013 - IIG

Annex A
(informative)

Enlarged projections of u and R_{y5} for cutting thicknessses up to 20 mm

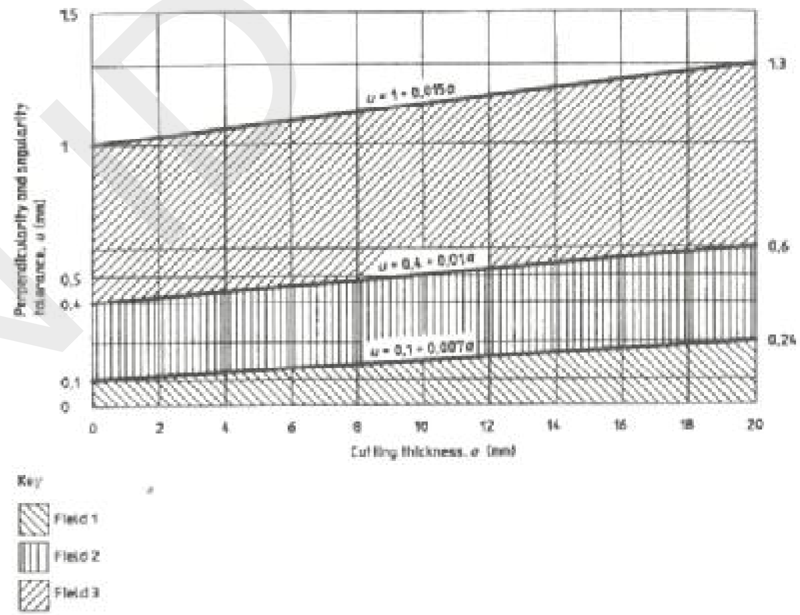


Figure A.1 — Perpendicularity and angularity tolerance, u

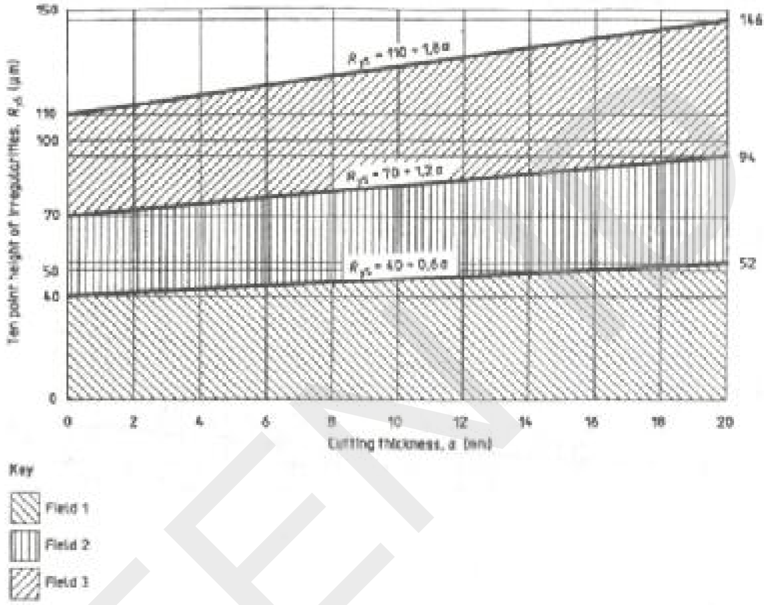


Figure A.2 — Permissible ten point height of irregularities, R_{y5}